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# Minimally Invasive Esophagectomy for Cancer - Short Up-to-Date

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## Abstract

Surgery remains the main treatment for localized resectable esophageal cancer. Open esophagectomy is still the standard surgical approach for esophageal cancer but it has a lower patient satisfaction when compared with other treatment options. In the era of "key-hole" surgeries, minimally invasive esophagectomy (MIE) stands as a solution to improve the results after standard open esophagectomies. The aim of the present paper is to provide a short update regarding the minimally invasive esophagectomy, with special emphasis on its indications, results and current controversies.

**Keywords:** Esophagectomy; Minimally Invasive Surgery; Open Esophagectomy; Thoracotomy; Thoracoscopy

## Introduction

Esophageal cancer, with its two main histopathological subtypes-squamous cell carcinoma (SCC) and adenocarcinoma (AK) is not included among the most common cancers. However, each year 462,000 people are diagnosed with esophageal cancer worldwide and 386,000 people die from it [1-4]. Despite improvements in oncology therapies and the increasing acceptance of multimodality treatment which both seem to enhance resectability and survival rates, esophageal cancer is still a deadly disease [5]. Most patients die within two years after the diagnosis and more than half of them are discovered with non-resectable cancer at the time of diagnosis [4].

Surgery remains the main treatment for localized resectable esophageal cancer. Open esophagectomy (OE) is an extensive and traumatic procedure, with mortality ranging from 1.4% to 23% and with a lower patient satisfaction when compared with other treatment options [6]. Transhiatal esophagectomy decreases operative trauma when compared to a transthoracic approach, but is palliative due to the impossibility of removing the lymph nodes in the middle and upper mediastinum [4]. In the era of "key-hole" surgeries, minimally invasive esophagectomy (MIE) stands as a solution to improve the results after standard open esophagectomies. Few attempts have been made until now with the intent to compare both procedures i.e. MIE vs OE in the form of meta-analyses and randomized control trials (RCTs).

The aim of the present paper is to provide a short update regarding the minimally invasive esophagectomy, with special emphasis on its indications, results and current controversies.

## Classification of MIE

Under the term of MIE several procedures are included (Table I) [7].

Total MIE (tMIE) implies a combined thoracoscopic and laparoscopic approach as opposed with hybrid MIE (hMIE) which is an esophagectomy using either the thoracoscopic or laparoscopic approach. According to a systematic review of the MIE cases published in English language up to June 2012, complete MIE is the most common procedure (58%), followed by hybrid MIE (29%). Hybrid MIE thoracoscopic approach has been performed in 17% of the patients and hybrid MIE laparoscopic approach counted for another 12% [4,8].

As far as we know, the largest series of tMIE is reported by JD Luketich, with more than 1000 operated patients [4,9]. Laparoscopic transhiatal approach was first reported as a case series by De Paola in 1995 [4,10].

Even if it could be performed using laparoscopy alone, there are centers where transcervical mediastinoscopic approach is added as a safety measure for mediastinal dissection. Robot-assisted MIE using the DaVinci system has only been introduced in a limited number of institutions [4,11,12]. Although the feasibility and safety of robot-assisted MIE has been validated, comparative studies between robot-assisted MIE and conventional MIE are still needed to clarify the benefits [4,13].

## Open versus Minimally Invasive Esophagectomy, A Current Dilemma

Several attempts have been made to determine whether these new minimally invasive procedures have results at least as good as the ones following "classical" open esophagectomy. Three meta-analyses published by Biere et al [14], Sgourakis et al [15] and Nagpal et al [16] showed at least comparable results in terms of postoperative outcomes between these treatment options, if not improvements in favor of MIE. Minimally invasive procedures were performed with less blood loss than open approaches [14] and the length of hospital stay and stay in the intensive care unit (ICU) were reduced in total MIE and thoracoscopic-assisted groups when compared to open surgery group, suggesting earlier recovery in the case of MIE [14]. Similarly with other minimally invasive procedures (laparoscopic colectomies or colectomies, bariatrics, etc.), MIE were followed by less pain and narcotic use. As regards the incidence of respiratory complications, some authors claimed that the results were similar [14,15] while others favored MIE [16].

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Thus, in the meta-analysis undertaken in 2010 by Nagpal et al. [16] the authors analyzed 12 studies and a total of 672 patients on whom tMIE or hybrid MIE was performed and compared these lots with an open esophagectomy control cohort of 612 subjects. The authors concluded that MIE is a safe alternative to open procedures, with few clear benefits such as the shorter hospital stay, lower respiratory complications and overall morbidity, but the necessity of further randomized control trials (RCTs) was also emphasized. Most authors agree that duration of MIE is longer than OE, especially at the early stages of experience. However, Nguyen et al [17] reported a non-statistical difference between duration of MIE vs OE, if the procedure is performed by experienced surgeons. Furthermore, Fabian and co-workers [18] performed the thoracic mobilization of the esophagus with the patient in prone position in less time than OE.

**Table I** Variations of the MIE (Watanabe et al [7])

<b>Total MIE</b> Thoracoscopic and Laparoscopic Esophagectomy
<b>Hybrid MIE</b> either Thoracoscopic or Laparoscopic Approach
<b>Video-assisted Mediastinoscopic Transhiatal Esophagectomy</b>
<b>Laparoscopic-assisted Transhiatal Esophagectomy</b>
<b>Robot-assisted MIE</b>

When oncological outcomes and survival rates come into account, the authors noted that MIE are not inferior to OE in all of the retrieved studies [4,19-22]. It is well established that the quality of lymph node dissection influences survival, the majority of loco-regional recurrences after esophagectomy being in fact lymph node metastases [23]. The number of the retrieved lymph nodes was higher after MIE procedures than in OE, suggesting a possible oncologic advantage of MIE over open procedures. This aspect needs further confirmation by RCTs.

The clear differences between MIE and OE are further emphasized when the quality of life following the surgery is analyzed. Every surgical intervention significantly reduces the quality of life. By analyzing two short series of patients, Zeng et al. [24] and Biere et al. [22] note significant differences between the two techniques. With regards to the patients operated on with the classic procedure, the quality of life is profoundly affected, with the patient requiring approximately 24 weeks to reach a standard of life quality similar to the one provided by the MIE in just 6 weeks. This finding shows that the patients operated on with a minimally invasive procedure are not only benefiting from a faster recovery, but are also able to recommence their social activities faster and are able to benefit from the adjuvant chemotherapy treatment earlier following the surgery. All these data which suggest the advantages of MIE should be confirmed by RCTs. At the moment, there are two RCTs, comparing outcomes after MIE and OE. The first one is TIME trial, conducted in Netherlands by Biere et al. [22]; the results of this trial have been published in 2012 showing a significantly lower rate of pulmonary complications 2 weeks after the surgery and during the stay in hospital in MIE group as compared with OE group. In the past decade MIE has been increasingly performed to treat locoregional esophageal cancer. In the UK, there has been a steady increase in the uptake of MIE, with 24.7% of esophageal cancer resections in 2009 being performed using a hybrid or completely minimally invasive approach [4,26].

The second study is MIRO trial, conducted in France by Briez et al [25]; this study aimed to compare OE with hybrid minimally invasive esophagectomy as regards the 30-day incidence of major postoperative pulmonary complications. The results, also published in 2012, showed that laparoscopic abdominal approach combined with open right thoracotomy for esophageal cancer is followed by fewer major pulmonary complications as compared with the standard approach.

This fact expresses attitude in favor of acceptance and distribution of minimally invasive procedures for esophageal carcinoma treatment worldwide.

Finally, one of the advantages of MIE is better cost-effectiveness. Lee et al [27] reported that MIE is cost-effective compared to open esophagectomy in the management of patients with resectable esophageal cancer. Due to its less invasiveness and safety, percent of MIE done for esophageal carcinoma is on rise in all world leading centers dealing with this pathology.

## Conclusion

As long as MIE is oncologically equivalent to OE in the short-term and long-term results, the cost savings and potential increased effectiveness, associated with MIE, should make it the preferred approach in high-volume esophageal centers that are experienced in minimally invasive procedures. Indeed, at the Department of Minimally Invasive Upper Digestive Surgery in the Clinic for Digestive Surgery in Belgrade, hybrid MIE (laparoscopic approach) is a standard of care for the patients with resectable esophageal cancer. The first procedure had been performed in 2009.

## Conflict of interest

Authors have no conflict of interests to disclose.

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# Therapeutic Management of Colon Cancer

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## Abstract

Colorectal cancer is a major public health problem worldwide, and a major cause of mortality and morbidity. Correct pretherapeutic staging has the role of guiding the management of colon cancer patients. The diagnosis is guided by the clinical symptoms. Chemotherapy is an important part of colon cancer treatment. Chemotherapy regimens are adapted to tumor stage and patient status and have various side effects and variable survival outcomes. International guidelines recommend different treatments depending on the presence or absence of metastases. The primary goal of treatment in nonmetastatic colon cancer is surgical removal of the tumor which could be the first step of the complex therapy or preceded by neoadjuvant therapy, depending on pretherapeutic staging. In resectable nonmetastatic tumors the preferred surgical procedure is colectomy with en bloc removal of regional lymph nodes. The extent of colectomy should be based on tumor location. The management of metastatic colon cancer also targets the therapeutic approach of the metastatic disease. Therapy is standardized and applied according to tumor stage. Surveillance has a major role in therapeutic success, reason why a time schedule and a protocol adapted to the primary lesion are essential. The goal of implementing the recommendations of international guidelines for the treatment of colon cancer is to provide a uniform treatment for this disease in view of improving overall survival of patients.

**Keywords:** Colon Cancer; Management; International guidelines

## Introduction

According to the World Health Organization in 2010 cancer overtook ischemic heart disease as a leading cause of death [1]. Colorectal cancer (CRC) is a major public health problem worldwide, representing a major cause of death and morbidity. Worldwide, CRC is the fourth leading cause of deaths [2], the third most common cancer in men (663,000 cases, 10% all cancer cases), and the second most common cancer in women (571,000 cases, 9.4% of all cancer cases) [3].

## Clinical Diagnosis of Colon Cancer

Alarm clinical signs are those which make a person seek medical attention, and thus the diagnosis is symptomatic in 71% of cases. Abdominal pain in the colon area is vague, or in progressively worsening episodes which subside after bowel movement, suggesting a tension in the colonic area upstream a stenosing lesion. Most frequently, pain reveals a right colon cancer. A change in bowel habits is common and includes rebel diarrhea, habitual constipation or alternating diarrhea and constipation. Changes in bowel habits and rectum bleeding most frequently are suggestive of left colon cancer. Intestinal bleeding is less abundant, but repeated, spontaneous or favored by anticoagulant therapy. The tumor is rarely accessible to palpation. Rectal or vaginal examination may reveal a tumor prolapsed into the Douglas pouch or the presence of peritoneal carcinomatosis lymph nodes. Colon cancer may suspected be in the presence of lung or liver metastases, perforation with manifestations of peritonitis, or stenosis with clinical picture of obstruction. Symptoms like anemia or unexplained fever may guide diagnosis [4].

## Pretreatment Staging

Preoperative staging of patients presenting with resectable invasive colon cancer requires the following investigations: total colonoscopy with biopsy, complete blood count, biochemistry, carcinoembryonic antigen, and chest-abdominal-pelvic computed tomography (CT). CT scan should be with contrast, and if the contrast is contraindicated an abdominal-pelvic MRI with contrast should be performed [5].

## Neoadjuvant Treatment

Chemotherapy is an important part in the treatment of colon cancer. Fluoropyrimidines, e.g., 5-fluorouracil (5-FU), administered both intravenously and orally, are extensively used first-line chemotherapeutic agents in the treatment of CRC. The most used are the regimens consisting in 48-hour bolus and intravenous 5-fluorouracil Leucovorin (5-FU/LV) every two weeks. Combinations of 5-FU/LV/ Oxaliplatin (FOLFOX) or 5-FU/LV/irinotecan (FOLFIRI) have a much higher response rate, a longer disease-free interval and longer survival. FOLFOX and FOLFIRI have a similar activity but different toxicity: alopecia and diarrhea for irinotecan and polyneuropathy for oxaliplatin. The combination capecitabine plus oxaliplatin (CAPOX) is an alternative to the combination 5-FU/oxaliplatin. The second-line chemotherapeutic agents are oxaliplatin and irinotecan. In patients refractory to FOLFOX or CAPOX an irinotecan-based regimen is proposed as second-line treatment [6].

Monoclonal antibodies against epidermal growth factor (EGF), vascular endothelial growth factor (VEGF) and cyclooxygenase-2 (COX-2) inhibitors in combination with chemotherapeutic agents should be considered in the treatment of metastatic colon cancer. Bevacizumab (rhuMab -VEG, Avastin®) is a recombinant, humanized monoclonal antibody that binds to VEGF receptor. VEGF stimulates endothelial cells growth being expressed in 50% of cases, and correlates with a poor prognosis. 5-FU/LV plus bevacizumab as first-line

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treatment showed: response rates of 17% for 5-FU/LV alone and 40% for 5FU/LV plus bevacizumab; time to disease progression 5.2 vs. 9.0 months and median survival 13.8 vs. 21.5 months, respectively. Cetuximab (Erbix\*) is a monoclonal antibody with highly specificity and high affinity for EGFR causing a direct inhibition of angiogenesis. It demonstrated response rates of 17% in association with irinotecan in pretreated patients refractory to irinotecan and 5-FU. Irinotecan ± Bevacizumab/Cetuximab association in CRCs refractory to irinotecan resulted in a partial response of 35% and 23%, and a time to disease progression of 5.8 and 4.0 months, respectively [7].

## Recommendations from International Guidelines

### Management of no metastatic colon cancer

According to the National Comprehensive Cancer Network (NCCN) guidelines the treatment options for colon cancer depend on the histopathological stage [5]. In resectable non-metastatic colon cancer the surgical procedure of choice is colectomy with regional lymph node removal. The extent of colectomy should be based on tumor location, part of the intestine and vascular arch containing the regional lymph nodes being removed. Other lymph nodes, such as those at the origin of the feeding vessels (e.g., apical nodes) and other lymph nodes located outside the resection field should have biopsy or be removed. To be curative removal should be complete, and positive lymph nodes left behind signifies incomplete resection (R2). Laparoscopic colectomy is an option in the surgical management of colon cancer.

Adjuvant treatment of resectable colon cancer has gained and increasing interest. The choice of adjuvant therapy for patients with non-metastatic colon cancer depends on the stage of disease.

- Patients with stage I colon cancer do not require adjuvant treatment
- Patients with low-risk stage II are eligible for clinical trials, observed without adjuvant therapy or administration of capecitabine or 5-FU/LV. Latest trials do not consider oxaliplatin based chemotherapy, and consequently FOLFOX (infused 5-FU, leucovorin, oxaliplatin) is a therapeutic option for these patients.
- Patients with high-risk stage II are defined as having a poor prognosis. The high-risk features include T4 tumors (stage IIB/IIC), poorly differentiated histology, except for patients with high frequency of microsatellite stability, lymphovascular or perineural invasion, bowel obstruction, lesion with localized or closed perforation, positive or indeterminate margins, or insufficient number of lymph nodes (<12 nodes) can be candidates for adjuvant chemotherapy with 5-FU/L, capecitabine, FOLFOX, capecitabine/oxaliplatin (CapeOx) or FLOX.
- For stage III patients the recommendations are 6 month-adjuvant chemotherapy after surgery. Therapeutic options are FOLFOX or CapeOX; bolus 5-FU/LV/oxaliplatin; or a single chemotherapeutic agent, 5-FU/LV or capecitabine, in patients in which oxaliplatin is presumed to be ineffective [5]
- According to ESMO (European Society for Medical Oncology) guidelines the treatment of colon cancer should be based on stage-specific strategies. As to surgical treatment, one of its objectives is the resection of the involved colon segment together with the draining lymph nodes. The extent of surgical resection is determined by blood transfusions and lymph node distribution. Resection should include a segment of colon at least 5 cm on either side of the tumor. The laparoscopic approach was accepted especially in left colon surgery in which it has proven its benefits. ESMO guidelines recommend the following treatment options:
- Stage 0 - (i): local excision or polypectomy, (ii) segmental

resection for larger lesions not amenable to local excision.

- Stage I: wide surgical resection with anastomosis
- Stage II: (i) wide surgical resection with anastomosis; (ii) after surgery, patients considered at high risk should receive adjuvant therapy (stage II). All patients should be evaluated for entry into randomized clinical trials evaluating new therapeutic options for adjuvant treatment
- Stage III: (i) wide surgical resection with anastomosis; (ii) after surgery, the standard treatment is a doublet schedule with oxaliplatin and 5-FU/folinic acid (LV) (FOLFOX4 or FLOX). When oxaliplatin is contraindicated, monotherapy with intravenous 5-FU/LV or oral fluoropyrimidines (capecitabine) can be administered. The benefits of doublet scheme with oxaliplatin and 5-FU/LV (FOLFOX scheme) have been demonstrated by a number of clinical trials that showed a significant increase in disease-free interval after 3 years, and a 23% reduction in relapse rate compared to patients receiving only 5FU/LV [8].

### Management of Metastatic Colon Cancer

Approximately 50-60% of the patients with colorectal cancer develop metastases and of these 80-90% have unresectable liver metastases. About 20% to 34% of patients present synchronous liver metastases. Although the standard treatment for patients with liver metastases is surgical resection, they may benefit from targeted treatment instead of surgery.

Port-a-cath implantation into the hepatic artery during surgery for liver resection with administration of chemotherapeutic agents may be an option. The administration of 5-FU with or without LV using a hepatic artery catheter proved superior to systemic chemotherapy, with a liver disease-free interval of 2 years.

Radiation delivered directly to the liver by arterial radioembolization with yttrium -90 microspheres is a therapeutic option. External beam radiation therapy can be used in very carefully selected cases, when the patient has a limited number of liver or lung lesions or is symptomatic. Tumor ablation can be a treatment option in patients who do not require hepatic resection because of comorbidities, location of tumors, or inadequate liver size after ablation. Approximately 17 % of patients with metastatic colon cancer have peritoneal carcinomatosis, in 2% the peritoneum being the sole site of metastasis. The treatment of peritoneal carcinomatosis is palliative rather than curative consisting of systemic therapy. Another treatment strategy could be hyperthermic intraoperative intraperitoneal chemotherapy [5].

### Therapeutic Indications and Surveillance

- **Tis, T1, N0, M0** - no treatment; surveillance by colonoscopy at 1 year, if advanced adenoma repeat in 1 year, if no advanced adenoma repeat in 3, then every 5 years.
- **T2, N0, M0** - no treatment; surveillance by colonoscopy at 1 year, if advanced adenoma repeat in 1 year, if no advanced adenoma repeat in 3, then every 5 years.
- **T3, N0, M0** no high-risk - clinical trial/observation/capecitabine or 5FU/leucovorin
- **T3, N0, M0** high-risk for systemic recurrence; **T4, N0, M0** - capecitabine or 5-FU/LV, or FOLFOX, or CapeOX, or FLOX, or clinical trial, or observation.
- Surveillance for stages T3N0M0 and T4N0M0 includes history and physical examination every 3-6 months for the first 2 years, then every 6 months for 5 years; carcinoembryonic antigen every 3-6 months for the first 2 years, then every 6 months for

5 years; chest-abdominal-pelvic CT annually for up to 5 years in patients at high risk for recurrence; colonoscopy in 1 year, if no preoperative colonoscopy due to obstructive lesion, and in case of preoperative colonoscopy in 3-6 months, repeated at 1 year if advanced adenoma or at 3 years and then every 5 years if not advanced adenoma; PET-CT is not routinely recommended.

- **T1-3, N1-2, M0 or T4, N1-2, M0** – FOLFOX, or CapeOX, or FLOX, or capecitabine or 5-FU/LV
- Surveillance includes history and physical examination every 3-6 months for the first 2 years, then every 6 months for 5 years; carcinoembryonic antigen every 3-6 months for the first 2 years, then every 6 months for 5 years; chest-abdominal-pelvic CT annually up to 5 years for patients at high risk for recurrence; colonoscopy in 1 year, if no preoperative colonoscopy due to obstructive lesion, and in case of preoperative colonoscopy in 3-6 months, repeated at 1 year if advanced adenoma or at 3 years and then every 5 years if not advanced adenoma; PET-CT is not routinely recommended.
- **Any T, any N, M1:** suspected or proven metastases, synchronous tumors - diagnosis by colonoscopy, chest-abdominal-pelvic CT, blood count, biochemistry, carcinoembryonic antigen, determination of KRAS gene status (if K-RAS is non-mutated, BRAF testing), needle biopsy if clinically indicated, PET-CT if M1 disease can be surgically approached, multidisciplinary assessment including a surgeon experienced in the resection of liver and pulmonary metastases

### Resectable Synchronous Liver and/or Lung Metastases

1) colectomy with resection of liver or lung metastases followed by chemotherapy FOLFOX or CapeOx;

2) neoadjuvant treatment for 2-3 months (FOLFIRI or FOLFOX or CapeOx ± bevacizumab);

3) FOLFIRI or FOLFOX ± panitumumab or FOLFIRI ± Cetuximab (if K-RAS is wild-type) followed by synchronous colectomy and resection of metastatic disease.

4) colectomy followed by chemotherapy (for 2-3 months) FOLFIRI or FOLFOX or CapeOx ± bevacizumab or FOLFIRI or FOLFOX ± panitumumab or FOLFIRI ± Cetuximab (KRAS wild-type) and resection of metastatic disease.

Surveillance includes history and physical examination every 3-6 months for 2 years, then every 6 months for 5 years; carcinoembryonic antigen every 3-6 months in the first 2 years, then every 6 months for 3-5 years; chest-abdominal-pelvic CT every 3-6 months in the first 2 years, then every 6-12 months for 5 years; colonoscopy in 1 year, if no preoperative colonoscopy due to obstructive lesion, and in case of preoperative colonoscopy in 3-6 months, repeated at 1 year if advanced adenoma or at 3 years and then every 5 years if not advanced adenoma [9];

### Unresectable synchronous liver and/or lung metastases:

- 1) FOLFIRI or FOLFOX or CapeOx ± bevacizumab
- 2) FOLFIRI or FOLFOX ± Panitumumab
- 3) FOLFIRI ± cetuximab (K-RAS wild-type)
- 4) FOLFOXIRI ± bevacizumab
- 5) Colon resection should be considered only if there is imminent risk of obstruction or significant bleeding

Reassess for conversion to resectable every two months, if resectability is a reasonable goal. If the lesions are resectable perform synchronous resection of colon and metastases followed by chemotherapy regimens recommended for advanced disease. If

metastases remain unresectable chemotherapy for metastatic disease should be administered. Surveillance of patients with unresectable metastases is the same as for those with resectable metastases.

### Synchronous Abdominal/Peritoneal Metastases

1) When nonobstructing administer chemotherapy regimens for advanced disease.

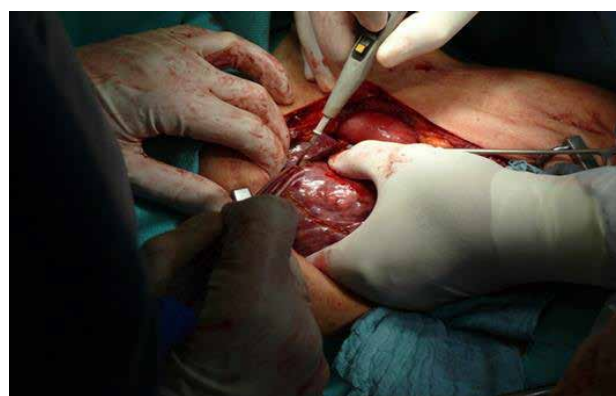
2) the presence of obstruction or imminent obstruction requires colon resection, or colostomy, or bypass surgery to prevent obstruction or stenting, followed by chemotherapy for advanced disease.

### Recurrent Colon Cancer

When there is an elevation in serum carcinoembryonic antigen, the recommendations are: physical examination, colonoscopy and chest-abdominal-pelvic CT. If the results of these imaging investigations are negative should consider a PET-CT, with reassessment in case of negative results in 3 months by chest-abdominal-pelvic CT. If a tumor recurrence is found administer the treatment recommended for metastatic disease [9].

### Conclusions

Colon cancer is a major public health problem. The treatment of this cancer is standardized, and the recommendations from international guidelines are specific to tumor stage. An effective treatment heavily depends on accurate staging of patients and the administration of the treatment regimens adequate for each patient category. Oncologic surveillance plays a very important role in therapeutic success, being based on a time-schedule and a protocol adapted according to the



**Figure 1:** Surgical treatment of liver metastases in colon cancer – before resection (Collection of V Scripcariu).



**Figure 2:** Surgical treatment of liver metastases in colon cancer – after resection (Collection of V Scripcariu).

primary lesion. The goal of implementing the recommendations of international guidelines for the treatment of colon cancer is to provide a uniform treatment for this disease in view of improving overall survival of patients.

### Conflict of interest

The authors have no conflicts of interest to declare.

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## Role of Sentinel Lymph Node in Early Stage of Uterine Cervical Cancer

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### Abstract

Cervical cancer is currently the second most common form of neoplasia worldwide and third in the female population. Dissemination can occur directly (isthmus, parametrium, vagina, urinary bladder and/or rectum), through the lymphatic system (parametrium, internal iliac, external iliac, common iliac, obturator lymph nodes and rarely in the inferior gluteus, superior gluteus, superior rectum, sacrum, aortic lymph nodes) and through the circulatory system (lung, mediastinum, bones, liver). The risk of pelvic lymph nodes invasion in stage IB (FIGO) is 9-17%. The standard surgical treatment, for stages IA2-IIA, is radical hysterectomy with pelvic lymphadenectomy. The risk of intraoperative (vessel or nerve damage) or postoperative complications (lymphedema) is not negligible. The sentinel node concept refers to the first lymph node in which the cancerous lymphatic drainage takes place. This idea has radically changed the therapeutic approach in the treatment of breast cancer and melanoma. In cervical cancers, this technique is 92% accurate with only an 8% false negative rate. Currently, the sentinel node protocol is not included in the standard treatment for cervical cancer because certain issues need to be addressed (the sensitivity of the frozen section examination, the pathologist's subjectivity, the uniformity of the protocol, the surgical experience, the size of the tumor).

**Keywords:** Uterine Cervical Cancer; Sentinel Node; Radical Hysterectomy; Neoadjuvant Treatment

### Introduction

Cervical cancer is currently the second most common form of neoplasia worldwide and third in the female population. It is the first or second most common cancer (after breast cancer) in less developed countries. Cervical cancer accounted for approximately 275,000 deaths worldwide in 2008 [1]. The incidence rates of invasive cervical cancer per 100,000 women in different geographical areas largely vary, reflecting differences in HPV infection and access to screening [2].

Radical hysterectomy with pelvic lymphadenectomy is the standard treatment for early stage cervical cancer. The goal of a systematic lymphadenectomy is to identify and remove tumor cells transported to the lymphatic tissue draining the uterine cervix and the upper vagina.

The term "sentinel lymph node" was first used in 1960 [3], but the initial results on the success of sentinel node hypothesis were largely misinterpreted.

The concept of sentinel lymph node was introduced in 1977 by Cabanas for penile neoplasm. In 1992, Morton took this idea and demonstrated the veracity of sequential lymphatic invasion in cutaneous malignant melanoma [4]. In 1993, Giuliano and Krag initiated the first researches for assessing the sentinel node in breast cancer and provided information on therapeutic management in the early stages of disease [5]. When neoplastic dissemination by lymphatic embolization occurs, invasion is initially in the first tumor-draining lymph node. This lymph node was called sentinel node. Identification, excisional biopsy, histopathology and immunohistochemistry allow to assess regional nodal status and to determine if regional lymphadenectomy is indicated or not [6].

Sentinel lymph node is the first lymph node in a nodal basin to drain an anatomically well-defined region and its histologic assessment is representative for all the other lymph nodes in that region.

This concept can be used particularly in patients diagnosed with cervical cancer stages IA to IIB, with a low incidence of lymph nodes invasion. Morbidity associated with complete pelvic lymphadenectomy (vessel or nerve damage, lymphedema) can be avoided [7-9].

### Sentinel Node Technique

Sentinel node technique is by minimally invasive approach and its goal is to detect the first lymph node to drain the primary tumor and if the sentinel node is not invaded to avoid complete regional lymphadenectomy. Sentinel node technique uses radioactive tracers or vital dyes that are injected around the tumor and trace the route of tumor cells detached from the primary tumor to the first draining lymph node. Excisional biopsy and histopathological examination of the sentinel node are useful for selecting the patients requiring complete pelvic lymphadenectomy is required.

The technique using vital dye is easier and is performed intraoperatively. Marking with dye can be done using several types of dyes, of which the most used are: isosulfan blue, patent blue, methylene blue, China ink, indigo carmine, indocyanine green. Shortly after dye injection, the stained lymphatic channels which lead to sentinel node are visualized. The time window for sentinel node detection is short because the vital dye washes out rapidly.

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The radioactive method consists in the preoperative injection of a radioactive tracer, preoperative scintigraphy, and the use of intraoperative gamma probe. It implies a high cost, requires specific technical equipment, and interdisciplinary collaboration. The most commonly used radioactive agent is technetium-99m metastable colloidal sulfide (Tc - 99m), which has the advantage of rapidly enhancing the regional nodes and washes out after several hours.

Scintigraphy is useful as it identifies the location of sentinel node and indicates the incision site, the gamma radiation detection probe intraoperatively identifying the radioactive lymph nodes.

Sentinel lymph node is noted as follows: pNx (sn): sentinel node cannot be assessed; pN0 (sn): no sentinel node metastasis; pN1 (sn): sentinel node metastases [10].

Based on the encouraging results in patients with vulva, penile, and breast cancer and in some cases of malignant melanoma, sentinel node technique was introduced for patients with cervical cancer in 1999, when several procedures were reported: in some studies sentinel node biopsy was performed by laparotomy or laparoscopy [11].

### Sentinel Lymph Node Concept in Gynecologic Disorders

Sentinel lymph node biopsy is the preferred method for assessing axillary nodal histopathologic status in patients with breast cancer stages I and II. This technique has been recommended following the publication of the results of several recent randomized clinical trials showing the low morbidity in breast cancer patients performing sentinel node biopsy versus axillary lymph node dissection. However, this approach is not recommended by the American Society of Clinical Oncology (ASCO) in the following situations: large or locally advanced breast tumors (T3 and T4), signs of inflammatory breast cancer, tumor diagnosed during pregnancy, or the presence of palpable axillary lymph nodes. NCCN (National Comprehensive Cancer Network) guidelines recommend sentinel node biopsy in patients diagnosed with breast cancer without clinically evident axillary lymph nodes [12].

In breast cancer, the identification of sentinel nodes with a dye-based technique is considered inferior to gamma radiation technique. Cox et al. reported a sentinel node identification rate of 80.3% with the dye technique, 88.6% with gamma radiation method, and 96.7% when both techniques were used [13]. Kim et al. reported a detection rate of 83.1%, 89.2% and 91.9% for the dye method,  $\gamma$  radiation-based technique, and combined technique, respectively, with a false-negative rate of 10.9%, 8.8%, and 7.0%, respectively [14].

In a study of 374 breast cancer patients in which sentinel node biopsy was performed using dye (indigo carmine, 2-4 mL injected around the primary tumor and periareolarly), followed by surgery with radical intent, the sentinel node was identified in 362 patients (96.8%). In 54 patients sentinel node metastases were identified for which axillary lymph node dissection was performed. Sensitivity in detecting lymph node metastasis in final histopathology was 96.4% with a specificity of 100%. The accuracy of sentinel node biopsy for the detection of metastatic disease was 98.1%. The intraoperative diagnosis of sentinel node metastasis was confirmed in 362 patients by final histopathology, with a false-negative rate of 12.9% (8 patients) [15]. Vulvar cancer is a good target for sentinel node detection because the tumor can be easily injected with radiocolloid substances or vital dye and the lymphatic drainage is predictable in one or both inguinal areas.

In a study by Levenback et al. on a series of 452 patients diagnosed with vulvar cancer, in 418 at least one sentinel node was identified. Sensitivity of sentinel node testing was 91.7% [16].

Hauspy et al. reported in a study of 41 patients with vulvar cancer stages I and II in which following sentinel node assessment a complete inguinofemoral lymphadenectomy was performed, a detection rate for at least 1 sentinel lymph node per patient of 95%, and bilateral sentinel nodes detected in 46% of patients [17].

Another study evaluated postoperative morbidity in patients with vulvar cancer who underwent sentinel node biopsy (29 patients) versus inguinal sentinel lymph nodes dissection (46 patients). The reported results showed that inguinal sentinel lymph node dissection was associated with a shorter operation time, a reduced rate of inguinal seromas, wound breakdown and infection, fewer days of inguinal drainage, and reduced postoperative lymphatic secretion [18].

### Sentinel Lymph Node Cervical Cancer

Dissemination can occur directly (isthmus, parametrium, vagina, urinary bladder and/or rectum), through the lymphatic system (parametrium, internal iliac, external iliac, common iliac, obturator lymph nodes and rarely in the inferior gluteus, superior gluteus, superior rectum, sacrum, aortic lymph nodes) and through the circulatory system (lung, mediastinum, bones, liver). The incidence of pelvic lymph node invasion varies with FIGO stages. The literature reports an incidence of 11-21% in stage IB and of 39-43% in stage IIB. The incidence of paraaortic lymph nodes invasion ranges from 2-4% stage IB to 7-17% in stage IIB [19,20]. In stage I cervical cancer the risk of lymph node dissemination depends on tumor size, depth of stromal invasion, and presence of lymph-vascular space invasion.

In stage I cervical cancer the presence of lymph node invasion is the most important prognostic factor. If lymph node metastases are present at the time of surgery, the 5-year survival rate decreases from 85% to 50% [21,22]. The alternative explorations of nodal status in cervical cancer (including imaging techniques) were disappointing.

Cervical cancer is a type of cancer in which sentinel node technique can be used for several reasons; literature data report an incidence of lymph node metastasis of 0-16% in patients with cervical tumors not exceeding 2 cm and of 15-31% in patients with FIGO stage IB [23] anatomically, uterine cervix is characterized by a complex lymphatic drainage, the following lymph node stations being described:

Station I includes the lymph node groups located anterior to a transverse plane crossing the bifurcation of the common iliac vessels, represented by: Lucas-Championniere lymph nodes (near the junction of uterine vessels and ureter), internal and external iliac nodes. During station I lymph node dissection it is important to recognize and remove the following lymph nodes: Cuneo-Marcille (situated at the bifurcation of the iliac vessels) and obturator nodes described by Thoma Ionescu and Leveuf-Godard (actually belonging to the medial external iliac lymph node chain, located between the inferior medial margin of external iliac vein and obturator nerve) [24]

- Station II, represented by the common iliac, promontorial, and lateral and presacral lymph nodes
- Station III, represented by inframesenteric aortic lymph nodes
- Station IV, intrarenal aortic lymph nodes.



In 2010, Cibula et al. reported a proposal for a new classification system of types of pelvic lymph node dissection. The four types are:

- Type sentinel lymph node: only the sentinel lymph nodes detected in the pelvic basin are removed.
- Type I dissection: external iliac region: removes lymph nodes anterior and medial to the external iliac vessels, ventrally up to the deep circumflex iliac vein. Obturator region: removes obturator nodes above the obturator nerve. Common iliac region: removes nodes anterior (superficial common iliac region) up to the mid common iliac vessels.
- Type II dissection: this is a type I dissection which also includes all of the following steps:

External iliac region: removes nodes between the external iliac vessels and psoas muscle after vessel mobilization and complete skeletonization; removes distal nodes caudal to deep circumflex iliac vein.

Internal iliac region: exposes the internal iliac vein and removes internal iliac nodes. Obturator region: removes nodes below obturator nerve.

Presacral region: complete removal of presacral nodes.

Type III dissection: type II dissection which also includes all of the following steps:

Common iliac region: removal of superficial common iliac nodes up to the aortic bifurcation;

Complete medialization of the common iliac vessels and removal of deep common iliac nodes between the lateral aspect of the common iliac vein and the psoas muscle exposing lumbosacral trunk [25].

The literature shows a one-side sentinel node detection rate of over 90% (range 55% to 100%). This detection rate is not influenced by the surgical approach (laparotomy or laparoscopy). Also, bilateral sentinel node was detected at a rate ranging from 31% [26] to 94% (Pijpers et al., 2004) [27].

In 2000, Medl et al. were the first to report the sentinel node concept in cervical cancer. They studied only 3 patients in which sentinel node was identified by using a blue substance during radical hysterectomy. In all 3 cases the sentinel node was positive [28]. Another study conducted at the University of Texas on 21 patients identified the sentinel node in 60% of them by injecting isosulfan blue-based substance into the cervix [29].

In 2003, Dargent et al. recommended laparoscopic sentinel node biopsy for cervical cancer staging and determining the therapeutic management: surgical or neoadjuvant treatment [30].

Recently, some authors have evaluated preoperative and intraoperative lymphoscintigraphy for sentinel node detection (detection rate 84-100%) [7]. Verheijen et al. [31] used a combined technique (vital dye and lymphoscintigraphy) in a group of 10 patients and reported an 80% sentinel node detection rate in cervical cancer.

A systematic review of the literature on the benefit of sentinel node biopsy in the assessment of lymph node status in cervical cancer and which technique is best (vital dye, Tc -99m or combined method) was conducted and the results were presented in an article that included 842 patients. Data were collected from international databases (Medline and Embase).

Finally, 23 studies were selected with a sentinel node detection rate of 97% for the combined approach versus 84% ( $p < 0.0001$ ) for dye and 88% ( $p < 0.0018$ ) for Tc -99m [32].

Optimization of sentinel node technique refers to the use of method that is inexpensive, feasible for cervical cancer patients, and has a high detection rate. Colorimetric technique based on the peritumoral injection of 2-4 ml methylene blue 10-360 minutes preoperatively was studied in 77 patients who underwent abdominal radical hysterectomy and pelvic lymphadenectomy. Results of the study showed that methylene blue is a useful tracer to detect sentinel nodes the ideal dose being 4 ml injected 60-90 minutes prior to surgery [33].

In the assessment of lymph node status in patients diagnosed with cervical cancer by the use of sentinel node technique, regardless of the method, colorimetric, radioisotopic or combined, laparoscopy plays an important role in determining the subsequent treatment [34-36].

Another study provided information on radical surgery, emphasizing that parametrial resection can be minimized in patients with cervical tumors and negative sentinel node. Inclusion criteria for the study group were: patients with stage IA1 cervical cancer and lymphovascular space invasion, IB1 with tumor size below 2 cm and stromal invasion detected by imaging below 50%. The 60 patients underwent laparoscopic sentinel node mapping. All patients with positive nodes also had positive sentinel node [37].

Like many other studies in the literature, Roy et al. compared the two methods of sentinel node detection in cervical cancer: colorimetric method with isosulfan blue and radioisotopic method with Tc-99. The study included 211 patients with early stage cervical cancer, in which surgery was performed laparoscopically to identify and remove the sentinel node, followed by systematic pelvic lymphadenectomy with or without paraaortic lymph node sampling. The colorimetric method was used in 152 patients, and the radioisotopic method in 166 patients. The authors concluded that sentinel node mapping using the radioisotopic technique had a higher detection rate (96.9%) compared with the use of dye (92.8%). The most frequent locations of the sentinel node (85%) were the bifurcation of the iliac vessels and/or obturator fossa. It should be mentioned that complete pelvic lymphadenectomy can be performed in patients in whom sentinel nodes were not detected [38].

In order to minimize the need for pelvic lymphadenectomy, sentinel node technique seems to be a good option for assessing nodal status in early stage cervical cancer. A prospective study by Cormier et al. based on colorimetric and radioisotopic techniques reported similar results on sentinel node detection with those previously published in the literature. At least one sentinel lymph node was identified in 93% of cases (114 of the 122 study patients), while optimal (bilateral) mapping was achieved in 75% of cases (91/122). Moreover, the authors believe that this procedure accompanied by sentinel node ultrastaging is an effective technique to increase the detection rate of lymph node metastases by 3.5% [39].

The studies recommend the use of sentinel node technique in early stage cervical cancer.

### Where to Look for the Sentinel Node?

Bader et al. reported that in cervical cancer patients with only one positive node, this is most frequently located in the external iliac artery and obturator fossa or parametrium. Thus, sentinel node should be first looked for in these regions. If only one node is positive, the location of the other invaded nodes is hard to predict. However, dissemination of tumor cells to paraaortic lymph nodes is rare [40].

Di Stefano et al. in a study on a series of 50 patients with FIGO stage IA2 - IIA cervical cancer concluded that sentinel node detection using vital dye is a feasible procedure with important role in surgical staging of patients with small cervical tumors. The described method was based on dye injection 5-10 mm into the cervix at 3, 6, 9, 12 hours (dye injection directly into the tumor was avoided). Once the abdomen was opened, blue lymph nodes were detected in the pelvis in no less than 15 minutes and no more than 70 minutes the reported results indicated a sentinel node detection rate of 90%, unilateral and bilateral sentinel nodes being detected in 72% and 60% of the cases, respectively.

Topographically, sentinel nodes were found in the external iliac artery in 55% of cases and obturator fossa in 38% of cases, with only 5 sentinel nodes isolated in the common iliac region [23].

Similar results were published and Diaz et al. in a prospective study that included 81 patients with early stage cervical cancer (FIGO stages IA1-IIA) with indication for surgical treatment. All patients received intraoperative injection of vital dye. Sixty-three patients who underwent preoperative lymphoscintigraphy also received a 99m Tc sulfur colloid injection and imaging assessment one hour after the injection at tumor periphery in all four quadrants of uterine cervix. Sentinel node mapping was successful in 77 (95%) of the 81 patients. The total number of sentinel nodes evaluated was 316, with an average of 3 nodes per patient. The three locations of sentinel node were: external iliac (35%), internal iliac (30%), and obturator fossa (20%) [41].

Sentinel lymph node mapping in early stage cervical cancer (IA1 - IIA) was once again a topic debated by Darlin et al. in a study on 105 patients. The technique described for obtaining the results was based on radioactive tracer injection (1.5 mL of Tc99 nanocolloid human albumin) in the four cervical peritumoral quadrants 18 hours before surgery, dynamic scintigraphy (15 minutes after tracer injection up to 45-60 minutes), and use of intraoperative gamma probe. During surgery (robot assisted laparoscopic approach-da Vinci Surgical System in 90 patients, laparotomy or laparoscopy in the remaining 25 patients) the detection rate of at least one sentinel node was 90% (94/105 patients), and 94% in patients with tumor size equal or less than 2 cm. Bilateral nodes were detected in 62 of the 105 patients. The authors concluded that sentinel node technique may be useful in patients with cervical tumors not exceeding 2 cm. However, complete pelvic lymphadenectomy has to be performed in cases with unilaterally positive sentinel node [42].

### Diagnostic Accuracy of Sentinel Node

The question is whether sentinel node has significance in locally advanced cervical cancer. Barranger et al. gave some answers in a study on 33 patients, 23 with early stage cervical cancer who underwent complete laparoscopic pelvic lymphadenectomy after sentinel node assessment (combined vital dye- radioisotope) and 10 with locally advanced cervical cancer who underwent laparoscopic pelvic and para-aortic lymphadenectomy. The results of this study showed that sentinel nodes were detected in 86.9% of early-stage cervical cancer cases and in 80% of the locally advanced cervical cancer cases. Since the cervix is a middle organ in the pelvis, another important aspect approached by the study was the unilateral or bilateral involvement of the sentinel node. It is therefore impossible to predict the preferential side of lymphatic drainage in these cases. The false-negative rate of sentinel node biopsy was 0 in the early stage group and 20% in the group with locally advanced cervical cancer.

When the side of dissection was analyzed, the false-negative rate reached 42.9% in patients with locally advanced cancer and remained 0 in the early-stage group ( $p = 0.038$ ) [43].

Many authors report, in addition to sentinel node detection rate, the false-negative rate (defined as negative sentinel node but presence of neoplastic dissemination to other nodes in the region), which seems to be the most important performance index.

A retrospective multicenter study evaluated the false-negative rate of sentinel lymph node ultrastaging in patients with FIGO stages I-IIb cervical cancer. 645 patients were included in the study, and sentinel lymph nodes were detected bilaterally in 72% of cases and unilaterally in only 28%. The authors reported a sensitivity of the technique (using either vital dye alone or in combination with radioisotope) of 97% with a false-negative rate of 1.3% for patients with bilaterally detected sentinel nodes. The most important contribution of sentinel lymph ultrastaging in the management of cervical cancer is to improve detection of lymph node metastases, including micrometastases (deposits of 0.2 to 2 mm) and isolated tumor cells (deposits not exceeding 0.2 mm, including the presence of single, non-cohesive cytokeratin-positive tumor cells) [44].

Another challenge that arises in many studies is that of complete lymphadenectomy in cervical cancer and why sentinel node seems to be a better solution in the pretherapeutic staging of these patients. Therefore, a study by Gortzak-Uzan et al. provided information about node metastatization and therapeutic management of early stage cervical cancer. The results showed that lymph node metastasis detection rate was two-times higher when using the sentinel node technique as compared to complete lymphadenectomy. The authors believe there are two explanations: one attributed to extensive histological examination (ultrastaging) of sentinel node, and the second explanation is that lymph node metastases in sentinel node procedures are related to aberrant pathways and unusual locations (e.g., common iliac or paraaortic regions). Since postoperative morbidity can be reduced and the negative rate is quite low in many studies, sentinel node procedure is adequate for assessing lymph node status in early stage cervical cancer [45].

### Discussions

Lymph node involvement in cervical cancer is the main prognostic factor. Lymph node assessment can be done by imaging methods before treatment, but the data are insufficient or inaccurate; therefore, the most accurate method is pelvic lymphadenectomy, but it is also associated with complications described in the literature. Sentinel node concept has become the topic of many studies aimed at investigating the feasibility of this technique in early cervical cancer.

Lymphatic mapping and sentinel node identification are procedures used in almost all solid tumors, and sentinel node status has become part of the staging criteria in both breast cancer and malignant melanoma.

At the present time, sentinel lymph node is still investigational and not standard of care in cervical cancer. The overall sentinel lymph node identification is around 90%, with a sensitivity of 92%, and an approximately 8% false negative rate, with a negative predictive value of 97%. Challenges to adoption include the sensitivity of frozen section, availability of pathologic expertise, uniformity of technique, surgical experience, and clinical impact of tumor size [46].

## Conclusion

Sentinel lymph node biopsy is a technique that can be used to assess nodal status in early stage cervical cancer patients, mentioning that complete pelvic lymphadenectomy minimizes postoperative morbidity. A fast and accurate image of the lymph nodes allows the correct selection of therapeutic approach: concomitant neoadjuvant chemoradiotherapy or radical hysterectomy.

However, there are questions that need answers and optimal results for the introduction of sentinel node procedure in cervical cancer treatment. For example, which is the acceptable false-negative rate? What does the learning curve for this technique involve? If the sentinel

node is negative, is it oncologically safe to abandon pelvic lymphadenectomy? What is the role of micrometastases and isolated tumor cells in pelvic recurrences?

## Conflict of interest

The authors have no conflicts of interest to disclose.

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# Extended Low Hartmann Operation with Total Mesorectal Excision - Optimal Surgical Treatment in Stage IV Mid and Upper Rectal Cancer

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## Abstract

**Background:** The main surgeries that can be performed in upper and mid rectal cancer are low anterior rectal resection (LAR), lateral colostomy (LC), and extended Hartmann operation with mesorectal excision (EHO). Compared to lateral colostomy, EHO is a curative surgery; it also takes a shorter time to perform and has a lower mortality compared with LAR.

**Objective:** The aim of this study was to analyze the postoperative surgical complications in patients who underwent LAR, LC, or EHO.

**Methods:** The study is a prospective analysis based on a *Surveillance protocol for patients with liver metastases of colorectal origin* used in First Surgical Oncology Unit, Regional Institute of Oncology Iași, Romania. The postoperative complications occurring within 60 days postoperatively were analyzed.

**Results:** In the interval June 2012 – May 2014, 87 patients were diagnosed with upper and mid-rectal cancer and liver metastases; LAR was performed in 18 patients, LC in 19 patients and in 50 patients EHO with pelvic drainage abdominally exteriorized or perineally (37 and 13 patients, respectively). The postoperative complications related to surgical wound, stoma, pelvic abscess, postoperative bleeding, prolonged postoperative ileus, anastomotic leakage, reinterventions, readmissions, and mortality were analyzed. A higher rate of pelvic abscesses was found in EHO patients (24%, n=12), of which 9 patients (18%) required reinterventions for drainage of pelvic fluid collection; all these patients had pelvic drainage exteriorized abdominally. No presacral abscesses were recorded in patients with pelvic drainage exteriorized perineally.

**Conclusions:** Extended Hartmann Operation (EHO) remains a safe technique, that shares some indications with LAR and LC; however, it is associated with a higher percentage of pelvic abscesses and reinterventions that can be avoided by postoperative perineal drainage of the presacral space

**Keywords:** Extended Hartmann Operation; Rectal cancer; Pelvic abscess; Perineal drainage

**Abbreviation:** LAR=Low Anterior Rectal Resection; LC=Lateral Colostomy; EHO=Extended Hartmann Operation with Mesorectal Excision; EHO-abd=Extended Hartmann Operation with Mesorectal Excision and Pelvic Drainage Abdominally Exteriorized; EHO-per=Extended Hartmann Operation with Mesorectal Excision and Pelvic Drainage Perineally Exteriorized

## Introduction

Colorectal cancer is the third most common cancer in the world with nearly 1.4 million new cases diagnosed in 2012 [1]. In Romania, the incidence has doubled in the last 20 years reaching 22.8 cases per 100,000 population, making it the second leading cause of cancer death after lung cancer [1].

Colorectal cancer treatment is multimodal, involving a multidisciplinary team and periodic reassessments of the patients to determine the need for adjusting the initial therapeutic strategy. In terms of finding an optimal therapeutic strategy, the most difficult challenge a surgeon faces is the advanced stages of rectal cancer. The presence of distant metastases (M1a, b) and/or a high degree of local invasion (T3, T4a, b) in patients with rectal cancer most often involves a new interpretation of existing treatment protocols, and their adjustment depending on age, associated diseases, anesthetic risk, and patient decision after he has been properly informed

In the last three decades significant progress has been made in the management of rectal cancer by the introduction of the concept of total mesorectal excision [2], neoadjuvant radiochemotherapy [3,4], updating of TMN classification based on clinical studies, description of the two mechanisms of colorectal carcinogenesis (LOH +phenotype and MSI + phenotype) [5,6], identification of new locoregional therapies, discovery of new chemotherapeutic molecules, and the introduction of targeted therapies with monoclonal antibodies. Due to these advances, the median survival of patients with metastatic rectal cancer may exceed 24 months [7,8]. Surgical removal of the primary tumor and metastases still remains the only curative treatment.

The main surgical options for upper and mid rectal cancer are:

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- low anterior resection (LAR) with total mesorectal excision or mesorectal transection by classical or laparoscopic approach – the preferred treatment for rectal cancer.

- classic or laparoscopic lateral colostomy (LC) is a palliative surgery that takes a shorter time to perform; it is used in patients with unresectable rectal tumors awaiting response to adjuvant therapy or in patients with a high anesthetic risk.

- extended Hartmann operation (EHO) with total mesorectal excision or transection; first described in 1921 by the French surgeon Henri Albert Hartmann as the surgical resection of the rectosigmoid colon with closure of the rectal stump and end colostomy, used to treat cancer or rectosigmoid diverticulitis [9,10]. It is a curative-intent surgery by which the rectal tumor is removed with oncologic safety limits with mesorectal excision (total in mid rectal tumors or partial in the upper ones) after ligation of the inferior mesenteric vessels at the origin or above the emergence of the left colic artery. The closure of the rectal stump can be done mechanically (mid rectal cancer) or manually (upper rectal cancer). Postoperative pelvic drainage can be exteriorized abdominally (EHO-abd) or perineally (EHO-per). It is considered a sequential operation, because a second surgery in addition to restoring digestive continuity also includes an intraoperative assessment of the lesion and the surgical resolution of any local or distant recurrence. Not infrequently terminal colostomy becomes permanent. In the literature it can be found under the name of low Hartmann procedure or low anterior resection end-colostomy with closure of the distal rectal stump.

The aim of this study was to analyze the complications occurring within 60 days after surgery in patients diagnosed with upper of midrectal cancer who underwent LAR, LC or EHO.

## Materials and Methods

The study is a nonrandomized, prospective analysis over a 24-month period, based on *Surveillance protocol for patients with liver metastases of colorectal origin* used at First Surgical Oncology Unit, Regional Institute of Oncology Iași, Romania. According to this protocol the patients are classified into 4 classes of hepatic resectability: resectable, possibly, susceptible, and unresectable metastases.

Inclusion criteria: age over 18 years, pathology diagnosis of rectal carcinoma, imaging diagnosis (CT/MRI) of liver metastases, rectal tumor located at more than 6 cm from the anal verge.

Exclusion criteria: patients diagnosed with rare rectal cancers (sarcomas, lymphomas, melanomas, endocrine tumors, carcinoid tumors), patients diagnosed with rectal tumors with anal sphincter invasion, patients who refused the treatment recommended by the Regional Institute of Oncology Commission.

Preoperative assessment included patient history, physical examination including the assessment of physical status, and anesthetic risk class according to ASA classification. Also included was the rectal examination aimed to assess anal sphincter competence useful in selecting the surgical procedure.

For the comparative evaluation of postoperative surgical complications, the selected patients were divided into 3 groups depending on the surgical procedure they underwent [11]: LAR, LC or EHO, and 2 subgroups: EHO-abd, EHO-per.

Anterior resection of the rectum (LAR) was performed in patients with ASA I/II anesthetic risk, resectable tumors (R0) without extrahepatic metastases. In mid rectal tumors total mesorectal excision, identification of hypogastric nerve, mobilization of the splenic angle of the colon, and stapled end-to-end colorectal anastomosis were performed; protective ileostomy was performed in all patients. Pelvic drainage was exteriorized abdominally. In upper rectal tumors

mesorectal transection or total mesorectal excision was performed depending on the intraluminal extension of the tumor. Mobilization of the splenic angle of the colon was not required in all patients. End-to-end colorectal anastomosis was usually hand-sewn and protective ileostomy was performed only when there were doubts of anastomotic tightness. To meet all demands of radicality of surgery the following associated interventions were performed: anexectomy, hysterectomy, enterectomy, partial cystectomy, and appendectomy. Liver metastases were classified as resectable or possibly and we chose to perform metastasectomies (atypical limited liver resections or wedge resections), thermoablation and/or insertion of port-a-cath in the hepatic artery.

The indication for performing lateral colostomy (LC) was: unresectable rectal tumor, unresectable liver and extrahepatic metastases, or ASA III/IV anesthetic risk. Liver metastases were classified into the following resectability classes: possibly, susceptible or unresectable.

Extended Hartmann operation (EHO) was performed in patients at ASA II/ or III anesthetic risk, patients in whom after rectal tumor removal there was a suspicion, biopsy-confirmed or unconfirmed of residual pelvic tumor, with or without extrahepatic metastases. Total mesorectal excision was required in mid rectal tumors when the stapled closure of the rectal stump and pelvic drainage exteriorized abdominally or perineal pararectal were practiced. In the upper rectal tumors, mesorectal transection and closure of the rectal stump were performed either by using stapler (pelvic drainage abdominally exteriorized) or hand-sewn (pelvic drainage transrectal exteriorized). The associated surgical interventions are the same as in the curative-intend procedures: ovariectomy, hysterectomy, enterectomy, partial cystectomy, appendectomy and peritoneal biopsies – most frequently.

Data were extracted from IRO Iasi electronic system and observation sheets. The general characteristics of the patients (age, gender) were examined. The associated diseases were analyzed and classified using of ASA Risk Score and Charlson Comorbidity Index Risk [12]. Postoperative surgical complications (postoperative wound complications, stoma complications, postoperative bleeding, pelvic abscess, prolonged postoperative ileus, anastomotic leakage, reinterventions, readmissions, postoperative mortality) were analyzed according to Dindo-Clavien Classification.

The obtained data were processed in MS Excel, and statistical analysis was performed with RStudio software. Fisher exact test of independence was used. Significance threshold was  $p < 0.05$

## Results

In the interval June 2012 – May 2014, at IRO Iasi, Romania, 87 patients were diagnosed with upper and mid rectal cancer with liver metastases; LAR was performed in 18 patients, LC in 19 patients, and 50 patients underwent EHO with pelvic drainage abdominally exteriorized ( $n=37$ , subgroup EHO-abd) or perineally ( $n=13$ , subgroup EHO-per) (Figure 1,4,5).

The general characteristics of patients (age, sex), comorbidities (according to ASA Risk Score and Charlson Comorbidity Index) and primary tumor staging according to pathological analysis are shown in Table 1, Figure 2 and Figure 3.

As expected, we found a significant association ( $p < 10^{-10}$ ) between the type of surgery and anesthetic risk expressed by ASA score. This can be explained by the careful selection of patients according to the extent and risks of surgery. Survival expressed by Charlson Comorbidity Index also showed a significant association ( $p < 10^{-7}$ ) with the type of surgery.

Postoperative surgical complications are presented in detail, before and after the use of Dindo-Clavien Classification, in table 2 and 3.

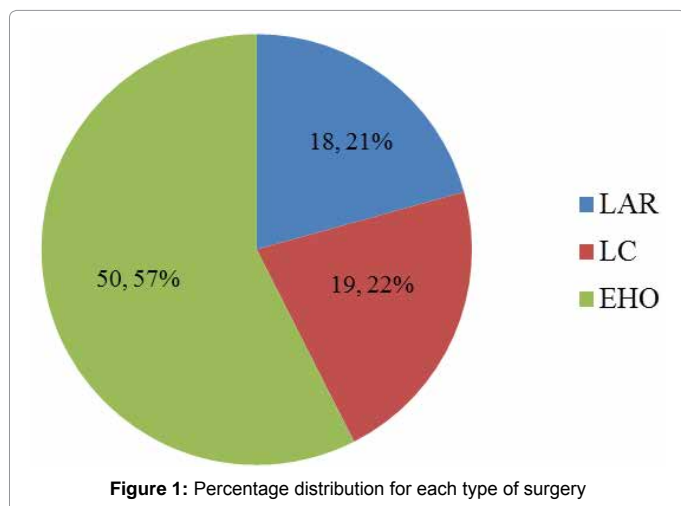


Figure 1: Percentage distribution for each type of surgery

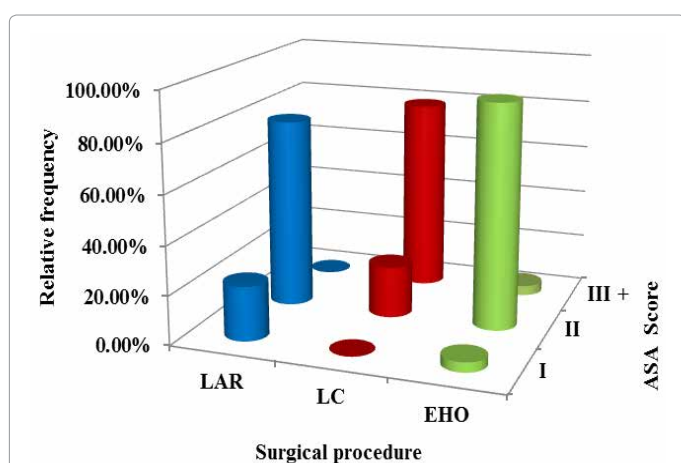


Figure 2: Relative frequency of the anesthetic risk expressed by ASA score for each type of surgery

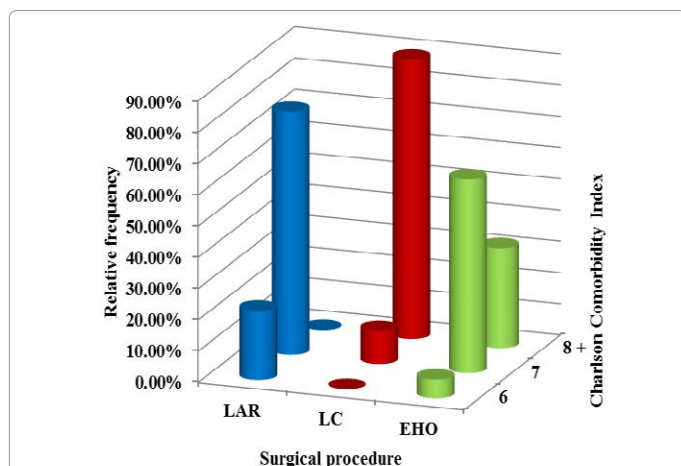


Figure 3: Relative frequency of the survival prognostic expressed by Charlson Comorbidity Index for each type of surgery

Surgical wound complications (seromas, hematomas, infections, dehiscence) were more common among the patients who underwent LC (36.84%) compared with those who underwent LAR and EHO with showed approximately equal rates (22.22% vs. 22%). No ileostomy complications were recorded in the patients who underwent LAR, but a relatively high rate of colostomy complications were found in patients who underwent LC (15.78%) compared with those who underwent EHO (8%). Postoperative bleeding did not require reinterventions. In percentages, there was a important difference between postoperative

bleeding in patients with LAR and those with EHO (16.66% vs. 6%). A higher rate of pelvic abscesses was found in patients who underwent EHO (24%, n=12) of which 9 patients (18%) required reinterventions for pelvic collection drainage; all these patients had pelvic drainage abdonally exteriorized (EHO-abd). No presacral abscesses were found in patients with pelvic drainage perineally exteriorized (EHO-per).

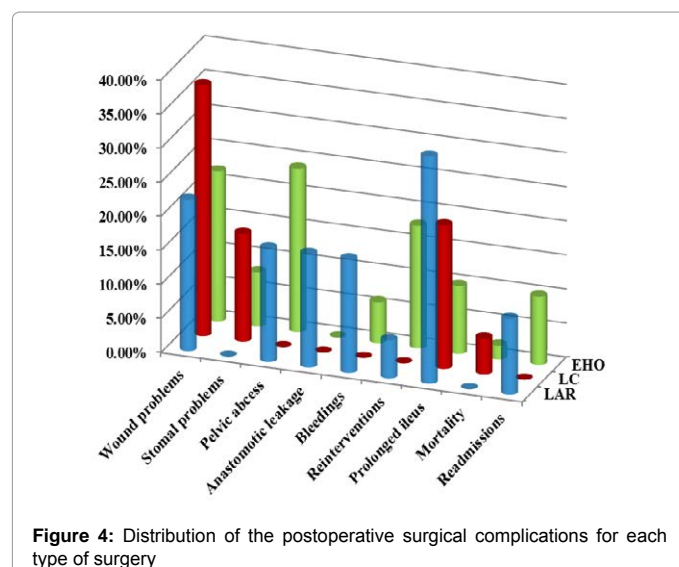


Figure 4: Distribution of the postoperative surgical complications for each type of surgery

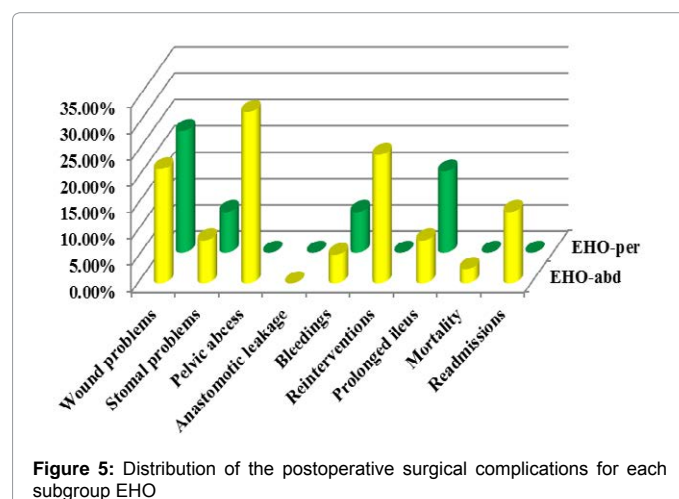


Figure 5: Distribution of the postoperative surgical complications for each subgroup EHO

Table I: Patient and tumour characteristics according to type of surgical intervention

Variables	LAR n=18	LC n=19	EHO n=50	Total n=87	p-value
Age (mean)	65.77	66	61.84	63.56	-
Gender					0.55
Male	10 (55.55%)	9 (47.37%)	31 (52%)	50 (57.47%)	
Female	8 (44.45%)	10 (52.63%)	19 (48%)	37 (42.52%)	
ASA Score					<10 <sup>-10</sup>
I	4 (22.22%)	0	2 (4.00%)	6 (6.90%)	
II	14 (77.78%)	4 (21.05%)	46 (92.00%)	64 (73.56%)	
III +	0	15 (78.95%)	2 (4.00%)	17 (19.54%)	
Charlson Comorbidity Index					<10 <sup>-7</sup>
6	4 (22.22%)	0	3 (6.00%)	7 (8.05%)	
7	14 (77.78%)	2 (10.53%)	31 (62.00%)	47 (54.02%)	
8 +	0	17 (89.47%)	16 (32.00%)	33 (37.93%)	
pT-stage					-
pT3	12 (66.67%)	n.a.	26 (52.00%)		
pT4a,b	6 (33.33%)	n.a.	24 (48.00%)		

**Table II:** Postoperative surgical complications for each type of surgery

Variables	LAR n=18	LC n=19	EHO n=50	p-value	TOTAL n=87	EHO-abd n=37	EHO-per n=13	p-value
Wound problems	4 (22.22%)	7 (36.84%)	11 (22%)	0.43	22 (25.29%)	8 (21.62%)	3 (23.08%)	1
Stomal problems	0	3 (15.78%)	4 (8%)	0.22	7 (8.05%)	3 (8.11%)	1 (7.69%)	1
Postoperative bleedings	3 (16.66%)	0	3 (6%)	0.12	11 (12.67%)	2 (13.51%)	1 (7.69%)	1
Pelvic abscess	3 (16.66%)	0	12 (24%)	<b>0.041</b>	15 (17.24%)	12 (32.43%)	0	<b>0.0221</b>
Anastomotic leakage	3 (16.66%)	n.a.	n.a.	-	3 (3.45%)	n.a.	n.a.	-
Prolonged ileus	6 (33.33%)	4 (21.05%)	5 (10%)	0.08	15 (17.24%)	3 (8.11%)	2 (15.38%)	0.59
Reinterventions	1 (5.55%)	0	9 (18%)	0.07	10 (11.49%)	9 (24.32%)	0	0.08
Readmissions	2 (11.11%)	0	5 (10%)	0.43	7 (8.05%)	5 (13.51%)	0	0.30
Postoperative mortality	0	1 (5.26%)	1 (2%)	0.67	2 (2.30%)	1 (2.70%)	0	1

**Table III:** Standardized surgical complications by Clavien – Dindo Classification

The Clavien-Dindo	LAR n=18	LC n=19	EHO n=50	TOTAL n=87
Classification				
Grade I	4 (22.22%)	9 (47.36%)	14 (28%)	27 (31.03%)
Grade II	6 (33.33%)	4 (21.05%)	9 (18%)	19 (21.83%)
Grade III	1 (5.55%)	0	9 (18%)	10 (11.49%)
Grade IV	1 (5.55%)	0	2 (4%)	3 (3.45%)
Grade V	0	1 (5.26%)	1 (2%)	2 (2.30%)

Fisher's test of independence was used to each type of postoperative complication for identifying statistically significant differences between the frequency and type of surgical complication. At this stage, the study included three groups - LAR, LC and EHO - without distinguishing between drainage types in the EHO group. Very close to the significance threshold of 0.05, the number of reinterventions varied considerably by procedure type ( $p=0.07$ ), with a higher frequency for EHO; all reinterventions in the EHO group were related to EHO-abd subgroup, no reinterventions being performed for EHO-per subgroup.

Prolonged ileus, also very close to the significance threshold ( $p=0.08$ ), had a higher incidence in LAR and LC than in ECO.

For the other postoperative complications, we do not have statistically significant evidence for a procedure type-related dependence.

Assuming that the pelvic abscess rate tends to be 0% in LC-type procedures, the frequency differentiation of pelvic abscesses could be

analyzed by applying the Fisher test to the surgical procedure types that can cause this complication (Table 2). Test result ( $p=0.041$ ) indicated significant differences in the incidence of pelvic abscesses by type of surgical procedure. Comparing only the two EHO groups the pelvic abscess rate was significantly higher for EHO-abd compared with EHO-per ( $p=0.0221$ ).

The 95% confidence interval for the proportion of pelvic abscesses in LAR procedures was (4.40%, 42.26%), while for EHO-per it was (0%, 28.34%) - (i.e. the probability of more than 28.34% pelvic abscess is only 5% for EHO with perineal drainage).

## Discussions

Postoperative wound complications have proven to be a relatively numerous in all three groups (perhaps due to the proximity to the stoma), but without significant differences. All these surgical wound complications were minor (Clavien - Dindo grade I). The rate of colostomy complications was higher in the LC group, but were most commonly minor. In the EHO group one patient developed colostomy necrosis causing his death. Prolonged postoperative ileus was found in large numbers of patients in LAR group, one patient requiring hospital readmission. Appreciable differences, close to statistical significance ( $p=0.08$ ) were found between the 3 groups.

The main complication in this study was the pelvic abscess (presacral abscess). In the LAR group pelvic abscesses occurred in patients who developed postoperative anastomotic fistulas, one patient requiring reintervention for drainage of presacral collection. The large number of pelvic abscesses (24%,  $n=12$ ) in EHO group determined a high reintervention rate (18%,  $n=9$ ), some of them performed during the same hospitalization, others (13.16%,  $n=5$ ) 3-4 weeks after a new admission. These results are in agreement with those reported in the literature [13-16]. The analysis of the two EHO subgroups (EHO-abd and EHO-per) showed that all abscesses occurred in patients with drainage abdominally exteriorized. These encouraging results of the use of drainage perineally exteriorized made us consider its extended use in LAR-type surgeries.

Drainage of abscesses in EHO group patients was performed under sedation, transrectal, under ultrasound guidance, via a laparoscopic trocar through which a drain was introduced.

A recent Dutch study [17] suggests a significant association between the amount of blood lost during LAR surgery and anastomotic fistula - with high mortality and morbidity due to pelvic abscess formation - suggesting the use of an EHO-type surgical procedure in the case of severe intraoperative bleeding. There are studies concluding that EHO is a lifesaving operation, but not devoid of postoperative complication risks related to colostomy and frequent occurrence of pelvic abscess, without discussing the postoperative drainage type [18]. Patients who undergo LAR may develop anal incontinence (postoperatively or post radiation therapy) affecting their quality of life [19]. In patients with colostomy, their quality of life does not appear to be affected, even if colostomy is permanent [20].

## Conclusions

Extended Hartmann operation remains a safe alternative technique, which shares indications with LAR and LC, and is associated with a higher rate of pelvic abscesses and reinterventions that can be avoided by postoperative perineal drainage of the presacral space. It is a lifesaving surgery when performing LAR fails due to intraoperative incidents.

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# Laparoscopic vs. Open Right Hemicolectomies: Short Term Outcomes within an Enhanced Recovery After Surgery Programme

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## Abstract

**Aims:** Studies that recommend laparoscopic right hemicolectomies within an Enhanced Recovery After Surgery (ERAS) programme are based on data from all types of colorectal procedures. This study compares short-term outcomes following right hemicolectomies within an ERAS setting.

**Methods:** Retrospective analysis of elective right hemicolectomies carried out between October 2008 and April 2012. Exclusion criteria:- patients not managed with an ERAS programme; inflammatory bowel disease; ASA IV and above; extended right hemicolectomy; formation of a stoma. Patients were split into laparoscopic (Group A) and open procedure (Group B). Patient demographics, hospital stay, operative details, tumour characteristics, analgesia usage and complications were compared between the two groups. Discharge criteria was standardised for both groups. Significance was taken as  $p < 0.05$

**Results:** 32 patients were included in Group A and 37 patients in Group B. No significant difference in terms of sex, mean age, ASA grade, tumour stage, lymph node yield and epidural usage. BMI was statistically higher in Group A (27.9 vs. 24.8 kg/m<sup>2</sup>). Four laparoscopic procedures were converted to open. There were two anastomotic leaks in group B. No significant difference in complication rates. Median post-operative stay for Group A was significantly less at 5 days compared to 7 days for Group B. Patients in Group A also opened their bowels earlier (median day 4 vs. 5).

**Conclusions:** Our study demonstrates that in the setting of ERAS, laparoscopic right hemicolectomies are associated with a shorter hospital stay without an increase in complication rate compared to the open method.

**Keywords:** Right hemicolectomy; Laparoscopy; Enhanced recovery after surgery; Colon cancer

## Introduction

Since the introduction of laparoscopic colorectal surgery in 1991, studies have demonstrated shorter hospital stay [1-3] reduced blood loss [4] and lower post-operative morbidity [5,6] compared to open procedures whilst oncological clearance [4,7] and long-term survival [8-11] have been comparable between the two.

An important development in peri-operative management has been the use of the Enhanced Recovery After Surgery Programme (ERAS). This protocol minimises disturbance of peri-operative physiology and aims to shorten hospital stay [12,13] by reducing pre-operative dehydration, encouraging mobilisation and commencing an oral diet from day one [14].

Randomised controlled trials have demonstrated that the benefits of laparoscopic colorectal surgery can be improved if these are carried in an ERAS setting [15-18]. However these trials have included a heterogeneous group of colorectal resections:- right, extended right, left, sigmoid and rectal [16,18,19]. Right hemicolectomy differs in the type of incision, anatomy, operative technique and potential complications [20,21]. Studies advocating laparoscopic right hemicolectomies over open resections have not integrated the ERAS programme [9,22-25]. It remains unclear whether the benefits of laparoscopy combined with ERAS can be applied to right hemicolectomies.

This study compares the short-term outcomes of laparoscopic and open right hemicolectomies performed within an established ERAS setting.

## Method

### Patient data

All notes for patients who underwent an elective right

hemicolectomies between October 2008 and April 2012 in this unit were reviewed. Patient data was collected retrospectively. Only patients managed with an ERAS programme were included in the analysis, details of which are described below. Exclusion criteria were procedure for inflammatory bowel disease, emergency surgery, extended right hemicolectomy, additional procedure not directly related to the right hemicolectomy (for example removal of rectal polyp by Endoscopic Mucosal Resection), formation of a stoma, palliative procedure and ASA IV or above. For analysis the patients were divided into laparoscopic (Group A) and open (Group B) groups on an intention to treat basis. Therefore laparoscopic procedures converted to open were included in group A. The two groups were compared for the following: age, sex, ASA grade, tumour grade, clearance margins, lymph node yield, operating time, time to first bowel movement, removal of urinary catheter, cessation of parenteral analgesia and complications within 30 days. Primary end-point was length of hospital stay. Patients from both groups were only discharged once they were able to maintain an enteral diet, were mobilising safely and had opened their bowels. Patients were

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discharged with a urinary catheter in situ if they failed a trial without catheter.

### Perioperative care

Patients were counselled regarding ERAS in pre-assessment clinic. They received a carbohydrate rich drink up to 2 hours before the operation. Bowel preparation was not given. Nasogastric tubes were not inserted routinely. Oral fluid was started on the operative day once fully recovered from anaesthesia. An enteral diet and mobilisation was encouraged from the 1<sup>st</sup> postoperative day. Once this was established, parenteral analgesia was switched to oral and the urinary catheter was removed. The choice of perioperative analgesia was determined by the anaesthetist, which included epidural, TAPP block, spinal or parenteral analgesia. If required, laxatives or suppositories were given postoperatively. Prophylactic enoxaparin and anti-thromboembolic stockings were prescribed if there were no contra-indications.

### Procedure technique

All procedures were carried out by one of four consultants. The decision to perform a right hemicolectomy for malignant or dysplastic lesions was made at the colorectal multi-disciplinary meeting. However the decision whether a patient should undergo an open or laparoscopic procedure was determined by the surgical consultant in conjunction with the patient on a case-by-case basis. Previous abdominal surgery was not a contraindication to laparoscopy. Procedures involving ligation of the middle colic artery were excluded. Open procedures were carried out either through a midline vertical or transverse incision. Anastomosis in both groups were formed using a linear stapler device between the ileum and transverse/ascending colon. During a laparoscopic resection colonic mobilisation was carried out intracorporeally. The anastomosis was performed extracorporeally through a right transverse, peri-umbilical midline or pfannenstiel incision. Individual surgeon preference determined whether the right colic artery ligation was carried out either extra- or intra- corporeally. Similarly medial to lateral or lateral to medial mobilisation of the right colon was carried out according to surgeon's technique. Procedures were converted to open to aid mobilisation. All patients received broad spectrum antibiotics at induction. Drains were not used routinely. The laparoscopic and extraction sites were routinely infiltrated with long acting Marcaine adrenaline solution to a maximum dose of 4mg/kg.

### Statistical analysis

The data was analysed according to intention to treat basis. Therefore the laparoscopic converted to open procedures were included in group A. Chi-squared test was applied to discrete data, and Mann Whitney U-test to continuous data. Statistical significance was taken at  $p < 0.05$ .

### Results

Sixty-nine right hemicolectomies fulfilled the inclusion criteria. Thirty-two patients (46.3%) underwent a laparoscopic procedure (Group A). Four of the laparoscopic procedures (12.5%) were converted to open. The remaining thirty-seven patients had an open procedure (Group B). The demographics of both groups are outlined below in Table 1. The two groups were similar in terms of age, sex, and ASA. The mean BMI of group A (27.9kg/m<sup>2</sup>) was significantly higher than for Group B (24.8kg/m<sup>2</sup>). A similar percentage of patients in each group had undergone a previous abdominal operation.

Table 2 describes the operating and histology details. There was no significant difference in terms of tumour type, tumour stage or lymph node yield. However the mean operating time for Group A was significantly longer than for Group B (153 minutes vs 109 minutes,

$p < 0.05$ ). The majority of laparoscopic anastomoses were carried out through a right transverse incision (n=22, 68.8%). The remainder were performed either through a midline (7, 21.9%) or pfannenstiel (3, 9.4%) incision. Two of the four laparoscopic procedures were converted to open as the tumour was more locally advanced than determined pre-operatively. The other two were due to adhesions from previous surgery. Nine (24.3%) open procedures were performed through a transverse incision and 28 (75.7%) through midline laparotomy.

Table 3 outlines the post-operative recovery. Of note length of post-operative hospital stay for patients in Group A was statistically lower than those in Group B (day 5 vs median day 7,  $p < 0.05$ ). Although not significantly difference, patients in Group A passed flatus and opened their bowels one day earlier than patients from group B. There was no difference in the type of analgesia used for either group, with an epidural PCA being the most common. The epidural when used was taken down at the same day in both groups (median day 3). The urinary catheter was also removed at a similar stage (median day 3).

Complication rates for both groups are set out in Table 4. Some patients may be represented twice within this table, as a patient may have had an intra-abdominal collection as well as a wound infection. There were two reoperations in group B (5.4%), both for an anastomotic leak. Although the hospital stay was prolonged, both patients were eventually discharged. There were also two re-operations in group A (6.3%) - one for an iatrogenic perforation of the jejunum and another for bleeding. Two deaths (2.9%) occurred in total. The single death in group A occurred due to multi-organ system failure following the

Table I: Patient Demographics

	Laparoscopic Group A	Open Group B	P value
Number	32	37	
Age; years	72.0 (35 to 92)	77.3 (32 to 94)	0.12
Male:Female	20:12	23:14	0.956
BMI; kg/m <sup>2</sup>	27.9 (17.8 to 33)	24.8 (17.6 to 36.7)	<0.001
ASA grade			0.629
I	3	5	
II	24	26	
III	5	6	
Previous Operation n (%)	6 (18.6%)	10 (27.0%)	0.46

Table II: Operation Details and Tumour Characteristics

	Laparoscopic Group A	Open Group B	P value
Number	32	37	
Laparoscopic converted to open	4 (12.5%)	-	NA
Type of incision			
Midline	7 (21.9%)	28 (75.7%)	
Right Transverse	22 (68.8%)	9 (24.3%)	
Pfannenstiel	3 (9.4%)	-	
Operating time, mean; minutes (range)	153 (98 to 277)	109 (54 to 185)	<0.001
Lymph node yield, mean (range)	14.4 (0 to 33)	18.3 (0 to 62)	0.237
Tumour type			
Adenocarcinoma	26 (81.3%)	33 (89.1%)	
Adenoma	5 (15.6%)	4 (10.8%)	
Carcinoid	1 (3.1%)	0	
pTNM Stage of non-adenomas			0.623
I	9 (33.3%)	4 (12.1%)	
II	7 (25.9%)	15 (45.4%)	
III	11 (40.7%)	13 (39.4%)	
IV	0	1 (3.0%)	

Table III: Post-operative Management

	Laparoscopic Group A	Open Group B	P value
Median postoperative length of stay; days (range)	5 (3 to 16)	7 (3 to 22)	0.019
Median day first passed flatus; days (range)	3 (2 to 10)	4 (1 to 10)	0.183
Opened bowels	4 (2 to 11)	5 (1 to 11)	0.082
Type of postoperative analgesia			
Epidural PCA	21 (65.6%)	29 (78.3%)	
Peripheral PCA	4 (12.5%)	4 (10.8%)	
IV analgesia PRN	3 (9.4%)	2 (5.4%)	
Not recorded	3 (9.4%)	3 (8.1%)	
Median day parenteral analgesia stopped (range)	3 (2 to 5)	3 (1 to 7)	
Urinary catheter used; n <sup>1</sup>	26/29	31/34	
Median day urinary catheter removed	3 (1 to 11)	3 (1 to 14)	0.251

<sup>1</sup>Data regarding urinary catheter missing for 3 patients in each group

Table IV: Complications

	Laparoscopic Group A	Open Group B	P value
Number	32	37	
Re-operation	2 (6.3%)	2 (5.4%)	0.65
Postoperative complication			0.535
Anastomotic leak	0	2 (5.4%)	
Iatrogenic bowel injury	1 (3.1%)	0	
Main wound infection	3 (9.4%)	4 (10.5%)	
Port site wound infection	3 (9.4%)	-	
Intra-abdominal collection	3 (9.4%)	2 (5.4%)	
Bleeding requiring transfusion	2 (6.3%)	5 (13.5%)	
Pneumonia	2 (6.3%)	4 (10.8%)	
Mortality	1 (3.1%)	1 (2.7%)	0.65

jejunal perforation. One death in group B was due to pneumonia. There was a higher incidence of pneumonia (10.8% vs. 6.3%,  $p>0.05$ ) and bleeding (13.5% vs. 6.3%,  $p>0.05$ ) requiring transfusion in group B.

## Discussion

Our study demonstrates patients who underwent a laparoscopic right hemicolectomy (group A) within an ERAS setting had a significantly reduced postoperative stay compared to those that had an open procedure (group B). Although not statistically significant, those in group A also opened their bowels and passed flatus a day earlier. There was no difference in the number of days taken to stop parenteral analgesia, or to remove the urinary catheter. Operating time for the laparoscopic group was significantly longer. Tumour staging, lymph node clearance and complications were comparable between the two groups.

Since the introduction of laparoscopic colorectal resections and ERAS, various groups have investigated the optimum combination of operative technique and peri-operative management [17,18,26-30]. Studies have demonstrated laparoscopic colorectal resections together with ERAS reduces hospital stay by 2 - 4 days compared to open procedures with ERAS [4,16]. When comparing laparoscopic procedures within an ERAS setting or traditional post-operative management, the former combination has shown to be beneficial in terms of length of stay and wound infections [28].

However these studies have amalgamated right sided with extended right, left, sigmoid and rectal cancer resections. Due to the operative anatomy, technique and therefore unique complication profile, we believe it is inaccurate to apply these conclusions to right-sided

operations. To date a subgroup analysis for right hemicolectomies within an ERAS setting has not been published.

Tan et al. [31] compared short term outcomes between laparoscopic and open right hemicolectomies within a peri-operative management protocol described as a co-ordinated clinical pathway (CCP). Both techniques resulted in the same median post-operative length of stay – 5 days. All patients in this study received bowel prep, which differs to our ERAS protocol. This can worsen dehydration and prolong post op ileus [32,33]. Our results are similar to Khan et al [34]. The median length of stay in their study following a laparoscopic procedure was 4 days compared to 8 days for an open procedure. The laparoscopic group also had fewer anastomotic leaks (0% vs. 4%) and a lower mortality rate (0% vs 5.3%). Although all the procedures were carried in a ERAS setting similar to ours, this study differed in that 25% of the open and 10% of the laparoscopic resections were for tumours involving the transverse and splenic flexure, requiring an extended right hemicolectomy

The position and length of incision are important factors in post-operative opiate use and risk of ileus. Tanis et al. [35] demonstrated transverse incision and laparoscopic right hemicolectomies were associated with a shorter hospital stay compared to midline laparotomies. Loshiriwat et al. [36] have shown no difference in short term outcomes between laparoscopic and transverse open right hemicolectomies, although Veenhof demonstrated a shorter hospital stay following a laparoscopic procedure [37]. Meta-analysis by Grantcharov et al. [38] described less pain for transverse compared to midline incisions. In our study, a similar percentage of patient in both groups used an epidural, and in both groups it was stopped at a similar stage (median post-operative day 3). However we were unable to determine if the mean opiate usage in milligrammes per kg body weight was different between the groups. Larger studies to compare transverse, midline incisions and laparoscopic right hemicolectomies within an ERAS setting are warranted. A transverse incision right hemicolectomy compared to laparoscopy has the added advantage of a shorter operating time and lower equipment costs.

Similar to other publications, a lower percentage of patients in Group A had pneumonia and required a blood transfusion compared to Group B [5,4]. One patient in Group A had an iatrogenic bowel perforation. This patient underwent a re-operation, however the repair leaked. This patient (ASA III) subsequently died. One death occurred following pneumonia, again in an ASA III patient. The overall anastomotic leak rate (2.9%) and 30-day mortality (2.9%) is comparable to larger series [39,40,3,34,41,35]. Both patients who had an anastomotic leak were re-operated and were eventually discharged home. The mean operating time for a laparoscopic procedure for 153 minutes compares well to other studies [39-42]

Post-operatively a consultant or registrar would ensure the daily ERAS targets were being met. The consultants, whose data was included for this analysis, all had laparoscopic colorectal experience. Therefore both ERAS and laparoscopic surgery were well established before the first procedure included in this study

Our study is not without its limitations. Although both groups were similar in terms of tumour characteristics and patient demographics, there is a lack of randomisation and blinding. Patients' and health professionals' perception that recovery after an open procedure is expected to be longer than a laparoscopic operation, may have increased the hospital stay. A number of patients in both groups could have been discharged earlier if their social circumstances had been assessed at pre-operatively. Cost analysis to determine if the increased cost of the laparoscopic procedure is balanced by the reduced cost of a shorter hospital stay is outside the aims of this study.



## Conclusions

Our study demonstrates that patients undergoing a laparoscopic procedure for right sided tumours within an ERAS setting had a reduced hospital stay by 2 days compared to open procedures without a significant increase in complications or mortality. The operating time for laparoscopic procedures was significantly higher but there was no difference in lymph node yield. A randomised controlled trial comparing the different extraction sites for open procedures and laparoscopy is warranted.

**Disclosure of interests:** None to disclose

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## Perforated Colorectal Cancer. A Retrospective Analysis.

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### Abstract

#### Introduction

The perforation of colorectal cancer (CRC) had always had a poor prognosis, regardless of whether the perforation evolved into forming an abscess or it was a free perforation into the abdominal cavity. The associated conditions as elder patients and different comorbidities seems to greatly reduce the chance of survival, as well as limit the therapeutic surgical options. AIM: The aim of this study is to review our surgical department data in order to analyze the outcomes after colorectal cancer perforation.

#### Material and Methods

A retrospective study was conducted the Department of Surgery of Prahova County Hospital. All the patients admitted for a CRC perforation were included in the study.

#### Results

During one year, 136 patients with CRC were admitted in our department. Only 7.35% (n=10) had a perforation. The median age was 70 years old. The men to women ratio was 6 to 4. The tumor was located on the right colon in 40% (n=4), on the left colon in 30% (n=3) and on the rectum in the other 30% (n=3). There were performed 4 right colectomies, 5 Hartmann resections and in one case, a colostomy. The postoperative mortality was null. A review of the literature data was also performed.

#### Conclusions

Perforated CRC is more frequent in elderly patients, with neglected cancers. The choice of surgical procedure has to be appropriate to the cancer site and patient's comorbidities and general condition.

**Keywords:** Colorectal Cancer; Perforation; Peritonitis; Colectomy; Hartmann Procedure; Colostomy

### Introducere

Perforația este o complicație gravă a neoplasmului colorectal, care apare, de obicei, la bolnavul vârstnic, de obicei tarat, adăugând o morbiditate și o mortalitate importante [1].

Perforația este a doua ca incidență în cadrul complicațiilor cancerului colorectal (CCR) (ocluzie intestinală, perforație, hemoragie masivă). Din totalul cazurilor de CCR operabile, perforația se întâlnește în 0,8-3,7% și are o frecvență de 10-26% din toate CCR operate în urgență [2].

### Material și metodă

S-au evaluat retrospectiv rezultatele postoperatorii la bolnavii cu cancer colorectal perforat, cu referire la perforația (a tumorii sau diastatică) în peritoneul liber (peritonită acută generalizată stercorală) și cloazonată (abces perineoplazic), într-un serviciu de chirurgie generală al unui spital de urgențe regional.

Am evaluat rezultatele postoperatorii la bolnavii cu cancer colorectal perforat operați în secția Chirurgie I, Spitalul Județean de Urgență Ploiești, în perioada 1 ianuarie-31 decembrie 2008, prin analiză retrospectivă nerandomizată.

Din totalul de 4373 de bolnavi internați în secție, 358 (8,18%) au prezentat neoplazii cu diverse localizări; 136 dintre aceștia au avut cancer colorectal (3,1% din totalul bolnavilor și 37,98% din bolnavii neoplazici). Din cei 136, doar 10 (7,35%) au prezentat perforații ca și complicație a bolii; ei au reprezentat obiectul prezentului studiu.

Preoperator, algoritmul de evaluare a inclus: examenul clinic, explorări paraclinice (determinări serice, radiografie toracică și abdominală pe gol, ecografie abdominală). S-a notat prezența sau absența patologiei asociate.

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Toți bolnavii diagnosticați cu neoplasme colorectale perforate au fost operați în urgență imediată sau amânată, după reechilibrare hidroelectrolitică în Secția de Terapie Intensivă. Procedul utilizat a fost adaptat cazului și opțiunii medicului curant (4 hemicolectomii drepte; 5 operații Hartmann; 1 coloproctie), la care s-a asociat toaletă peritoneală și drenaj multiplu.

Stadializarea inițială (de la data operației) a fost actualizată după sistemul TNM AJCC a 7-a ediție (2010). În perioada postoperatorie s-au monitorizat următorii parametri: reluarea tranzitului intestinal, morbiditatea, mortalitatea postoperatorie (definită ca decesul apărut în interval de 30 de zile de la operație sau pe parcursul perioadei de internare), durata spitalizării, reintervențiile, supraviețuirea la 5 ani..

Toți bolnavii au primit chimioterapie adjuvantă cu xeloda.

## Rezultate

Incidența perforației în cancerul colorectal este de 7,35% (n=10).

Vârsta mediană a bolnavilor a fost de 70 ani; toți bolnavii au avut peste 60 de ani. Raportul bărbați/ femei a fost de 6 / 4.

Cea mai mare parte (70%) din bolnavii cu perforații, în cadrul evoluției cancerului colorectal, au provenit din mediul rural.

În privința comorbidităților, 80% dintre bolnavi aveau afecțiuni cardiovasculare (hipertensiune arterială, cardiopatie ischemică cronică, fibrilație atrială, sechele infarct miocardic), 60% anemie, 20% diabet zaharat, 20% sechele după accident vascular cerebral și 10% ciroză.

Bolnavii s-au prezentat cu dureri abdominale (80%), vărsături (40%), febră (80%), inapetență (50%), hemoragie digestivă inferioară (20%), meteorism (40%).

În urma investigațiilor de laborator s-a evidențiat o valoare mediană a Hb serice de 10 mg/dL (limite: 7,4 - 15,1) și o valoare mediană a leucocitozei de 11710/mm3 (limite: 6800 - 7200).

În ceea ce privește localizarea, tumora a fost situată pe colonul drept în 4 cazuri (cec, n=1, ascendent și unghi drept, n=3), pe colonul stâng în 3 cazuri (toate pe sigmoid) și pe rect în 3 cazuri (rect ampular superior).

Din cele 10 cazuri de cancere perforate, 30% au prezentat peritonită generalizată difuză (un caz cu perforație a tumorii și respectiv, două cu perforație supratumorală diastatică), iar 70%, perforație cu abces peritumoral. În 30% din cazuri, localizate pe colonul drept, tumora invadea peretele abdominal antero-lateral. Distribuția acestor abcese în funcție de localizare a fost: 3 la nivelul colonului drept, 3 la nivelul colonului stâng și 1 la nivelul rectului. Dintre abcesele situate la nivelul colonului drept, 2 au beneficiat de hemicolectomie dreaptă cu anastomoză ileo colică cu rezultate imediate satisfăcătoare.

În trei cazuri radiografia abdominală pr gol a evidențiat pneumoperitoneu unilateral. În 6 cazuri ecografia a evidențiat tumora și abcesul perineoplazic. Tomodensitometria efectuată doar în 2 cazuri a oferit cele mai bune date preoperatorii, privind localizarea tumorii, existența

Cea mai mare parte a pacienților (80%, n=8) s-au prezentat în stadiul IIIC, iar restul în stadiul IV.

S-au efectuat 4 hemicolectomii drepte (2 rezecții cu anastomoză în același timp și 2 rezecții cu ileostomie temporară), 5 rezecții primare fără anastomoză (operație Hartmann) și o derivație externă (colostomie supratumorală). În cazul pacienților I-a care s-a efectuat operația Hartmann sau derivație externă, s-a recomandat revenirea pentru refacerea continuității digestive. Dintre aceștia doar 3 au revenit pentru restabilirea continuității digestive, iar ceilalți 3 au fost pierduți din evidența secției.

Reluarea tranzitului intestinal a fost notată la 4 zile (valoare mediană) de la intervenția chirurgicală. Durata mediană de spitalizare a pacienților a fost de 15 zile (limite: 10 - 22), fără complicații postoperatorii majore imediate. S-a înregistrat un deces la 40 zile postoperator prin bronhopneumonie. S-au înregistrat 4 complicații parietale (infecții ale plagii operatorii), 3 pulmonare și 2 urinare.

Supraviețuirea la distanță la 5 ani a fost de 30%.

## Discuții

Tumori colonice perforate local sau diastatic se întâlnesc în 5% din cazuri, ele reprezentând o urgență chirurgicală majoră [1]. Perforația tumorală sau diastatică, apanajul vârstei a 3-a, este urmată rapid de peritonită hiperseptică, cu evoluție rapid gravă [1,2]. Gravitatea peritonitelor este dată de septicitatea colonului și statusul biologic al bolnavului vârstnic. Morbiditatea și mortalitatea perioperatorie se mențin ridicate, iar supraviețuirea la 5 ani nu depășește 18% [3,4].

Perforația cancerului colorectal se prezintă sub trei aspecte anatomoclinice: perforație liberă în cavitatea peritoneală, perforație localizată, cu formarea unui abces și perforație într-un organ cavităar de vecinătate sau la nivelul tegumentelor, cu constituirea unei fistule.

Rezultatul perforației poate fi peritonita acută difuză fecaloidă, abces intraperitoneal, abces extraperitoneal. Mai rar, perforația se poate realiza într-un alt organ abdominal sau la nivelul tegumentelor, cu constituirea unei fistule (interne, respectiv externe) [5]. În cazul perforațiilor cu formarea unor abcese, tabloul clinic poate să semene cu o diverticulită complicată [6], pacienții prezentând febră, frisoane, dureri abdominale, leucocitoză, iar examenul computer tomografic relevă aspect de abcese pericolicice. Aceste abcese sunt localizate de obicei în regiunea paracolică sau pot evolua ca un abces pelvin, dar pot, de asemenea, să se insinueze de-a lungul diverselor planuri tisulare și, în consecință, se prezintă sub forma unor abcese în flanc, abcese în psoas sau abcese subcutanate la nivelul trunchiului. [7]. Un cancer de colon sigmoidal poate perfora în situația rară, în care tumora se gasește într-un sac de hernie inghinală ireductibilă [8]. Un cancer rectal perforat se poate prezenta cu o gangrenă Fournier [9].

Localizarea perforației asociată cancerului colorectal este mai frecventă la nivelul masei tumorale și este cauzată de invazia locală a cancerului, care determină o breșă în integritatea peretelui colonic. Perforațiile se mai pot localiza și proximal de o leziune primară obstructivă, spre exemplu perforația cecului secundară unei obstrucții intestinale tumorale cu valvulă ileo-cecală competentă într-un carcinom obstructiv de sigmoid sau colon descendent [10]. La nivelul colonului drept și transvers, perforațiile dau de două ori mai frecvent peritonite difuze decât abces. Pe de altă parte, formarea unui abces este mai frecventă la nivelul colonului stâng, sigmoid sau rectosigmoid. [6,11]

Gradul contaminării stercorale a cavității peritoneale în perforațiile libere poate fi evaluat în trei grade: (1) contaminare minimă, în imediata vecinătate a perforației; (2) contaminare moderată, extinsă la un cadran abdominal; (3) contaminare masivă, în care o cantitate importantă de conținut fecaloid ocupă mai mult de un cadran abdominal [1,5]. Cuantificarea gradului septicității peritoneale se poate face după scorul Hinchey, utilizat în cazul diverticulitei perforate, după indexul Mannheim al peritonitei [5] sau după scorul de severitate a lui S. Biondo, care ia în calcul vârsta (sub 70 ani), gradul

ASA, insuficiența de organ preoperatorie, imunodepresia, ischemia colonică. Acest scor se corelează cel mai bine cu prognosticul [6].

Simptomele frecvent întâlnite în cancerul colorectal (tulburări de tranzit intestinal, dureri abdominale, meteorism, sângerare pe cale rectală, tenesme, anemie inexplicabilă, scădere în greutate, apetit scăzut) sunt modificate în cazul perforației, simptomatologia fiind în funcție de locul perforației (perforație a tumorii sau perforație diastatică) și de spațiul unde are loc perforația (cavitatea peritoneală sau spațiul extraperitoneal) [5].

Alături de examenul clinic, explorările paraclinice de tipul ecografiei abdominale și tomodesitometriei pot oferi date importante pentru diagnosticul perforației cancerului colorectal. Sensibilitatea ecografiei este de numai 30%, pe când a tomodesitometriei de 85% [1]. În lotul studiat tomodesitometria a avut o sensibilitate de 100%, iar ecografia de 50%.

Perforația, ca și obstrucția sunt semne de prognostic nefavorabil, fiind asociate cu stadii avansate ale bolii. Deoarece pacienții sunt operați de urgență, morbiditatea și mortalitatea sunt crescute. Perforația cancerului are o mortalitate operatorie de 9% în comparație cu cancerul obstructiv (5%). [7,8]

Pacienții operați în urgență pentru peritonită difuză sau abces, secundare unui cancer colonic sau rectal perforat (local sau la distanță de tumoră), prezintă o incidență mai ridicată a complicațiilor postoperatorii. Prezența perforației obligă la suprimarea acesteia cu sau fără refacerea continuității digestive în același timp operator, lavajul abundent intraperitoneal și drenajul urmat de reanimare energetică, antibioterapie cu spectru larg [12]. Majoritatea chirurgilor evită refacerea continuității digestive în același timp operator, din cauza posibilității crescute de apariție a fistulei (colon nepregătit, sepsis, bolnav vârstnic tarat, interval de timp uneori mare între momentul perforației și prezentarea la spital etc.). De aceea, se preferă intervenția chirurgicală seriată (în 2 sau 3 timpi), mai bine suportată de pacienți în urgență [13,14].

În cazul perforațiilor cu formare de abces, managementul inițial trebuie să fie individualizat și depinde de gradul de sepsis prezent. În situațiile în care bolnavul prezintă febră, durere abdominală și apărare musculară, iar imagistica evidențiază un abces drenajul precoce poate fi necesar ca procedură inițială. Deși rezecția primară în prezența unui abces poate fi riscantă și inadecvată pentru tipul de cancer, abcesele strict localizate, în special la nivelul mezenterului, pot fi adesea îndepărtate și se poate realiza anastomoza primară [15]. Segmentul intestinal implicat este de importanță majoră, deoarece la nivelul colonului drept și transvers proximal, rezecția primară cu anastomoză este de cele mai multe ori posibilă. Pe de altă parte, la nivelul colonului transvers distal și colonului stâng, o procedură stadializată este preferabilă și de multe ori obligatorie când perforația se însoțește de obstrucție.

Câteodată, la un pacient cu risc scăzut, rezecția precoce a cancerului se poate realiza printr-o procedură tip Hartmann [12,16], așa cum am procedat la 4 dintre cei 7 pacienți cu perforații acoperite cu colecții priturale (3 abcese intraperitoneale și un abces retroperitoneal). La o dată ulterioară, se restabilește continuitatea intestinală.

Cancerul colorectal care perforază liber în cavitatea peritoneală reprezintă adevărate urgențe chirurgicale. Indiferent că peritonita este localizată sau difuză, trebuie luate măsuri imediate de combatere a șocului sau iminenței șocului de peritonită. În primul rând trebuie restabilit volumul intravascular și administrate antibiotice cu spectru larg pe cale parenterală pentru a pregăti pacientul pentru celiotomia exploratorie.

Tratamentul de elecție în urma unei perforații diastatice de cec, când cancerul este situat la nivelul colonului drept, este rezecția primară a leziunii. În cazul unei perforații de cec, cancerul situându-se la nivelul colonului stâng, literatura descrie următoarele proceduri: plicaturarea cecului, cecostomie și colectomie subtotală. [16,17].

## Concluzii

Perforația colică tumorală se întâlnește la bolnavii vârstnici, care au o evoluție neglijată. Tratamentul chirurgical trebuie instituit în urgență după o reanimare judicioasă care țină cont de comorbiditățile asociate.

Procedura chirurgicală adoptată va fi individualizată, ținând cont de gravitatea peritonitei, topografia leziunii și prezența stării de șoc dependent de intervalul de timp scurs de la debutul complicației.

Pentru localizările stângi se preferă și astăzi operația Hartman.

Un cancer colorectal perforat trebuie încadrat de la început în stadiul IV, chimioterapia fiind obligatorie.

## Conflict de interese

Autorul nu declară nici un conflict de interese.

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# Evaluation of External Fixation Results in High-risk Older Patients with Intertrochanteric Femur Fractures

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## Abstract

**Background:** Intertrochanteric femur fractures are common in older people. In high-risk patients, especially American Society of Anesthesiologists (ASA) scores 3 and 4, surgery with internal fixation can cause excessive stresses. Therefore, external fixation is another option for treating these patients

**Objective:** To evaluate the results and complications of external fixation in elderly patients with intertrochanteric fractures.

**Methods:** Twenty-six surgically high-risk patients with intertrochanteric fractures admitted to our clinic were treated with external fixation (January 2010- November 2011). Epidemiological and radiological data and also complications were recorded at each follow-up.

**Results:** No complications occurred in 13 patients. The remaining 13 patients had complications after surgery: Of the patients, 10 had implant failure (6 pin migration and 4 pin cut-out) and 3 had pin tract infections. Six patients who had implant failure (2 pin migration and 4 pin cut-out) underwent revision. Unrevised complicated patients (4 pin migration) and 2 of 3 patients with pin tract infections had malunion and shortening. High risk older patients with external fixation had a high complication and morbidity rate.

**Conclusion:** We do not recommend using pertrochanteric external fixators in high-risk patients due to the high revision rate and serious complications.

**Keywords:** Hip fracture; Trochanteric fracture; External fixation  
High-risk patient; Osteoporosis; Pin migration

## Introduction

Intertrochanteric femur fractures are common in older people. Advancing technology and treatment modalities have increased the life expectancies of males and females, so the incidence of these fractures is increasing [1]. Furthermore, with existing osteoporosis, bone fractures happen more easily with low-intensity trauma [2,3]. Given the high mortality and morbidity rates, it is important to treat these fractures surgically. In high-risk patients (American Society of Anesthesiologists (ASA) 3 and 4), however, surgery with internal fixation can cause excessive stress. Consequently, external fixation is another option for treating these high-risk patients [4,5]. External fixation [6-8], is superior to plate osteosynthesis due to shorter operation and hospitalization times, no need for blood transfusions, and earlier mobilization. We evaluated the results and complications of external fixation in elderly patients with stable and unstable intertrochanteric femur fractures.

## Patients and Methods

Patients with intertrochanteric femur fractures were classified as surgically high-risk, if they had ASA scores of 3 or 4 [9,10]. Between January 2010 and November 2011, we treated 26 surgically high-risk patients with intertrochanteric femur fractures with closed reduction and external fixation under spinal anesthesia.

The fractures were classified as stable or unstable according to the modified Evans classification. In addition, the patients' demographic information (age, sex, and involved side) was recorded. The medical conditions increasing the surgical risk were evaluated and stabilized by the anesthesiologists and internists. Once their medical condition was

stabilized, the patients were taken to the operation room and operated on under spinal anesthesia using a pertrochanteric external fixator (Orthofix® pertrochanteric fixator), which is a specialized fixator for intertrochanteric femur fractures. Reduction was established by using fracture and traction table under fluoroscopy guidance. Two or 3 shanz screws (6,5mm) were implanted for each proximal femoral region and femoral shaft

No patient required transfusion during or after the operation. The operating time (minutes) and hospitalization duration (days) were recorded. The patients were given first-generation cephalosporins intravenously for 24 h postoperatively as antibiotic prophylaxis. Low-molecular-weight heparin was given subcutaneously every 12 h postoperatively for 3 weeks as venous thromboemboli prophylaxis.

The patients were mobilized with two crutches on the first postoperative day and allowed to bear partial weight. Full weight-bearing mobilization was allowed 6-8 weeks postoperatively if the radiological and clinical conditions were appropriate. Patients and their

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relatives were informed how to clean and dress the wounds and how to exercise their knees and hips.

The patients were followed regularly at one month intervals. Anteroposterior and lateral x-rays were obtained. Fracture union, malunion, non-union, angulation, shortening, and implant failure (complications) were noted during follow-up. Varus malunion was defined as a  $>10^\circ$  difference in the femoral neck-shaft angle between the fractured and uninvolved sides. Shortening malunion was defined as a  $>2$ -cm leg length discrepancy. Bipolar hemiarthroplasty was performed for hip revision if there were serious mechanical complications or non-union.

## Results

Twenty-six high risk (ASA 3-4) patients with intertrochanteric femur fractures were admitted to our clinic over a nearly 2-year period. The average patient age was 85.5 (range 71–96) years and 16 patients (61.5%) had right-side fractures. There were 12 males (46.1%) and 14 females (53.9%). According to the modified Evans classification, there were eight (30.8%) stable and 18 (69.2%) unstable fractures.

Patients with ASA grade 3 accounted for 23.1% of the study population (six patients) and their average age was 82.6 years. The remaining 20 patients were ASA grade 4 (76.9%), and their average age was 86.3 years. All of the patients had at least one systemic disease that had to be stabilized preoperatively, including 14 in cardiac failure, 7 with prior myocardial infarctions, 3 with uncontrolled hypertension, and 2 with uncontrolled diabetes.

The average operating time was 27.1 (range 20–35) minutes and the median hospitalization was 7.8 days. The average time from fracture to operation was 2.4 days. The mean follow-up time was 24.4 months. Four (15.4%) patients died during early post-operative period due to systemic diseases; three of them were female. All four patients who died were ASA grade 4, so 20% of the ASA grade 4 patients died during follow-up (2 of them died during follow-up after revision surgery).

No complications occurred in 13 patients, 2 of them died during follow-up. Of the remaining 13 patients with complications during follow-up, 10 (38%) had implant failure (6 patients with pin migration, 4 patients with pin cut-out) and 3 (11.5%) had pin tract infections before union. Six (2 patients with pin migration, 4 patients with pin cut-out) of the twenty-six patients (23.1%) underwent revision surgery, and two of these died after the revision operation. There were no infections after revision (Figure 1).

Of the patients who had implant failure, 60% were underwent re-operation. The revision involved a bipolar hemiarthroplasty of the hip. Of the revision patients with pin migration, one of them died after the re-operation. The remaining four implant failure patients, who did not have revision, had delayed union resulting in shortening and varus

malunion. Two of 3 patients with pin tract infections had varus malunion and shortening after union. Six patients had malunion (shortening and varus), comprising 46% of the patients with complications (Figure 2).

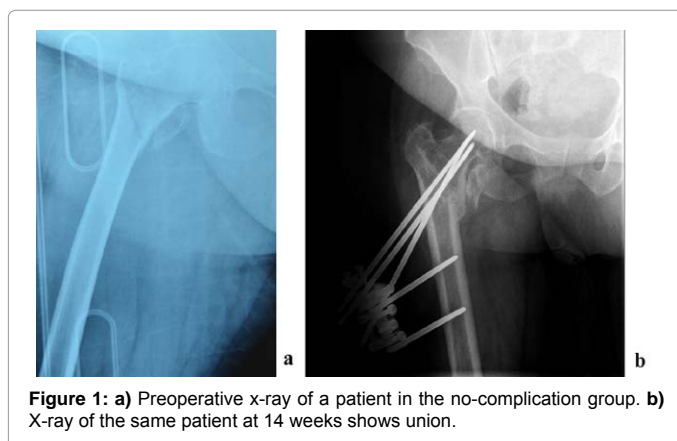
The patients with pin tract infections were treated with antibiotics, regular dressings, and periodic debridement. The external fixators were removed as soon as possible after union.

In the patients with no complications, the time to union was 13.4 weeks. The patients with complications (except dead and revised ones) achieved union after 17 weeks.

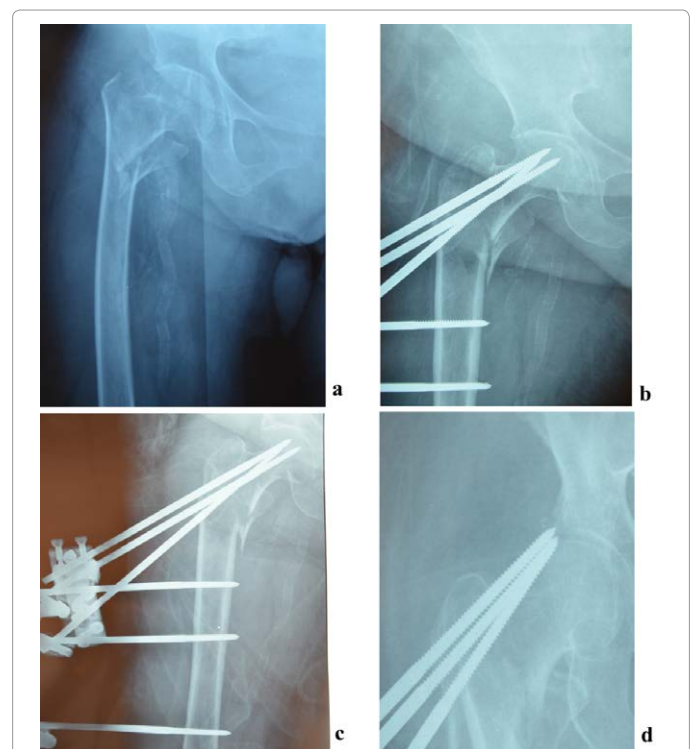
## Discussion

Advancing technology and treatment modalities have increased the life expectancies of males and females, so the incidence of intertrochanteric femur fractures [1] has increased. Given the high mortality and morbidity rates of these fractures [11,12], especially in older people, there are concerns about surgical treatment options. Furthermore, osteoporosis causes mechanical complications such as shortening, collapse, and pin penetration, increasing the concerns about the stability of fixation methods. In our series, although we demonstrated the advantages of external fixation [6-8], such as shorter operating and hospitalization times, no need for blood transfusions, and earlier mobilization, there was a high complication rate in our high-risk patient group especially due to mechanical causes. Some patients with complications underwent revision using bipolar hemiarthroplasty, which increases the hospital stay and blood loss, impairs the biology due to open surgical trauma, and places excessive stress on the patients' general health. Increased costs are another important concern. Although external fixation is useful for reducing patient mortality and morbidity, the results of complications can cause more devastating situations.

Pin tract infection is an important complication because of the high postoperative incidence [13-15]. However, treatment is relatively easy, especially after pin removal. In our study, the pin tract infection rate



**Figure 1:** a) Preoperative x-ray of a patient in the no-complication group. b) X-ray of the same patient at 14 weeks shows union.



**Figure 2:** a) Preoperative x-ray of a patient in the complication group. b) The x-rays at 4<sup>th</sup> week, c) The x-rays at 8<sup>th</sup> week, d) The x-rays at 11<sup>th</sup> week, There was pin migration and the hip was revised with a bipolar hemiarthroplasty.



was moderate and the infections were treated easily with antibiotics, debridement, and pin removal. However, this caused some patient discomfort.

Some clinical studies emphasize the advantages and benefits of external fixation in high-risk older people with intertrochanteric femur fractures, especially with newer-design external fixators. The surgical technique is an important determinant of mechanical complications. With optimum technique and improved implant design [7,14,16], mechanical complications can be reduced to a negligible level. Until that time, the golden standard treatments of pertrochanteric fractures should be DHS/DCS fixation systems or proximal femoral intramedullary nails. Because they have superior mechanical properties and less mechanical complications in compared to external fixation [17]

In conclusion, in light of our findings, we do not recommend using pertrochanteric external fixators in high-risk patients due to the high revision rate and mechanical complications. Well-designed prospective controlled studies with more subjects are needed to quantify the advantages and disadvantages of this technique.

## Conflict of interests

Authors have no conflict of interests to disclose

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# Total Knee Arthroplasty Infected by *Brucella melitensis*: Septic Loosening and Long-Term Results of Two-Stage Revision Knee Arthroplasty

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## Abstract

*Brucella* infection associated with arthroplasty is a rare event. An unspecific clinical symptomatology is associated with unclear radiographic signs of periprosthetic bone halisteresis. Only a positive anamnesis combined with an antibiogram of the joint liquid and a high serum antibody titer can lead to a definitive diagnosis. We herein report a case of *Brucella melitensis* infection in a patient who underwent total knee arthroplasty 2 years earlier. Plain radiography and bone scintigraphy confirmed septic loosening. The patient was successfully treated with two-stage revision arthroplasty.

**Keywords:** *Brucella*; Arthroplasty; Infection; Two-stage revision; Antibiotic therapy

## Introduction

Infection following total knee arthroplasty (TKA) is one of the most common and important complications in orthopedic surgery and is the second most common cause of surgical revision [1]. Most of these infections are caused by coagulase-negative staphylococci or *Staphylococcus aureus* [1]. Conversely, *Brucella* infection of implants after total joint arthroplasty is an extremely rare situation [2-5]. We herein present the long-term results of two-stage revision knee arthroplasty due to TKA infection by *Brucella melitensis*.

## Case Report

A 62-year-old man presented with a 4-month history of night sweats, high body temperature, and left knee pain in 2003. Two years previously, he had undergone a left TKA for treatment of gonarthrosis.

Upon examination, the knee appeared swollen, warm, and sore, and a sinus tract formation had developed at the incision area. Bacteriologic culture taken from the sinus tract discharge revealed *B. melitensis*. The patient's erythrocyte sedimentation rate (ESR) was 83 mm/h, C-reactive protein (CRP) level was 12.38 mg/L, and blood leukocyte concentration was 9425/mm<sup>3</sup>. Plain radiography confirmed septic loosening (Figure 1).

A two-stage revision TKA was planned to correct the septic loosening of the implant. The first stage involved removal of the infected prosthesis and debridement of the remaining cement and

necrotic tissue. Abundant purulent liquid was present in the knee joint, and both the femoral and tibial components were found to be loosened intraoperatively. Frozen tissue pathology demonstrated both acute and chronic inflammation. Removal of the prosthetic components and cement and application of an antibiotic-loaded spacer (doxycycline and rifampicin -impregnated) were also performed in the first stage (Figure 2). Oral rifampicin (900 mg) and doxycycline (300 mg) were administered daily for 12 weeks postoperatively. At the end of the antibiotic therapy, the patient was seen as an outpatient, and his ESR, CRP level, and antibody titer had decreased toward normal values. Finally, prosthetic revision was performed in the second stage of the TKA. Ten years following surgery, the patient had returned to full activities of daily living, described no knee pain, and was very satisfied

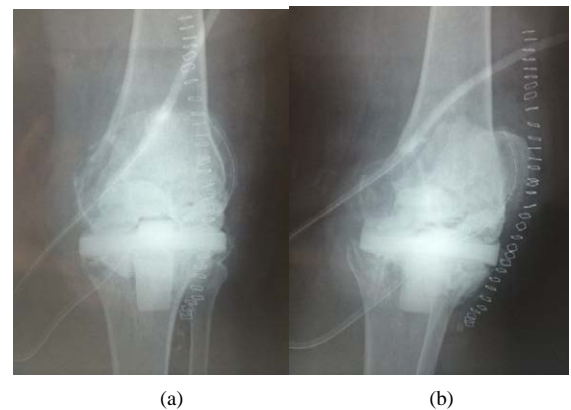


Figure 2: Plain radiography after the first stag

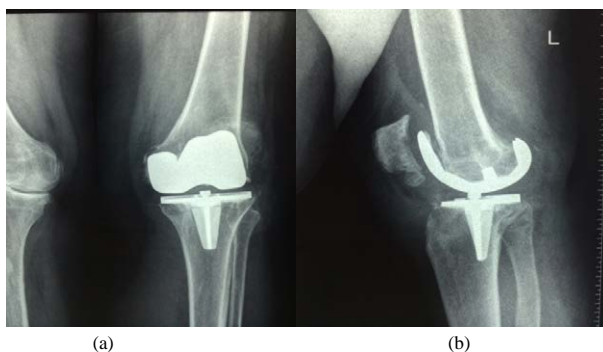


Figure 1: Anteroposterior and lateral plain radiography shows septic loosening

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with the outcome. No abnormalities associated with the femoral, tibial, or patellar components were observed on plain radiography 10 years following surgery (Figure 3). The results of a *Brucella* agglutination test at that time were negative.

## Discussion

The incidence of infection following primary total hip or knee arthroplasty varies from 1.0% to 5.6% [1,2,6] and is mainly caused by aerobic Gram-positive microorganisms including coagulase-negative staphylococci and *Staphylococcus Aureus*. Gram-negative aerobic microorganisms and anaerobes are rare and account for less than 10% of infections. Fungal or mycobacterial infections are extremely unusual [6]. Brucellosis is a common zoonosis worldwide but predominantly affects Persian Gulf, South America, and Mediterranean countries. It is caused by a variety of microorganisms from the *Brucella* genus and can be transmitted by inoculation through the conjunctivae and through cuts and abrasions in the skin, or by ingestion of unpasteurized milk or infected dairy products. Brucellosis is a systemic infection with nonspecific symptoms such as sweating, anorexia, fatigue, weight loss, fever, lymphadenopathy, and hepatosplenomegaly [7]. Brucellosis is a disease with protean manifestations, which can be either acute or chronic. It is a systemic infection in which any organ in the body can be involved. Osteoarticular complications are common in brucellosis, having been reported in 10%–85% of cases. The spectrum of bone and joint complications includes arthritis, spondylitis, osteomyelitis, tenosynovitis, and bursitis. Sacroilitis was the most commonly reported complication in several studies [6–8] whereas large, weight-bearing joints were the most commonly involved joints in other series [7,8].

Only a few cases of *Brucella* infection following total joint arthroplasty have been reported; thus, the most effective management remains unclear. Diagnosis is often difficult because patients usually present with no systemic symptoms. Only local symptoms (night pain, swelling, and suppuration) or mechanical loosening are typically present [4]. Adequate treatment depends on how and when the diagnosis is achieved.

Good results have been reported in three patients (two hips and one knee) treated with a two-stage procedure and antibiotic therapy (doxycycline [100 mg] and rifampicin [600 mg] daily) for 6 weeks before and after reimplantation [4]. Good results were also obtained in total hip arthroplasty patients who underwent two-stage reimplantation using a longer preimplantation antibiotic scheme of streptomycin (1 g daily for 3 weeks), doxycycline (100 mg daily for 3 months), and rifampicin (600 mg daily for 3 months) without postimplantation antibiotics [8]. These results were nonetheless considered preliminary because of the very short follow-up period of less than 1 year.



**Figure 3:** Femoral, tibial, and patellar components on plain radiography 10 years after surgery

Jones et al. reported a total hip arthroplasty implant loosening caused by *B. abortus* that was treated successfully with one-stage reimplantation and antibiotic therapy for 1 year [8]; however, with a follow-up period of only 2 years, there is not yet enough evidence to recommend this course of treatment. Nevertheless, our knowledge of the surgical treatment of *Brucella* infection is limited to a few case reports with only total hip arthroplasty infection with a mid-term follow-up [2,9,10]. There are no previously reported long-term results of two-stage revision knee arthroplasty in a patient with a *B. melitensis*-infected TKA.

We believe that two-stage revision arthroplasty is the first-line treatment of a loosened TKA infected with *B. melitensis*. In addition, if a systemic *Brucella* infection is identified, the patient should be managed with two-stage revision surgery. We herein report an excellent long-term outcome with two-stage revision knee arthroplasty in a patient with a *B. melitensis*-infected TKA.

## Conclusion

Osteoarticular disease related to *Brucella* remains a problem in endemic regions. Brucellosis should be kept in mind as a differential diagnosis of prosthetic joint infections, especially in patients with a history of brucellosis and exposure to possible sources of the bacteria.

## Conflict of interest

The authors declare no conflicts of interest

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# Quality of Life after Palliative Mastectomy for Stage IV Breast Cancer in Elderly

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## Abstract

Advance breast cancer still becomes a debate among surgeons either to act aggressively in view of the survival outcome. However the problem may arise from the disease progress which can be complicated by sepsis due to infection, severe bleeding, foul odour and sensation of heaviness. The decision will be more complicated if it occurs among geriatric patients. Here we presented a case of neglected right breast cancer which was treated late when it occupied the whole breast. The histopathological results revealed Poorly Differentiated Infiltrating Ductal Carcinoma and CT Scan showed liver and lung metastases (Stage IV). Palliative mastectomy was done to prevent complication such as infection and sepsis, bleeding and to reduce the sensation of heaviness. The discussion focused on the role of mastectomy to improve quality of life in elderly with advance breast cancer.

**Keywords:** Palliative mastectomy; advance breast cancer; Stage IV breast cancer

## Introduction

Breast carcinoma continues to dominate as the most common malignancy in women. As life expectancy increases at a steady rate, more patients with breast cancer will be over age 65 (elderly age group). Palliative care is defined as the active total care of patients whose disease is not responsive to curative treatment. Palliation is, simply in its purest sense, a treatment to enhance quality of life. Each patient's definition of quality of life is unique. As such, it is important to treat each person as an individual and to continue to view the patient holistically [1].

Therefore, palliative mastectomy is by means to prevent and palliate breast or chest symptoms, or pain in order to allow patients to resume active lifestyle as symptomless as possible with the fewest possible adverse effects of the treatment [2].

## Case Report

A 78-year-old lady presented to Surgical Ward with 4 months history of painless right breast lump. Initially it was small in size thus patient did not bother to seek any medical treatment. However the mass started to enlarge progressively within the next 2 months. It ruptured on the overlying skin and ulcerated. It started to bleed upon touch and produced bad odour. The patient at last sought medical attention when the mass occupied the whole breast and caused heaviness sensation. Upon examination, it was a fungating cauliflower like mass occupying the entire right breast (Figure 1) with area of slough and necrotic tissue.

The true cut biopsy of the mass revealed poorly differentiated



**Figure 1:** Right huge fungating breast cancer which occupy the whole breast

infiltrating ductal carcinoma. The patient was sent to palliative chemotherapy after CT scan staging showed multiple liver and lung metastases, which consist of Taxane, Cyclophosphamide and Adriamycin. After third cycle of chemotherapy the mass just shrunk about 30% of total volume. The patient refused to continue the chemotherapy due to its adverse effect. The decision for palliative mastectomy to improve the patient's quality of life. Intraoperative the mass infiltrated to the underlying pectoralis major muscle and bleeding upon excision (Figure 2) Primary closure of the skin successfully done and the patient recovered well postoperatively.

## Discussion

It is imperative to weigh the benefits and risks of the method of treatments with consideration of the sequelae of the aging processes in elderly patient with Stage IV breast carcinoma [3,4].



**Figure 2:** The appearance of right chest wall after the mastectomy. The pectoralis major muscle which was infiltrated by the tumour was excised exposing the intercostal muscles (arrow)

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Elazar et al. revealed the results of study that elderly women with breast cancer should be treated by surgical methods that offer the best chance of cure regardless of the patient's age. However, elderly women should be generally treated in a more conservative manner than younger women. In advanced stage of cancer, simple mastectomy is done for palliative purposes [4].

Associated illnesses were of particular concern because of the impact on surgical risks as well as the quality of life in elderly patient. Comorbidities and frailty are also important determinants of the outcome of treatment [3,5].

Though, it was unclear that palliative surgery would otherwise improve clinical outcomes [6]. Eun Young Kim, et al. showed that palliative mastectomy did not afford significant survival advantage [7].

However, the timing of surgical intervention has been found to be crucial. It was demonstrated in a study that surgical resection of the intact primary tumor and axillary nodes more than three months after the diagnosis of stage IV breast cancer was associated with improved metastatic progression-free survival and a trend towards better overall survival rate [8].

There was a study done on the predictors of the quality of life and found that arm problems, doctor communication, comorbidities and age had significant impact in patients' quality of life. Despite the vast literatures on this subject, it is still rather vague especially in elderly patient as not all of them were successfully recruited in the study [5].

Healthcare providers must not forget the patient's dignity, self-worth and personal goals. After multiple hospitalizations, elderly patients often tend to become debilitated and deconditioned quickly.

They are highly distressed by the loss of independent self-care and thus, can slide into depression. Comprehensive rehabilitation services should be provided to alleviate and improve their quality of life [9].

## Conflict of interest

Authors have no conflict of interest to disclose.

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# Gastric Ulcer - A Cause of Portal Cavernoma and Upper Gastrointestinal Bleeding: Case Report

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## Abstract

Gastric ulcers, with a long duration of the disease, can lead to an inflammatory process in the upper abdomen (supramesocolic floor), with repercussions on the surrounding structures. Such ulcers can penetrate the gastric wall, toward the pancreas and hepatic hilum, the inflammatory process can lead to splenic vein thrombosis and the appearance of a portal cavernoma. A complication of the portal cavernoma and the portal hypertension is the formation of esophageal varices. This paper reports the case of a 58 years old patient with multiple episodes of upper gastrointestinal bleeding, determined by both, esophageal varices and existing gastric ulcers. This patient was initially diagnosed with portal cavernoma and the esophageal varices were considered the cause of gastrointestinal bleeding. A spleno-renal shunt was proposed, but intraoperative it was found that this was not necessary because the portal vein was thrombosed and the bleeding was probably caused by the gastric lesions. We performed a distal spleno-pancreatectomy associated with a cuneiform resection of the gastric lesion, as well as the resection of the hepatic tumor. The patient had a favorable postoperative outcome.

**Keywords:** Cavernoma; Ulcer; Varices; Bleeding

## Introduction

It is known that upper gastrointestinal bleeding has many causes, esophageal and gastric lesions being the most frequent. Esophageal varices, the most common esophageal disease involved in the appearance of gastrointestinal bleeding, are due to portal hypertension, which is generated by different causes, including portal cavernoma [1,2]. It is also known that portal cavernoma can have many causes. One of these is represented by a chronic inflammatory process located near the portal vein. A long evolving posterior gastric ulcer can determine an inflammatory process in the adjacent area [3], affecting the pancreas, the splenic artery and vein and even the liver and the hepatic hilum. Although portal vein thrombosis is a rare entity in non-cirrhotic patients [4], this paper intends to present the case of a non-cirrhotic patient with esophageal varices secondary to portal cavernoma and gastric ulcer, who developed multiple episodes of gastrointestinal bleeding.

## Case Report

We report the case of a 58 years old, non-cirrhotic patient, diagnosed 3 years ago with portal cavernoma, with multiple episodes of upper gastrointestinal bleeding, who underwent therapeutic endoscopic ligation of second degree esophageal varices. He was admitted to the Gastroenterology Clinic, due to a recurrence of the upper gastrointestinal bleeding, presenting hematemesis and melena. On admission, the patient was in obvious distress, but with normal cardiovascular parameters. He presented anemia, with a hemoglobin level of 7.8 g/dl. The other biochemical tests showed low iron levels (21 µg/dl), normal values of white blood cells (8200/µl), transaminases (ALT=15U/l, AST=18U/l), blood creatinine (0.9 mg/dl) and a serum lipase of 209U/l. The emergency upper gastrointestinal endoscopy showed multiple esophageal ulcerations, with two residual rings after ligation; the stomach contained clear fluid and the duodenal bulb had a superficial ulceration covered with fibrin. The abdominal ultrasound examination confirmed the presence of a portal cavernoma and showed an enlarged spleen, with a diameter of 140 mm, and the absence of ascites. Treatment was started and after an initially favorable evolution, the gastrointestinal bleeding recurred, with decreasing level

of hemoglobin (7.3 g/dl), seven days after admission and intensive treatment. A new endoscopy was performed, showing small post-ligation varices and small ulcerations. The stomach contained bilious fluid and a blood clot, which was washed out. On the posterior surface of lesser curvature, a fibrin covered linear ulcer of 2 cm was identified. The mucosa covering the gastric body was "snake skin" like. Another fibrin covered ulcer of 2 mm was identified on the posterior surface of the duodenal bulb. It worth mentioning that the patient had no history of ulcerous disease and that the gastric lesion was never seen in previous endoscopic examinations. Given these facts, surgical treatment was indicated and the patient was referred to Surgical Department.

On admission in Surgery Clinic, the patient presented a hemoglobin level of 7.1 g/dl and an elevated level of serum amylase (526 U/l). Treatment was started and several units of blood were transfused. Due to patient's history of portal cavernoma, the opportunity of a spleno-renal shunt was discussed. Two days after admission in Surgical Department, massive upper gastrointestinal bleeding reoccurred and the hemoglobin level decreased to 4.9 g/dl. Given these facts, an emergency surgery was decided, making impossible further imagistic explorations (Doppler ultrasound, CT or MRI) in order to prepare spleno-renal shunt. For a proper operatory field, a bisubcostal incision was performed. We found a tumoral block in the upper abdomen, containing the posterior wall of the stomach, the pancreatic tail and the splenic hilum. Because the tumoral block was localized posterior to the stomach, clinical and ultrasound examination could not identify it. After dissecting the block, we identified a tumoral lesion generating in the gastric wall and

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penetrating the pancreatic tail. This lesion was not clearly described on endoscopic examination, but it may be assigned to “snake skin” like aspect of the mucosa in the gastric body. We also found a thrombosis of the splenic vein. The spleen was enlarged, measuring approximately 150 mm, with an irregular outline, and the veins tributary to the portal system were dilated, turgid, but permeable, excepting splenic vein. We identified the portal cavernoma in the hepatic hilum. The tumoral block invaded the liver segment 3, the rest of the liver being macroscopically normal. A distal splenopancreatectomy, at the level of the pancreatic penetration, was performed, associated with a cuneiform resection of the gastric lesion and a hepatic tumorectomy. It was considered that the last episodes of gastrointestinal bleeding were secondary to the gastric lesion and we considered that a spleno-renal shunt was unsuitable, due to the splenic vein thrombosis. The patient had a favorable outcome and was discharged 12 days after the surgery. A treatment consisting of Propanolol 2x20 mg/day and a proton pump inhibitor drug was prescribed at discharge.

Histopathological examinations showed: splenic parenchyma without tumoral lesions; lymph nodes with histiocytosis, without carcinoma metastasis; pancreatic parenchyma with marked interstitial inflammatory infiltrate; gastric wall with infiltration of granulocytes, eosinophiles, and limpho-plasmocytes; tras mural inflammatory necrosis and suppurative foci; no malignant lesions were found in the gastric specimen; liver parenchyma with biliary stasis and moderate chronic inflammatory infiltrate in the portal area

## Discussions

Penetrating ulcers with chronic evolution can lead to inflammatory blocks, affecting adjacent structures [5]. Furthermore, the bleeding may be violent [6], due to arterial or venous fistulas, even in the case of small ulcers surfaces, without bleeding marks by the endoscopic examination [7]. Moreover, a chronic inflammatory process, as seen in chronic ulcers, can cause the appearance of a portal cavernoma [1,2], leading to portal hypertension, esophageal varices and gastrointestinal bleeding. In this particular case, a vicious circle appeared, leading to recurrent gastrointestinal bleeding. The endoscopy could not precisely identify the main cause of gastrointestinal bleeding (esophageal varices or gastric ulcer) and the final diagnosis was established during the surgical procedure made. The surgical procedure we performed was indicated because the gastric ulcer had a long evolution and the macroscopic appearance of the surrounding inflammatory block could not exclude a malignant lesion. In this particular case, we performed the excision of all the structured contained in the inflammatory block. The histopathological examination excluded a malignant lesion but confirmed a chronic inflammatory process in all the resected specimens. Although portosystemic shunt is indicated and can be performed with good results in noncirrhotic patients with portal hypertension [8], the procedure could not be performed in this particular case, because of the splenic vein thrombosis and the necessity of removing the entire

tumoral block. Primary local risk factors for extrahepatic portal vein thrombosis are cirrhosis, hepatobiliary malignancies and pancreatitis [9] and the major systemic factors are myeloproliferave disorders [10], but none of these factors was identified in our patient. In this case, elevated levels of serum amylase were rather attributed to ulcerous penetration. Given the facts, portal vein thrombosis can only be attributed to splenic vein thrombosis, secondary to gastric lesion.

## Conclusions

Gastric ulcers may have an unpredictable outcome, penetrating the surrounding structures and generating a chronic inflammatory process, that may lead to structural changes in the adjacent organs (portal cavernoma, splenic vein thrombosis, tumor-like lesions in the liver). The only clinical expression may be represented by gastrointestinal bleeding, being difficul to determine if gastric lesion or esophageal varices are its main cause. Endoscopy can diagnose and treat esophageal and gastric lesions causing upper gastrointestinal bleeding, but in some cases, associated lesions, minor at first glance, can lead to clinical manifestations and the definite diagnosis will be set during the surgical procedure.

## Conflict of interest

Authors have no confl i t of interest to disclose.

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# Pain in the Neck Following Colonoscopy

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## Abstract

Colonoscopy remains a widely used diagnostic and therapeutic procedure. However, like any invasive investigation it has the potential of complications; extraperitoneal perforation with pneumoretroperitoneum and subcutaneous emphysema being an extremely rare example.

We report such a case in a 57 year old woman who presented to the emergency department with abdominal pain and diffuse chest, neck and facial surgical emphysema following a routine colonoscopy with hot snare polypectomy.

## Keywords:

Colonoscopy; Pain in the neck

## Introduction

About 1 in 20 people in the UK develop bowel cancer during their lifetime. It remains the third most common cancer in the UK and the second leading cause of cancer deaths. Colonoscopy remains the gold standard investigation in the diagnosis of colon cancer and is routinely performed as part of the NHS bowel cancer screening programme.

However, complications such as perforation, bleeding and post-polypectomy syndrome may variably occur. The incidence of colonic perforation ranges from 0.016% to 0.2% following diagnostic colonoscopy and may be up to 5% following some colonoscopic interventions [1]. Perforations occur more often during therapeutic colonoscopy and in patients of advanced age or with multiple comorbidities.

Colonic perforation presenting with pneumoretroperitoneum, pneumomediastinum and subcutaneous emphysema is extremely rare [2]. We report the case of a patient presenting with abdominal pain and dysphonia associated with diffuse chest, neck and facial surgical emphysema following a colonoscopy.

## Case Presentation

A 57-year-old woman attended the emergency department complaining of left sided abdominal pain and swelling of the neck, face, and chest associated with minor breathing difficulties. According to her partner, her voice sounded different in pitch to normal.

Three hours prior to admission she underwent a colonoscopy for investigation of a change in bowel habit. At colonoscopy the endoscopist noted scattered diverticulosis of the left colon and a 10mm descending colonic sessile polyp which was excised and retrieved with a hot snare.

On examination a low grade pyrexia was noted and her respiratory rate was slightly elevated (RR 18, oxygen saturation 96% on room air). Palpable surgical emphysema with crepitus was noted over her face, neck and upper chest, which was tender. Her abdomen was soft with localised tenderness over the left flank and iliac fossa.

Abnormal laboratory findings included a mildly raised white cell count (11.26  $10^9/l$ ) and a minimally elevated C-reactive protein (10mg/L). The patient underwent chest radiograph and chest and abdominal computed tomography (CT) scan. Right subdiaphragmatic air and diffuse subcutaneous emphysema were observed (Figure 1).

The CT scan showed possible pneumoperitoneum, very significant retroperitoneum, pneumomediastinum with and upper thoracic, neck and facial surgical emphysema likely secondary to a bowel perforation in the proximal descending colon. Incidentally a right upper lobe lung lesion suspicious for primary malignancy was also noted with adjacent hilar lymph nodes but no evidence of distant metastases (Figures 2-4).

Initial management involved oxygen therapy, intravenous fluid and antibiotics (Amoxicillin, Gentamycin and Metronidazole).

The next day clinical examination revealed generalised abdominal tenderness with guarding and rebound tenderness. Surgery was decided in view of the spreading abdominal signs and a laparoscopy performed. Interestingly, laparoscopy was surprisingly normal, with



**Figure 1:** Chest X-ray Demonstrating Diffuse subcutaneous Emphysema and Subdiaphragmatic Retroperitoneal Free Air

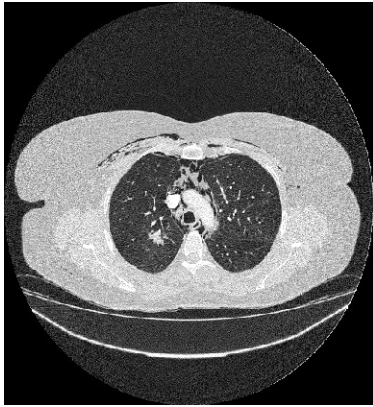
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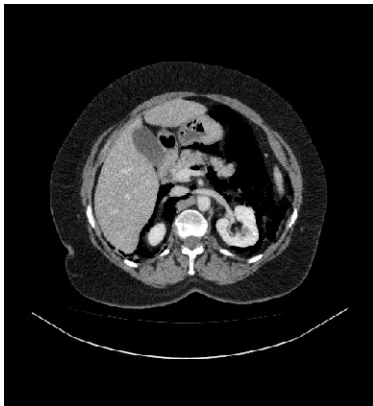




**Figure 2:** Axial CT Image of the Chest Revealing Bilateral Diffuse Subcutaneous Emphysema and Pneumomediastinum. Free Air is Noted at the Anatomical Region of the Aortic Arch



**Figure 3:** Axial CT Slice of the Upper Abdomen Demonstrating Pneumoperitoneum. Free Air Envelops the Retroperitoneal Structures



**Figure 4:** Extensive Amount of Retroperitoneal Air Displacing the Descending Colon Anteriorly

no contamination seen and only minimal amounts of pelvic free fluid identified. A laparoscopic aspiration and lavage was performed and tube drains left in situ as a precaution. The post-operative course was uneventful and she was discharged four days later.

## Discussion

Colonoscopy is a common and usually a very safe diagnostic and therapeutic procedure. Complications occur rarely and they include bleeding, perforation and post-polypectomy syndrome. Incidence of perforation varies and is higher after therapeutic procedures such as polypectomy or endoscopic mucosal resection. The sigmoid colon is

reported to be frequently involved [2].

Perforation may be caused by different mechanisms such as barotrauma, mechanical rupture, thermal injury during electrocautery and polypectomy. In our case, it is presumed that the perforation occurred during polypectomy. Thermal injury of the colonic wall during electrocoagulation for polypectomies is an important additional factor [3].

A second possibility is of an unnoticed perforation of a colonic diverticulum. Excessive pressure following insufflation may cause herniation of the mucosa of a false diverticulum making the mucosa permeable to the air without an evident point of perforation [4]. Alternatively mechanical rupture of a diverticulum is usually the result of excessive pressure against the colonic wall by the endoscope directly.

Perforations most commonly occur at points of previous weakness such as diverticula, previous colonic lesion sites, colitic areas, or neoplastic sites. Advanced age, comorbidities, and skills of the endoscopist further influence the risk of this complication [2].

Retroperitoneal perforations are unusual. Cirt et al. [3] reviewed literature from 1974 to 2006, 24 cases of retroperitoneal perforation have been reported. 14 of which were associated with polypectomies and only two were surgically managed.

How air enters and moves through the mediastinum can be understood by referring to the soft tissue compartments of the neck, thorax, and abdomen. The visceral space surrounding the trachea, oesophagus, and great vessels in the neck continues into the chest to envelop the mediastinal viscera and passes through the diaphragm with the oesophagus to communicate with the retroperitoneal space. Thus, it is possible for air that enters these tissue planes to track to any of the mediastinal structures.

Due to the rarity of this case, there is no ideal management. However, it is generally accepted that conservative management is perfectly reasonable in patients in good clinical condition in the absence of mechanical obstruction [3]. Success rate of non-operative management is approximately 33-73% [1]. Laparoscopic lavage has also been shown to be successful, leading to a good recovery without bowel resection. White et al. [5] showed the short term failures of laparoscopic washout were secondary to perforated cancer, fistula formation and inadequate washout leading to continued sepsis. Long-term problems may also exist with the technique. Resection and radiological drainage remain commonly used practices in the management of bowel perforation [1,3].

With regards to our case, both intra- and extraperitoneal perforation was evident. Retroperitoneal involvement was evident in view of the subcutaneous emphysema. Intraperitoneal perforation was clinically suspected and confirmed with radiological investigation. No obvious perforation or contamination was noted on laparoscopy. Prompt recognition and management allowed us to minimise the consequences of the perforation and allowed a relatively quick recovery.

## Conclusion

Perforations involving both the intra and extraperitoneal space are extremely rare. There are different management options available and the choice should be related to the clinical condition of the patient. Laparoscopic washout and drain insertion is an emerging technique used in non-faeculent peritonitis. Evidence has shown it is a safe procedure, avoiding the need for a laparotomy and stoma formation.

## Consent

Written informed consent was obtained from the patient for the publication of this report and accompanying images.



## Conflict of interest

We are not aware of any conflict of interest or any financial support received.

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# Kidney Preserving Resection of Leiomyosarcoma with Reconstruction of Left Renal Vein: Case Report

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## Abstract

**Background:** Leiomyosarcoma is a common retroperitoneal sarcomas mostly originating from muscles. Only about 5% of leiomyosarcomas arise directly from large blood vessels and more than 50% of cases originate from inferior vena cava. Primary leiomyosarcomas of renal veins are extremely rare (30 cases). Mostly diagnosed at advanced stages because of nonspecific clinical signs

**Case:** A 40-year-old woman was evaluated of a left retroperitoneal mass with severe back pain. CT scan revealed a left retroperitoneal mass 7 cm. in size adjacent to left renal hilum. During the operation; a multilobular, solid tumor in 7 x 6.5 x 3 cm size, surrounding the left renal vein was observed. Further dissection revealed that the tumor was originated from left renal vein wall. Total devascularization and partial left renal vein resection with tumor and end to end anastomosis was performed. Vascular outflow was confirmed with intraoperative and postoperative doppler examination. Pathology was reported as moderately differentiated leiomyosarcoma, originated from renal vein wall with tumor free resection margins and the patient was discharged with adjuvant chemoradiotherapy.

**Conclusion:** Although the radical nephrectomy is the gold standard approach for malign tumors of the kidney, kidney preserving tumor free resection with vascular reconstruction is a feasible alternative followed by adjuvant chemoradiotherapy and close follow up. Kidney preserving tumor free resection with vascular reconstruction and followed by adjuvant chemoradiotherapy is a feasible alternative instead of radical nephrectomy.

**Keywords:** Smooth muscle tumors; Leiomyosarcoma; Renal vein

## Introduction

Leiomyosarcoma is the third commonest primary retroperitoneal malignancy following liposarcoma and malignant fibrous histiocytoma. However, most of these are intramuscular in origin. Only about 5% of leiomyosarcomas arise directly from large blood vessels [1]. The majority of vascular wall related leiomyosarcomas originate from the inferior vena cava. Primary leiomyosarcomas originating from the renal veins are extremely rare; approximately 30 cases have been documented [2] as almost all being case reports. Most tumors are diagnosed at advanced stages because the disease has a relatively silence course initially and usually presents with nonspecific clinical signs

## Case

A 40-year-old woman presented to our clinic with the complain of back pain. She had no significant medical history. Routine biochemical work-up was normal. Upper abdominal ultrasound revealed a left retroperitoneal mass. The mass was described as a tumor that was not related to renal parenchyma or excretory route but in close contact with the renal vein. Further evaluation with contrast enhanced axial CT scan showed an infiltrative, probably malignant left retroperitoneal mass 7 cm in size neighboring the left renal hilum. After informed consent was obtained, the patient underwent exploratory laparotomy. During the operation, a multinodular solid tumor with a size of 7x6.5x3 cm, originating from the left renal vein was observed (Figure 1). The mass which is strongly adhere was not resected totally without left renal vein. So we decided to do a complete circumferential resection, and reconstruction of the left renal vein. The renal vein was freed from the surrounding tissue along its course preserving left gonadal vein. After en-bloc, kidney preserving resection of the mass including invaded part of the vessel was completed (Figure 2), an end to end anastomosis of the vein was performed using 6/0 polypropylene

(Figure 3). Histopathological examination showed that the tumor was a moderately differentiated leiomyosarcoma originating from the wall of the renal vein. It was also confirmed that all resection margins were negative. The early postoperative period was uneventful and the patient was discharged home on fourth day. Two years after receiving adjuvant chemoradiotherapy she is still doing well without any symptom or sign of recurrence.

## Discussion

Primary vascular leiomyosarcomas are quite rare; less than 300 cases have been reported in the literature mostly in the form of single case report. Leiomyosarcoma which is originating from vascular system can be fatal problem. More than half of them stem from IVC with a female predominance of 3:1 [3]. Patients with vascular leiomyosarcoma are usually in their sixth or seventh decade of life, but our case was in her forth decade [4]. The tumor is situated on the left-side 60 percent of the time. As was in the present case, these type of tumors are generally diagnosed at an advanced stage due to nonspecific clinical signs.

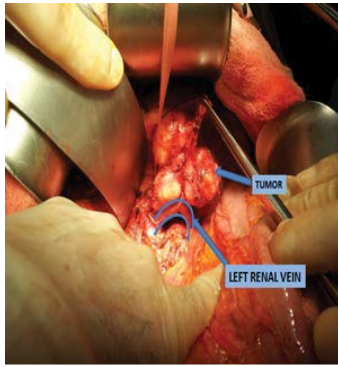
As a natural result of extremely rare occurrence of the disease,

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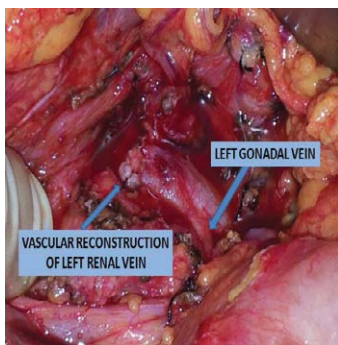
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**Figure 1:** Multilobüler mass / Left renal vein



**Figure 2:** The mass / After resection



**Figure 3:** After reconstruction of left renal vein

little is known about the factors impacting on long-term prognosis of patients with leiomyosarcoma of renal vein origin. There is no consensus regarding the optimal treatment strategy [5]. Jihoon T Kim et al. suggested that an aggressive resection with negative margins should be the goal of therapy for those without widespread metastases and who acceptable surgical candidates [6] are.

The most important prognostic indicator for vascular wall originated leiomyosarcoma is surgical resection with negative margins, which confers a 33 to 68 percent 5-year survival [7]. Authors from the University of California reported a five-year survival rate of 53 percent [8]. One of the commonly adopted surgical approaches has been to remove the tumor, en bloc including nephrectomy due to difficult-to-detach adherence to the renal vein [9-11]. We believe that securing a negative vascular margin during resection is adequate and can allow for an organ- or function-preserving removal provided that an appropriate chemoradiotherapy regimen follows when needed. In our case; the tumor was formed in the posterior wall of renal vein. We did not remove the mass, which has tumor free margin, without

circumferential resection of renal vein. Therefore we decided to make a complete circumferential resection and reconstruction of the left renal vein.

To summarize, we believe radical nephrectomy remains to be the gold-standard treatment modality for such malignant tumors; however, R0 resection can be a feasible alternative if supported with adjuvant chemoradiotherapy in those who require it and followed up closely.

### Conflict of interest

Authors have no conflict of interest to disclose.

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# Primary Hydatid Cyst of the Diaphragm: A Case Report

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## Abstract

Hydatid disease is a parasitic disease endemic in Romania which occurs frequently in liver and lungs, but it can also be present in almost any part of the body. We present the rare case of a 37-year-old male which was admitted in our service with a large hydatid cyst at the level of the right thoracic outlet and we were not able initially to establish its exact origin, liver or right lung. After imagistic investigations we decided for an abdominal approach considering that the cyst was liver related. Intraoperative findings showed a primary hydatid cyst of the diaphragm, a very rare entity that was successfully treated by the mentioned approach.

**Keywords** Echinococcus Granulosus; Hydatid Cyst; Diaphragm

## Introduction

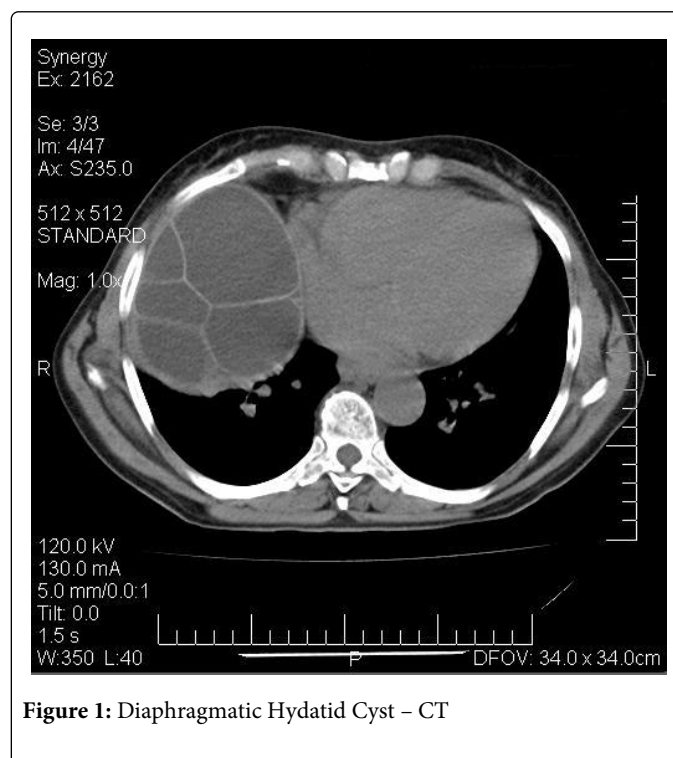
Hydatid disease (HD) is a parasitic disease caused by *Echinococcus granulosus*. The disease is endemic in Eastern Europe, including Romania which has a morbidity index of 5.6 to 100.000 people [1]. It occurs frequently in the liver (59-75%), but it can also be present in the lung (27%), kidney (3%), bone (1-4%) and diaphragm (1%), the last being generally associated with liver hydatidosis [2,3]. In this report we present a case with primary hydatid cyst of the diaphragm, with no other cysts present, which was successfully managed in our department.

## Case Report

A 37-year-old male, with no history of surgery, was admitted in our department for thoracoabdominal pain for 3 days. At admission the patient was without fever and in good general condition, despite suffering of thoracoabdominal pain. Laboratory tests showed slightly elevated leucocytes and no eosinophilia was present. Chest X-ray performed at admittance revealed right-sided subpulmonic opacity with elevation of the right hemidiaphragm. The CT scan performed the next day showed a giant hydatid cyst extending from the abdominal cavity in to the right thoracic cavity but did not offer any information regarding the origin of the hydatid cyst (Figure 1). As it was considered that we deal with a liver cyst, we have decided for an abdominal approach.

An exploratory laparotomy was performed on the third day, during which time we discovered a giant hydatid cyst (Figure. 2) between the muscle fibers of the diaphragm, without liver or lung involvement, pushing down on the liver and compressing the inferior right pulmonary lobe. Careful dissection of the muscle fibers was carried out in order to avoid spillage in the abdominal cavity (Figure 3). Upon reaching the membrane of the cyst we decided to first evacuate the content with the help of a 16G needle. Next we irrigated the site with 90% alcohol solution in order to inactivate the remaining content, and finally we evacuated the cyst again using the same 16G needle.

Removal of the cyst's membrane went without incidents, and closure of the defect was performed with individual silk suture points. Histological examination established the presence of muscle fibers in the pericyst and confirmed the diagnosis of hydatid cyst.



**Figure 1:** Diaphragmatic Hydatid Cyst – CT

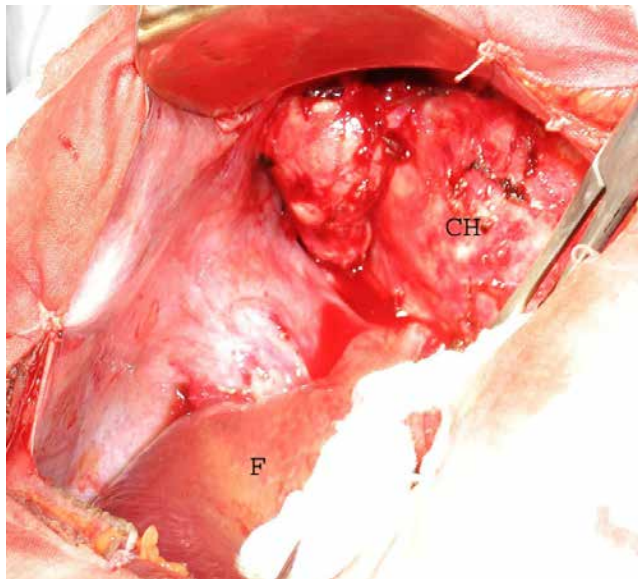
Postoperative recovery was uneventful and the patient was discharged on the fourth postoperative day and directed to a parasitological department for medical treatment.

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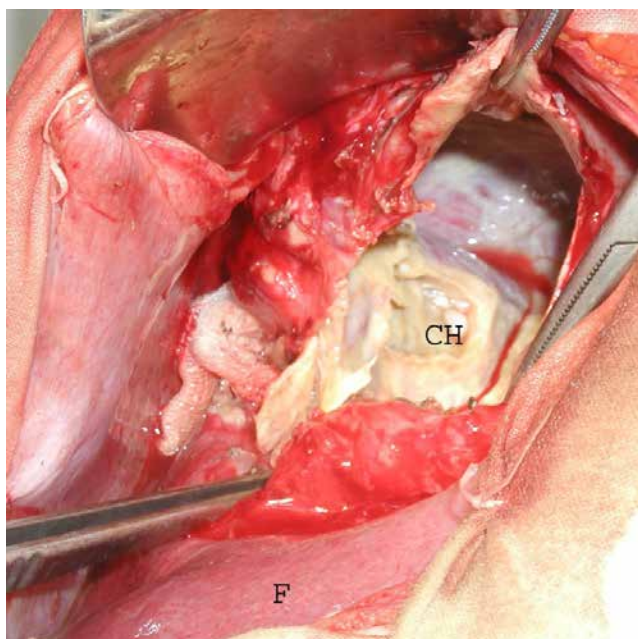
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**Figure 2:** Intraoperative Aspect



**Figure 3:** Diaphragmatic Hydatid Cyst is Opened (Intraoperative Aspect)

## Discussion

The primary hydatid cyst of the diaphragmatic is a rare clinical entity defined as a cyst with no involvement of the pulmonary

parenchyma and with no transmission from the abdomen to the thorax, whereas a secondary cyst is most likely caused by transdiaphragmatic migration from the posterior segments of the right hepatic lobe [4,5]. Diaphragmatic localization of the hydatid cyst is most likely caused by dissemination of the embryos through the arterial circulation [6]. Diagnosis is confirmed by the presence of muscle fibers in the pericyst during histological examination [7]. In the preoperative period careful topographic diagnosis between the diaphragm, lung, liver and abdominal localizations should be made either by use of CT or MRI examinations [8]. Although total excision of the cyst through the thoracotomy is considered an excellent approach [9], we prefer using the laparotomy in cases in which the CT examination doesn't rule out liver involvement. Also, we have achieved good long term results without excising completely the pericyst, simple removal of the membrane being sufficient. Suturing of the diaphragmatic defect is a must in order to avoid possible herniation and to ensure good pulmonary function.

## Conclusion

The primary hydatid cyst of the diaphragmatic is a rare clinical entity and the diagnosis is challenging. Although total excision of the cyst through the thoracotomy is considered an excellent approach, we prefer using the laparotomy in cases in which the CT examination doesn't rule out abdominal viscera involvement. A good diaphragmatic suture is mandatory to avoid possible herniation and respiratory dysfunction.

## Conflict of interest

Authors have no conflict of interests to disclose.

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# Left Side First Approach in Nissen Procedure for Gastroesophageal Reflux Disease; How We Do It.

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## Abstract

### Introduction

Gastroesophageal reflux disease (GERD) is a major public health problem. The "gold standard" in the surgical treatment of this condition is the laparoscopic technique called Nissen fundoplication.

### Aim

This paper presents a safer alternative of the laparoscopic Nissen fundoplication, with special focus on the most difficult moment of the intervention, the creation of a retroesophageal passage.

### Material and method (presentation of the surgical technique)

The conventional Nissen technique consists of the dissection of the esogastric junction in a clockwise direction, right to left: right pillar, hiatus, left pillar, retroesophageal passage, skeletonization of the fornix and reconstruction of the valve. We decided to perform a technique inspired from laparoscopic sleeve gastrectomy, which starts in anti-clockwise direction, with the skeletonization of the upper third of the greater curvature of the stomach, then continues with the complete dissection of the left diaphragmatic pillar ("left side first") and finally with the dissection of the right pillar and the creation of the retroesophageal passage, thus, the procedure becoming less complicated. A complete decollement of the area nuda is performed, this way avoiding possible complications at this stage, like: bleeding from the area nuda or short vessels, ruptures of the stomach, esophagus, spleen, penetrating the thoracic cavity with a retroesophageal clamp, etc.

### Results

Introduced in 2011, this technique was applied with success in all 20 consecutive cases of hiatus hernia operated in our clinic. There were neither intraoperative accidents and conversions nor early or late postoperative complications. 19 cases were primary Nissen while one case was a recurrent hiatal hernia after an insufficient cruroplasty made in another center. There were three cases in which we had to use Parietene Composite type mesh to strengthen the cruroplasty.

### Conclusion

The applied modification has improved the original laparoscopic Nissen fundoplication technique, thus this has become a less complicated procedure at the same time providing more security to the patient.

**Keywords:** GERD; Floppy Nissen; Diaphragmatic Pillars Dissection

## Introduction

Gastroesophageal reflux disease (GERD) is a major public health issue, which is caused by the quasi-constant problem of axial hiatus hernia. Short-term drug therapy has relative efficiency, which rather alters the properties of the refluxate than the reflux itself. Due to the mechanical character of the deficiency and concerns related to the lifelong use of proton pump inhibitors (PPIs), surgery remains the first therapeutic option for hiatal hernia with esophageal reflux (GERD).

The laparoscopic Nissen fundoplication technique is now considered the "gold standard" for the treatment of hiatal hernias, and the widely adopted two main surgical techniques are: the Short Floppy Nissen technique involving the skeletonization of the gastric fornix

and the Nissen-Rosetti technique with no skeletonization of the short gastric vessels [1].

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The key element of the initial dissection in both techniques is the right diaphragmatic pillar, preparation being performed in clockwise direction, from right to left. The key element of this technique is the creation of the retroesophageal passage, the main "source" of perioperative complications as: hemorrhage, splenic decapsulation, gastroesophageal perforations, intrathoracic "migration" with or without pleural lesions.

## Aim

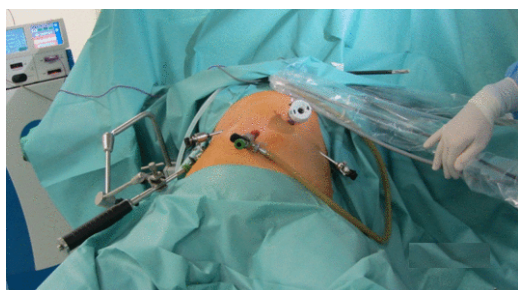
This paper aims to present a safer dissection technique of the esogastric junction, technique derived from the longitudinal laparoscopic sleeve gastrectomy (LSG), which consists of the primary preparation of the gastric fornix (future valve), the release of the gastric area nuda and full exposure of the left pillar, only then followed by the "right to left" approach of the right pillar and the construction of the retroesophageal passage.

## Method

The study, performed during April 2011 – January 2014, was approved by the Ethics Committee of the "St. Constantin" Hospital, Brasov. We included in the study 20 patients suffering from hiatal hernia, diagnosis established on the following criteria: clinical, based on the assessment scales for gastroesophageal reflux disease, upper gastrointestinal endoscopy, hiatal hernia also confirmed by CT scan. There were no patients excluded from the study, all interventions were performed by the same surgical team. In 19 cases, patients underwent primary treatment of hiatal hernia, we had one case of recurrence following Nissen surgery, referred to us from another healthcare center.

## Presentation of the Technique

The surgical setup is virtually identical to the one used during LSG, in French position, while operating the surgeon takes the standing position between the patient's legs, the first surgical assistant is located on the left of the patient, the instruments are placed between the surgeon and surgical assistant. The Storz laparoscopy tower is used with the monitor placed above the patient's head and ValleyLab Force Triad electrosurgery platform with Ligasure 10 mm blunt tip vessel sealer. We use 5 trocars positioned fanwise in the upper abdominal quadrants as follows (Figure 1):



**Figure 1:** Surgical setup

1. 10 mm optical trocar placed in the umbilical or supraumbilical area according to the patient's height;

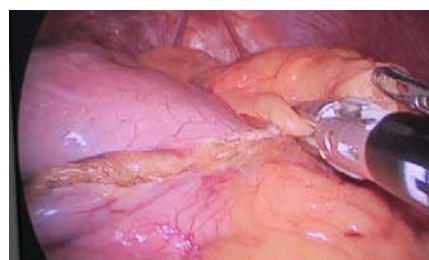
2. 12 mm trocar placed in the left paramedian area at 3-4 cm in the supraumbilical area: for Ligasure and suture (surgeon's right hand);

3. 5 mm trocar placed in the right paramedian area at 3-4 cm in the supraumbilical area: holding clamp (surgeon's left hand);

4. 5 mm trocar placed in the left anterior axillary line: assistant's holding clamp;

5. 10 mm trocar placed in the right anterior axillary line: self-retaining snake retractor.

The procedure begins with the skeletonization of the upper third of the greater curvature of the stomach, the opening of the omental bursa by using Ligasure Atlas vessel sealing instrument, which facilitates dissection at the division of the gastric wall. (Figure 2 and 3)



**Figure 2:** Starting the skeletonization of the greater curvature of the stomach



**Figure 3:** Sectioning of the short gastric vessels

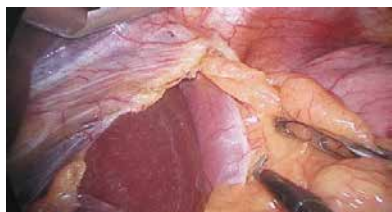
The procedure continues similarly to LSG: sectioning of the posterior vessels, complete release of the area nuda, the exposure of the left diaphragmatic pillar, sectioning of the Leimer Bertelli membrane, thus carefully preparing the left side of the retroesophageal passage. (Figure 4)



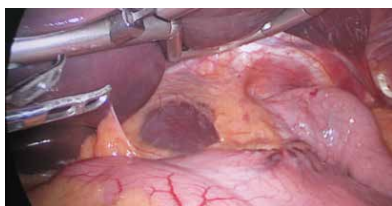
**Figure 4:** Complete exposure of the left pillar after releasing the gastric fornix



At this stage the stomach is released and the dissection of the right side of the esogastric junction is started according to the common procedures of the conventional technique as follows: sectioning the pars flaccida of the lesser omentum, exposure of the right pillar, sectioning the parietal peritoneum at the level of the right and upper esophageal hiatus, dissection of the fat pad in the hiatus, blunt retroesophageal penetration made simple and easy by applying left-side dissection, lifting the esophagus on a textile mesh. (Figures 5 to 11).



**Figure 5:** Exposure of the right side of the gastroesophageal junction and reduction of the hernia



**Figure 6:** Sectioning of the pars flaccida and the exposure of the right pillar



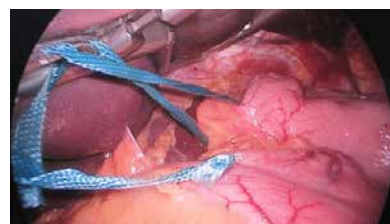
**Figure 7:** Dissection of the esophageal hiatus



**Figure 8:** Retroesophageal blunt dissection



**Figure 9:** Easily accessed retroesophageal passage



**Figure 10:** Lifting of the esophagus on a textile mesh

The mesh is drawn down by traction to enlarge the retroesophageal passage to allow the formation of a large, tension-free valve, “abdominalizing” as much of the lower esophagus as possible, then cruroplasty is performed around the esophagus with single silk or 2-0 polypropylene thread applied in X shape in the upper area. (Figure 11 and 12).



**Figure 11:** The final aspect of the hiatus before calibration



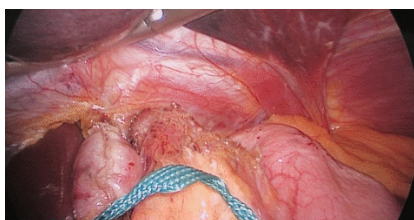
**Figure 12:** Single thread applied in X shape for calibration, placed in the upper area

If the lesion is too large stitches are placed both below and above the esophagus and a reinforcement mesh is applied too (Figure 13).

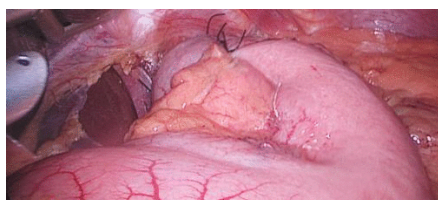


**Figure 13:** Composite reinforcement mesh around the esophagus

We finalize the intervention by reconstructing the valve with 3 staples of 2-0 silk/Prolene thread, the superior one anchored to the esophagus and sometimes to the right pillar. (Figure 14 and 15) We do not drain this area.

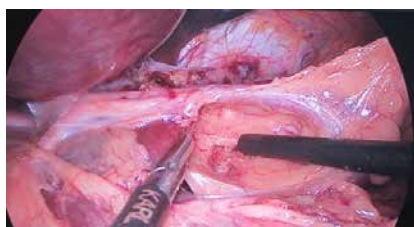


**Figure 14:** Floppy valve, situated in the right position without tension



**Figure 15:** Final aspect of a Floppy Nissen valve

The presence of a large accessory left hepatic artery in the small omentum requires a delicate dissection and its preservation. (Figure 16 and 17)



**Figure 16:** Hiatal dissection preserving the left hepatic artery



**Figure 17:** The final aspect of the valve situated above the artery

## Results

This article is not a retrospective study but a presentation of a surgical technique. We used this technique in the last 20 cases consecutively, with no record of inconveniences, conversions, significant peri- and postoperative complications, change of intraoperative strategies (choosing a different type of Dor or Toupet valve). We did not record any persistent reflux episodes or gas and bloating in the studied casuistry. The duration of the follow-up period was between 1 and 34 months.

## Discussions

We intended to achieve a simpler alternative, but most of all a safer version of the Floppy Nissen technique by simplifying the retroesophageal passage. The "left side first" approach allows safe intervention, without possible complications during the reconstruction of the retroesophageal passage, like: bleeding, perforation, splenic injuries, "misplacing" the left hand clamp in the thorax or area nuda.

This technique is similar to the skeletonization of the greater curvature and area nuda in a laparoscopic sleeve gastrectomy, thus becoming an almost natural development for experienced teams in bariatric surgery. The surgical setup is the same except for trocar No. 3. Its size is 5 mm instead of 10 mm.

The specialty literature describes other technical procedures that start dissection on the left side of the esogastric junction, variants that significantly differ from the one described above in some essential elements [2-4]:

- Top-down dissection of the left pillar.
- Sectioning the Leimer-Bertelli membrane only and complete release of the left pillar, similar to the gastric banding technique.
- The skeletonization of the fornix is performed subsequent to the retroesophageal passage, after the most difficult moment of the intervention, where the major benefit is the complete exposure of the area.

## Conclusion

The complete dissection of the left flank is the key to a large, tension-free floppy valve, thus efficient and without complications for the patient.

Inspired from the longitudinal laparoscopic sleeve gastrectomy, the original technique is slightly changed, which simplifies a lot and at the same time makes the laparoscopic Nissen technique more secure. The

key point of this intervention is the retroesophageal passage and the key point of the retroesophageal passage is the left pillar and the area nuda and not the right pillar, which is evident. For this reason, dissection should start from the left pillar and area nuda to the right, so the "left side first" technique should be applied.

### Conflict of interest

Authors have no conflict of interest to declare

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# History Elements of Campaign Surgery through the Ages

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## Abstract

Human history is usually confused with conflagrations history. Since ancient times, wars have led to deaths and injuries, and this has been considered as a normal situation. What has evolved over time was the value of the human life for the army and society in general. Aid to the injured has evolved from comradely aid to the formation of specialized structures, in good part due to the increased 'value' of the soldier, through the investment in his preparation. Only recently, a soldier is regarded as a being with intrinsic value for society, military and family, who is performing a social service, and to whom society owes to protect and do everything it can to save his life or to mitigate the effects of his injuries.

**Keywords** History of Surgery; Military Medicine; Campaign Surgery

Campaign surgery is a specialty of surgery, adapted to the particular conditions imposed by the needs of the battlefield. The use of increasing military forces, the increasing destructive power of weapons from one era to the next one, as well as conducting warfare on more extended areas with high intensity, have led to the development of military medicine and especially campaign surgery. The basic principles of the surgery remain the same as for any specialty, but their level is continuously enriched by the accumulated experience. Campaign surgery has always been a rich opportunity to purchase precious assets, with the consequence of improving surgical techniques and therapeutic concepts with further application in civil life.

Campaign surgery has a number of particularities arising from its nature. When executing surgery on the battlefield we must primarily face the large number of injured soldiers with wounds and injuries that occur in a short time, the so-called "epidemic trauma", this was how it was called by Pirogov [1]. War surgery is a collective surgery, which applies in several stages, to a great mass of wounded soldiers aiming at saving the soldiers' lives and recovering the troops.

Another feature of the campaign surgery consists of the extremely difficult working conditions, conditions that are almost always aggravated by continuous fluctuation of the combat situation: varied health losses, always larger than initially estimated, lack of security, lack of comfort and silence, activity in leaps and continuous surprises, impossibility of subsequent continuous monitoring of the wounded and not least, the loss of medical personnel. Improving these conditions can be obtained through a judicious organization of the surgical activity, rapid evacuation of the wounded and their triage according to the category of emergency of their injuries. The history of medicine is closely linked to the military history of human civilization. Since ancient times, the complexity and the way medical health care was organized influenced the fate of the wounded and therefore the fate of the entire conflict. Medical attitude towards the wounded varied depending on the historical moment.

## Ancient Times

In ancient times, the first written mention of the pathology of war was discovered by Edwin Smith in 1862, in an Egyptian papyrus dating from 1550 BC. 48 cases of trauma are presented in relation to the topographic regions, on cranio-caudal direction, with objective clinical description, as well as the diagnosis, treatment and prognosis.

Most of the treatments were conservative, eventually with the use of burns, but without use of the "knife". In that time, the science of healing was "sent by the gods", which explains the close relation of the medical practice with the religious one. Only in the 5th century BC the first "specializations" on various diseases emerge [2].

The first laws of medical practice appeared in Mesopotamia in the "Code of Hammurabi", which included the civil, criminal and commercial code. Babylonian King Hammurabi stated that he received this set of laws directly from the sun god Shamash. Draconian punishments are enforced for those who break the law, the verdict depending upon the gravity of the conviction, and the social position of the perpetrator. The doctors were part of the priest caste, located in the upper middle-class society. Of the 282 laws of the code, five of them referred to the medical practice. Thus, prices for medical gestures were fixed, depending on the social position of the patients, while the element of risk for the surgical gesture was established, both for the patient and for the surgeon (if the patient died or lost his sight, the surgeon's hand had to be cut), that then will remain ingrained in the medical practice [3].

From the Greek period we have little evidence of transmission of medical knowledge from the Egyptians and Mesopotamians. The Iliad represents an important evidence of the medical practice of that time, where Chiron, the demigod, initiates Achilles, the hero, into surgery. There are given examples of evacuation of the wounded from the battlefield into tents located in the rear, where they were treated (hemostasis, extraction of foreign bodies, bandages), including the first mentions about the treatment of pain.

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Savulescu F, Albăta O, Surdeanu D, Merticariu B, Cîrlan C. History Elements of Campaign Surgery through the Ages. Journal of Surgery [Jurnalul de chirurgie] 2014; 10(3): 261-265. doi:10.7438/1584-9341-10-3-15

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In Homers' *Epopée*, 140 injuries are described, thus proving actual knowledge of anatomy; they were grouped according to topographic regions and vulnerable agent with an overall mortality of 77%. There is no mention about the practice of magic, incantations or amulets. Therapy was achieved through a mixture of surgical techniques and topical applications of medicine. It is also noteworthy that "doctors" were not part of the caste of priests, but they were combatants and even leaders (ex. Patrocle) [3,4].

A big step in the history of medicine is the Hippocratic medicine, which includes a series of writings of Cnidos and Cart schools, between 430-380 BC. It represents the first rational and natural interpretation of diseases and the cancellation of the supernatural origin. Doctors are considered descendants of Asclepius. He was a mortal, son of the sun god Apollo and the nymph Coronis, which he kills before childbirth, finding that she deceived him with a mortal. The child is removed from the womb of his mother and given to the Centaur Chiron for care, who teaches him the secrets of surgery and healing remedies. Asclepius dies, killed by Zeus, for having committed the sacrilege of curing a patient doomed to die. The tripod diagnosis-treatment-prognosis is established as well as the Hippocratic Oath with "primum non nocere". It explains in detail the treatment for military injuries: sprains, fractures (reductions, splints immobilizations), hemostasis techniques, along with chronic conditions such as bladder stones, inguinal hernia, cataract treatment, tracheostomy, treatment of cataract with a needle. Rules of conduct for doctors are established, they have to be healthy, clean, and to inspire trust. Discussion with the patient becomes confidential, home visits are performed for internal conditions that do not require surgical maneuvers. Surgery is performed at the "cabinet" – *Iatreion*, which needs to have enough light, to be ventilated, equipped with clean water and minimal furniture [3,4].

The Roman period represents a period of development for medicine, by assimilating knowledge of Greek medicine in parallel with a better organization of military medicine. In the imperial period the first - *Valetudinarium* military hospitals are established, with operating rooms, baths and toilets with running water, heating water and enclosures systems. On the other hand, anyone could state that he was a doctor and earn a lot of money due to people's credulity. Medicine is no longer the prerogative of men, because there were also women who have gained fame. These are the reasons why Plinius the Old, in "*Historia naturalis*", expresses a deep distrust in the medical corps. Many doctors were actually among the slaves and some, due to their successes in medical practice, gained their freedom. Medical practice is divided into many specialties and it is viewed as a business from which a lot of money can be earned. Most prominent representative of that era is Galen of Pergamum, a theorist, who systematized and a follower of the Hippocratic medicine, with studies of anatomy and physiology. The Galenic humoral concept, with the 4 humors associated with certain viscera, will dominate Western medicine until the nineteenth century. Paradoxically, his dogmatism in considering surgery as a lower chapter of the medical practice will block the upsurge of Hippocratic medicine in the Middle Age.

## Middle Age

In the Middle Age, despite the medieval dogmatism, medicine continues to grow and health became an issue of public accountability. Universities for training doctors are created and the hospital gradually becomes the place of choice for the treatment of patients. However, a lot of counseling and therapeutic maneuvers are performed at the patient's home, in the absence of aseptic conditions. In the Middle Age, the influence of previous civilizations is felt.

In the middle period, the progresses of medicine are determined by the Arabs, where the doctor enjoys a high esteem. In the tenth century, Abulcasis writes a surgery treaty that contains theoretical and practical considerations. Abulcasis influences European medicine in later centuries, especially in hospitals that were organized near the military orders of the Crusaders and the Templars [3,4].

In the last part of the Middle Age, European medical schools appear at Salerno, Toledo, Montpellier, Paris, Padua and Bologna. The basic campaign principles of treatment are established here, with indications of achieving haemostasis by using tamponade, ligature or cautery, guidance regarding the treatment of pain (potions or vapors of opium), the use of restraining devices for fractures, drainage systems for pus as well as discussions concerning the time to suture the wound. If the aseptic conditions are not known, the only chance of survival was the amputation of the wounded limb and for major visceral lesions nothing could be done. For the wounded enemies there was no compassion, and thus, with a decision of the Swiss Diet in 1499, it was decided that most prisoners are to be killed and care for their own wounded was to be provided only after the cessation of hostilities. The term *felcer* (medical assistant - *feldscherer* - field surgeon) has its root in the German nations' vocabulary. There were few instruments used: amputation knife, razor, sponge, scissors, forceps to extract foreign bodies, pins [4].

With the advent of firearms, injuries produced by them became the majority of overall injuries in the fifteenth and sixteenth centuries. Thus, Giovanni Andrea Della Croce of the Venetian Republic writes a treaty on wound treatment with projectiles extraction indications as well as wound cleaning instructions, reduction of pain and treatment of complications. There were appropriate extracting tools for projectiles from various anatomical regions. The establishment of mercenary armies determined the improvement of medical services with the designing of separate protected areas for treatment. The chief physician of the military was an internist, which graduated an important medical school, who would oversee the work of surgeons [4].

In France, Henry of Navarre (later King Henry IV), has established mobile and stationary surgical rooms, which in Spain are called "*AMBULANCIAS*". Paré Ambroise writes a campaign surgery treaty with small indications regarding neurosurgical techniques, visceral sutures, and amputations of limbs with cautery or left free. However, large visceral lesions still remained lethal. It is worth mentioned that surgeon "doctors" had to participate in battle, and only after the battle were they to provide healthcare. Only in 1629 each regiment is manned with its own surgeon, who is dressed with a distinct uniform, has his own supply of materials, organizes the evacuation of patients from the battlefield and is exempted from military duties in battle [3,4].

## Modern Era

In Modern Era, in 1731 the French Royal Academy of Surgery and Traumatology is established, which separates the surgeons from the barbers, giving them equal status with internists doctors. In Prussia, the same is done by King Frederick the Great in 1788, who mans field hospitals with surgeons along with internists and pharmacists that impose rules regarding food hygiene, waste and prevention of infectious diseases. In the same period, other military medical schools are established in Berlin in 1724 and in Vienna in 1784. However, most of the wounded continue to wait for the end of the fight in order to be evacuated and provided treatment [3].

A major step is the battle of Dettingen Am Main from 1743, where the first agreement between the warring parties (French and English) is made, which states the neutrality of hospitals and the requirement not to attack them [3].

In the nineteenth century, there is a tendency to exaggerate with the injured limb amputations. Thus, Jean-Dominique Larrey, chief surgeon of the Napoleonic armies, was performing not less than 200 amputations of limbs per day, with an average time of 4 minutes, but with a mortality of 80%. He is also the one who set up the first ambulance system that evacuated the wounded from the battlefield before the end of the fight [5,6].

Regarding the Navy, where surgeons initially received their knowledge through apprenticeship on board of the ship, when only few of them had solid medical studies, it was only after 1805 that only those licensed in medicine were accepted. England had the best naval medical service organization and the notes of Sir William Beatty, the surgeon of Lord Nelson flagship, the greatest admiral and hero of the British nation, whose victory at Trafalgar over the French- Spanish fleet secured a naval hegemony century for England, were of great historical value. After multiple injuries in earlier battles, in which Nelson lost his right arm and an eye, at the Battle of Trafalgar he is advised by his surgeon not to present his chest decorations on the deck. The admiral refuses and he is hit by a French sharpshooter, the bullet destroying his left shoulder and left lung. The bullet stops in his spine producing lower body paralysis. Despite extremely serious injuries, the admiral lives long enough to learn the news of his victory. After death, Lord Nelson's body was preserved in a barrel of brandy, until he was returned to England where a national funeral was held [7].

During the Crimean War (1854-1856), the extraordinary devotion of the nurse team headed by Florence Nightingale is recorded, as well as the first use of chloroform by the chief surgeon of the Russian army, N. Pirogov. At the same time, he attempted to preserve injured limbs by restraining them with plaster splints. In this conflict, the Anglo-French troops used Minnie type bullets that were empty at their base and had a much higher output speed, with lethal effect at 400-500 m [1,6].

The discovery of ether as an anesthetic agent by William Thomas Green Morton in 1846 represents a major step in the surgical treatment of the wounded, allowing execution of complex operations [5].

During the Second Italian War of Independence (1859), former doctor Larey's son - chief of the armies of Napoleon is the first who utilizes the train to evacuate the wounded behind the lines. At the same time occur the first injuries that are characteristic to the guerrilla war conducted in various areas, including the cities [8].

After the Battle of Solferino (January 24, 1859) Henri Dunant, a Swiss rich man, horrified by what he saw, funds the formation of the Red Cross Society, an international organization for humanitarian aid to all military personnel and civilians.

U.S. Civil War (1861-1865) was the biggest struggle hitherto, with 3.7 million combatants and more than 600,000 deaths. Most of these deaths were not due to the wound itself, but mainly to secondary infections. At the same period of time hospitals are based on boats or trains, special tents - operating rooms, and triage system and organization of hospitals according to affections. This conflict loomed the trenches war that will be taken to the extreme in the First World War, with specific pathology [8,9].

In 1876 Friedrich Esmarch wrote a pocketbook with campaign surgical techniques and created the first surgical individual package with bandages and also the aphorism that the fate of the wounded depended on this package [5,6,10].

## World War I

During the First World War, along with the introduction of antiseptics in campaign surgery and progress in anesthesia, antiseptics and bacteriology, an aggressive type of surgery is required on the battlefield, similar in magnitude to that performed in hospitals. Due to the appearance of shrapnel wounds, hemorrhage, traumatic and septic shock, aggressive and early executed surgical wound processing is required, along with ample interventions on abdominal viscera, resulting in the first significant decline in mortality, approximately 21%. The evacuation, transport and medical assistance system was also developed according to evacuation stages in terms of the static war at that time. Such conditions were also favorable for severe epidemics that occurred in the front lines and also behind the lines, especially when these conditions were responsible for a large number of casualties [5].

First World War represents the moment when war gas was introduced. This produced a shift in the pathology of war, but also induced changes in the soldier's psychology as well as changes regarding the means of protection required [4].

Overall principles and logistics associated with the evacuation were clearly established, associated with the stages of the treatment [3].

## World War II

*The Second World War* was the first total war, with massive involvement of all kinds of forces, land, aviation and marine. German Blitzkrieg's tactics led to the apparition of large spaces for maneuver with rapid deployment and many wounded on large areas that require greater flexibility in providing medical care to troops. Thus, as a novelty, German troops accompanied by tanks were accompanied by buses serving as operation rooms and evictions were carried on all possible ways. Specializations as neurosurgery, urology, oral-maxillofacial surgery, ophthalmology, otolaryngology, hematology, radiology, and laboratory appeared. All wounds are considered as infected wounds and therefore primary surgical processing is very important under conditions of well-managed anesthesia, associated with antibiotics. Anti - shock treatment by blood transfusion is also used. The theory of promptitude and complexity of the medical treatment in stages and evacuation according to destination is finalized. Overall mortality was 37.66% [11].

## Present Times

*In the major conflicts after the Second World War*, due to the intensive use of aviation and bombing on a wide scale, the strict delineation of the medical care definition in the combat zone and the inner zone disappeared. This is why the proportion involving civilians in conflict changed, as shown in the Table I, where the reference is made for 100 wounded. This has led to the disappearance of differences in the organization of treatment between military and civilian, with the advent of military hospitals with humanitarian nature, with treatment of the civilian population caught in the conflict [12].

**Table I:** Civilians Casualties in Different Wars (reported to 100 wounded) [12]

Mexican war 1910-1920	50 soldiers	50 civilians
First World War	60 soldiers	40 civilians
Second World War	24 soldiers	76 civilians
The War In Vietnam	2-50 soldiers	98-50 civilians
Iraq War	60 soldiers	30 civilians

In the twentieth century the topography of injuries has changed, depending on the affected regions, type of war, the tactics used, weapons and terrain. Table II depicted this situation [13].

**Table II:** Topography of Injuries [13].

	WW I	WW II	Korea	Vietnam	Borneo	Ireland	Malvinas
Head	17	4	17	14	12	20	2
Thorax	4	8	7	7	12	15	7
Abdomen	2	4	7	5	20	15	4
Limbs	70	75	67	54	56	50	76
Other	7	9	2	20	-	-	11

The proportion of injuries in different regions is different, yet there is a preponderance of limb affections associated with lower mortality compared with wounds in other regions. Injuries to the thorax and abdomen exponentially increased during the war in Borneo (rainforest, small arms, and short distances) and in urban warfare conditions in Northern Ireland. Injuries were produced by various types of projectiles and according to the campaign type [13].

Wounds produced by fragments represent the majority of wounds in the modern conflagrations, as shown in the Table III [13].

**Table III:** Wounds etiology [13].

	WW I	WW II	Korea	Vietnam	Borneo	Ireland
Fragments	61	85	92	44	9	25
Bullets	39	10	7	52	90	55
Other	-	5	1	4	1	20

Despite the increased effect of modern lethal weapons, due to the good organization and complexity of medical care, in modern campaigns a steady decrease in mortality has been achieved (25% in Korea, 24% in Vietnam). The Korean War is the turning point in the management of the wounded, by introducing advanced medical teams, with the role of obtaining hemostasis and painkiller treatment, and subsequently rapid evacuation by air (with helicopters) so that the wounded would arrive at the Mobile Army Surgical Hospital (MASH) in the gold range of up to one hour (the average of 20-30 min) [13,14].

It was in Korea that vascular surgery, sutures and vascular grafts that eliminated amputations of limbs gained momentum. Until then, this was considered inevitable, and transfusions were widely practiced, and blood ceased to be a problem. Very low temperatures which the troops had to face made the infusion solutions unusable. This resulted in entirely original therapeutic ideas, and the realization of mixtures with vodka infusion [3].

Recent conflicts (Iraq, Angola, Somalia, Bosnia, and Afghanistan) involved the participation of Romanian troops, both with fighting forces as well as medical troops, who went from battalion medical points to campaign hospitals. These missions that were carried out far away from the country, in areas with different climates, topography and socio-political situation were very different from the Romanian ones and posed serious problems. However, these problems were overcome as experience was gained. Health care was particularly complex, being given both to fighting Romanian troops as well as local population caught in the middle of fighting. Most often, professional medical aid was granted especially to civilians of all ages and sexes, with injuries caused from a wide range of weapons. This highlighted the deeply humanitarian nature of the Romanian mission and explained the friendship with which the Romanian soldiers were surrounded by the locals and thus the low loss of life compared to other nations involved in this conflict [15,16].

Currently, all armies of civilized countries are working hard to provide the highest possible survival rate of their wounded soldiers. To achieve this, rapid evacuation and the doctrine of granting medical aid according to evacuation stages was imposed (20 minutes after injury until the first surgery). Each evacuation stage involves another kind of specialized medical aid, starting with vital functions to the execution of lifesaving and limb surgical procedures. The end state is to have finalized surgical procedures performed as further as possible from the front line. Of course, this procedure involves logistics and very high costs, but the results are noticeable. We also have to take into consideration the financial burden that the state has to carry further on, considering that the mutilated wounded will require specialized care for many years. A soldier who knows that his country will do everything it can in order to save or restore his health will fight more efficiently [16].

## Conflict of interest

Authors have no conflict of interest to disclose.

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