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Quality and Safety in Children's Hospital: The Onset of Accidental Skin Lesions after Surgery

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Abstract

Introduction: The problem of the onset of accidental skin lesions after surgery is actually underestimated and yet quite unknown, especially in the pediatric setting. Skin involvement after surgery may be related to chemical, electrical, thermal or mechanical causes. The purpose of this report is to increase awareness among professionals about the postoperative skin lesions, to discuss their possible causes and to provide recommendations regarding these avoidable adverse events.

Methods: This is a retrospective, observational study from June 01, 2015 to December 31, 2015. All detected lesions were investigated by using a monitoring form developed for this purpose.

Results: A total of 3614 surgical procedures were performed. Fifteen lesions were detected after surgery, 10 erythematous and 5 II-degree lesion. Eleven patients were male and 4 were female (average age 5.3 years). The incidence was 0.41%. At univariate and multivariate analysis lying on the right-side position during surgery and urologic procedures were significantly associated with skin lesions.

Discussions: The analysis of our series did not allow us to identify an unequivocal etiology but only several hypotheses about the main cause related to the onset of the skin lesion. The skin lesions were generally superficial and transient. The figures in our series were not conclusive enough to consider the position on the operating table and the urologic surgery as independent factors for the onset of skin lesions.

Conclusions: A more accurate understanding of the problem and some strategies for adequate prevention turn out to be mandatory for the sake of the patient's safety.

Keywords: Skin injuries; Safety; Prevention; Surgery; Children

Introduction

Children undergoing surgical procedures may develop acute skin lesions. These lesions may increase morbidity and extend the hospitalization time, thus significantly increasing costs both for patients and for hospitals. Skin involvement after surgery may be related to chemical, electrical, thermal or mechanical causes and sometimes may be related to adverse pharmacologic reactions or peculiar medical conditions [1].

Every antiseptic substance used in the operating theatre may have a highly irritating potential [2]; the most commonly involved antiseptic is povidone iodine. Free iodine in the liquid phase has germicidal power and, as it is consumed, more iodine is released from the complex. Free iodine is irritant and, if this antiseptic solution remains in contact with the skin in liquid form for a long period of time, it can give rise to serious irritant contact dermatitis in dependent or occluded areas. Special care must therefore be taken during the use of these solutions and, in particular, they should be allowed to dry up [3-5].

Flammable solutions, like alcohol containing antiseptics, should be avoided as far as possible and alcohol-free solution preferred. If diathermy is used before the evaporation of the alcohol-based solution, it can cause fire in the operating room. Fire in the operating room is a relatively rare event, but when it does occur the medical outcomes are often catastrophic for the injured patient, with severe legal and economic consequences for the surgical team and the facilities [6,7].

Incidence of diathermy-induced injuries ranges from 1 to 5 cases per 1000 surgical procedures and may lead to the death of the patient in case of involvement of vital structures [8]. Diathermy instruments, both monopolar and bipolar, are widely used by surgeons. In the most commonly used monopolar diathermy the current enters the patient through an active electrode and exits through a neutral one, where the density of current is usually low because of its large surface. In bipolar mode, the neutral electrode is not necessary, because the current passes between the two electrode poles without any significant flow through the patient's body [9-12].

Electric burns during surgery may have several causes, such as when the active and neutral electrodes are on contact with the patient's skin, or the overheating of alcoholic solutions by electrode activity, or the possible onset of electric circuits out of the operative fields generated by the active electrode and an alternative ground source [6,13].

Heating blankets and warming mattresses may also be responsible for thermal injuries generally because of prolonged surgical procedures. Friction, rubbing and prolonged pressure are the main mechanical causes of skin lesion. They are often related to underlying diseases and usually associated with prolonged operating time [1,14].

At our hospital, during 2014 and the first semester of 2015, a

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significant amount of adverse cases in surgical patients was observed. These skin lesions were detected immediately after surgery or within 24 h to 48 h postoperative.

The purpose of this report is to increase awareness of accidental acute injuries occurring in pediatric patients after surgery, to discuss their possible causes and to provide recommendations for prevention.

Methods

This is a retrospective, observational study from June 01, 2015 to December 31, 2015. Post-surgical skin lesions were defined as "any skin lesion found in the patient after surgical procedure and not previously present". All skin lesions detected before surgery were excluded from the study.

All lesions detected during the perioperative period were referred anonymously to the Clinical Hospital Management Staff.

In order to classify and describe skin lesions, a monitoring form was developed, divided in three sections, "before surgery", "immediately after surgery", "follow-up after surgery".

In the first section operating room nurses recorded the following data: age, sex, weight, height, type of surgery and the skin lesions detected before surgery. The pre-existing skin lesions were excluded from the study.

In the second section, the results of whole-body skin inspection immediately after surgery were recorded. Furthermore, the following information were collected by operating room nurses: position of the patient on the operating table, use of mono- or bipolar diathermy, type of anesthesia, operating room, operative table, use of bedsore mattress, name of surgical team members, starting time and duration of surgical procedure.

The third section, aimed to identify the occurrence of possible skin lesions in the postoperative period by in-charge of ward nurses. At ward, the child's skin was inspected everyday by nurses until discharge.

Continuous variables were expressed as mean ± standard deviation (SD); categorical variables were expressed as number and percentage (%).

A Student t-test was performed for comparison of continuous data and crosstabs were used to compare categorical data. Associations of clinical variables with primary endpoint were assessed by univariate analysis.

Outcome independent predictors were detected by a stepwise backward multivariate analysis. Odds Ratio (OR) represents the endpoint risk associated with clinical variables. Any $p<0.05$ was considered significant. All statistical data were managed with SPSS 24 Software (SPSS Inc, Chicago IL).

Results

During observational period 3614 surgical procedures were performed, 2446 patients were male (68%) and 1168 were female (32%), with an average age of 8.35 years. The following surgical branches were involved: Urology, Otorhinolaryngology (ear, nose, and throat surgery, ENT), Pediatric Surgery, Neonatal Surgery, Orthopedic Surgery and Traumatology, Digestive Endoscopy, Dentistry, Ophthalmology, Maxillofacial Surgery, Hand Surgery, Orthopedic Oncology, Neurosurgery, Burns Surgery.

In order to identify the cause of accidental injuries, the operators were requested to fill in the monitoring form and 1439 (40%) were correctly returned.

Excluding 55 skin lesions detected at pre-operative evaluation (22 erythematous, 21 abrasions, 6 bruises and hematomas, 4 skin discoloration, 2 burns), 15 cases were observed from July 2015 to December 2015.

In the postoperative period 10 erythematous and 5 II-degree lesion were detected, with an incidence of 0.41%. Among all, 11 were male and 4 were female with an average age of 5.3 years (from 1 to 14 years).

The surgical specialties involved were Urology (4 orchidopexies, 4 operations on penis, 1 pyeloplasty), Pediatric Surgery (2 appendectomies, 1 cancer ablation), Neurosurgery (1 craniotomy, 1 cancer ablation), ENT (1 adenoidectomy).

The duration of surgical procedures ranged from 40 min to 5 h 35 min (average time 153 min). The skin lesions were mainly on lumbar and pelvic areas. Thirteen out of 15 patients were lain on their back during surgery, 1 on his right side and 1 was prone.

Monopolar electro-surgery device was used in each procedure, while in 2 cases, both monopolar and bipolar devices were used. No accidental burns were detected under the neutral electrodes. The bedsore mattresses were used in 6 cases out of 15. General anesthesia was performed in 14 patients and spinal anesthesia in 1. Povidone iodine was used in all patients.

The skin lesions in all operating rooms were observed and more events (9 out of 15) found in operating room number 1. Referring to timing of the onset of the skin lesion, 11 injuries were detected immediately after surgery and 4 were found at the ward. Skin lesions healed within 96 hours in 13 patients, where in 2 cases, II-degree lesions were present until discharge. No operator-related events was found. Details of all cases were shown in Table 1 (skin lesions observed after surgery).

Among the patients with skin lesions, no significant difference was found in the youngest ones with the lowest body weight (7.6 ± 5.5 years no skin lesions vs 5.3 ± 4.1 years skin lesions, $p=0.113$; 29.7 kg ± 20.5 kg no skin lesions vs 24.0 kg ± 16.2 kg skin lesions, $p=0.333$).

Skin lesions incidence was similar in both patients who received spinal anesthesia and who didn't (1.8% vs 4.0%, $p=0.59$).

Minor but not significant decrease of skin lesions onset found with regards to bedsore mattresses aspects (16.9% without mattresses vs 1.7% with mattresses, $p=0.088$).

Urology was associated with a significant incidence of skin injuries with 1.6% vs 0.3% in other surgical specialties ($p<0.01$).

At univariate analysis, patients with surgery on right side position ($p<0.01$) and urologic procedures ($p=0.03$) were significantly associated with skin lesions. At multivariate analysis both these variables showed an independent association with significate skin lesions (urology OR=3.1, $p=0.036$; right side position OR=16.6, $p=0.012$).

Discussion

The problem of skin lesions after surgery in children is underestimated and quite unknown. Very less literature is available on this topic and the data which is available, mainly refers to adult series only [8,14-18]. The lack of similar studies in pediatric cases did not allow us to compare our results with those reported in the literature.

Age (years)	Sex	Lesion degree	Surgical division	Start time	Duration	Electrosurgical device	Neutral electrode position	Site of the lesion	Time of onset of skin lesion
5	F	II	Otorhinolaryngology	11:15	40 min	Monopolar	Right thigh	Tongue	At the end of intervention
5	M	II	Urology	13:25	45 min	Monopolar	Right thigh	Sacrum	At the ward (4 h after the intervention)
8	M	II	Pediatric Surgery	18:45	50 min	Monopolar	Right thigh	Scrotum	At the end of intervention
1	F	II	Urology	9:10	2 h	Monopolar	Right thigh	Left thigh	At the end of intervention
2	M	II	Urology	10:20	1 h 50 min	Monopolar	Left thigh	Back	At the ward (48 h after the intervention)
4	M	I	Urology	15:00	1 h 20 min	Monopolar	Left thigh	Gluteus	At the end of intervention
3	M	I	Urology	12:55	1 h 15 min	Monopolar	Left thigh	Gluteus	At the end of intervention
4	M	I	Urology	15:16	1 h 14 min	Monopolar	Left thigh	Gluteus	At the end of intervention
12	M	I	Pediatric Surgery	10:55	2 h 35 min	Monopolar	Left thigh	Sacrum	At the end of intervention
14	F	I	Pediatric Surgery	10:50	2 h 50 min	Monopolar	Right thigh	Sacrum	At the end of intervention
5	F	I	Neurosurgery	10:10	5 h 35 min	Monopolar and bipolar	Right thigh	Gluteus	At the end of intervention
11	M	I	Neurosurgery	11:45	5 h 5 min	Monopolar and bipolar	Left thigh (post)	Face	At the end of intervention
2	M	I	Urology	13:25	1 h 20 min	Monopolar	Left thigh	Gluteus	At the end of intervention
2	M	I	Urology	13:10	2 h 15 min	Monopolar	Right thigh	Gluteus	At the ward (24 h after the intervention)
2	M	I	Urology	8:15	2 h	Monopolar	Left thigh	Gluteus	At the ward (24 h after the intervention)

Table 1: Skin lesions observed after surgery.

The incidence of skin lesions after surgery in our study is 0.41%. Although, this figure cannot be considered conclusive enough because only 40% of all monitoring forms were correctly returned to the Clinical Hospital Management Staff.

The low compliance and the absence of similar studies in pediatrics were major limitations in our study. The analysis of our results did not allow us to identify a clear etiology but only several hypotheses about the main cause related to the onset of skin lesion. Acute skin lesions (that arises as a result of surgical intervention) can be of physical or chemical origin. Physical causes include burns and lesions due to traction, friction or pressure, while the mechanisms underlying lesions produced by contact with a chemical product may be irritant or allergic.

The site of the skin lesions occurrence, description of their morphology and the relationship with the surgical wounds were previously evaluated [19]. For example, dropping marks observed on the groin after 24 h of orchidopexies because of inflammatory reactions on the scrotum. A rectangular morphology of skin lesion observed on the buttocks on more than one occasion which might be caused by the combination of one or more risk factors.

As most operations were performed on the patients in supine position, the lesions were found most commonly on the back, particularly in the sacral region. The differential diagnosis of post-operative inflammatory lesions in this area must include not only irritant dermatitis due to the antiseptic, but also an electrical cause. We suggest that the irrigation of the pelvic area before the surgical procedures and the possible stagnation of antiseptic in the body areas normally more subject to pressure in a supine position (i.e. gluteus) might attract currents generated by the passage of electricity through the patient's body while electrosurgical devices are being used. The current emitted by the electrosurgical device and returned to the neutral electrode might follow low-resistance alternative ways, thus triggering skin damage [6,13].

Urologic surgery seemed to be an independent factor related to the skin lesions onset, even if we think that these lesion on the sacral area might be triggered by the same pathogenic mechanism commented above.

The electrical skin injury may be caused also by the detachment of plate from the patient's body but no skin lesion on the place of the neutral electrode was found [1,19]. The skin lesion detected on the patient's tongue could be attributed to accidental direct contact of electrosurgical device with the mucosa during adenoidectomy.

In both univariate and multivariate analyses, a significant association between right position during surgery and the onset of skin lesion was found, even if this was not enough evidence to consider position on the operating table as an independent factor for skin lesions onset due to low figures in our series (1 patient out of 15).

No significant association was found between the starting time and the length of surgical procedure with the onset of skin lesions. Even if the anti-decubitus devices were used properly, the mechanical factor might have played an important role in our two cases of the neurosurgery, presenting surgical time upper 5 h. The erythema detected on the left cheek and on the back's area could be related to the development of shear forces on a contact area moist for perspiration. The traction lesions and moisture lesions are more common, while the postoperative skin lesions due to prolonged pressure are very rare in the pediatric setting because there are not frequent risk factors, like malnutrition, arterial insufficiency, venous disorders, etc. [20-22]. No difference in operating rooms was observed. No operator-related event was found.

In our study, 15 cases were observed from July 2015 to December 2015. The skin lesions were generally superficial and transient. Our cases were not enough to identify a clear etiology of skin lesions. Our hypothesis is that the main pathogenic mechanism is either chemical or physico-chemical. In some cases, the mechanism was an irritative contact dermatitis while in other cases the antiseptic liquid stagnation in under-pressure areas, in particular in urological surgery, led to electrical injuries. One case was probably caused by contact of electrosurgical device with patient's tongue.

Although mild skin complications after surgical interventions have not been extensively studied, they can be relatively common. We believe that the knowledge of possible causes of post-surgical skin lesions may significantly reduce the incidence. Clinical risk activity and the retraining courses on safety about surgical procedures can be a good opportunity to keep attention high on these avoidable adverse events [23-25].

We recommend observational studies such as our research, mainly in the pediatric setting, for a more accurate understanding of the problem and some strategies for adequate prevention.

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