

Late Onset Infections after Surgical Treatment of Spinal Deformities in Children

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Abstract

Study design: Retrospective review of monocentric database.

Objective: To determine the rate of late infection (LI) after surgical treatment for spinal deformities in children, to assess the risk factors and to follow them after treatment.

Summary of background data: Late infection is not very well documented. They are described as less frequent than early infection (EI) with a relatively good prognosis after implants removal. Review of a monocentric database with a long follow-up will address the questions.

Methods: We went through our database to look for any septic problem and compared the population with LI, without infection and with EI.

Every spine deformity in children or adolescent treated between 1983 and 2010 were included with at least two years of follow up.

Results: During the study period, 1091 surgeries were performed. Nine EI occurred (8-33 days postoperatively) and sixteen LI (8 months-22 years).

If we compare LI surgeries versus no infection the risk factors we found are posterior instrumentation (0.05) especially subcutaneous rod insertion (0.0003), the type of implants we used, with more infection with stainless steel than titanium (0.013) and diamond-shape rod than smooth rod (0.013).

If we compare LI surgeries versus EI surgeries, fever, discharge, raised CRP are not seen frequently.

Cultures were positive in fourteen of the sixteen cases, frequently with low virulence organisms than in EI (0.003).

Removal of the implants and antibiotics were used as treatment. Infection resolved in all the cases after initial surgery more frequently than in EI (0.0002).

In six cases we observed a loss of correction after implant removal.

Conclusion: LI are frequent. They may be due to low-virulence organisms. Smooth and titanium rods should be preferred. If removal of implants is the treatment of choice, reinstrumentation must be considered later. LI could be underestimated if the follow up is too short. Risk factor analysis could be done only if data are collected prospectively. This was done in our study.

Keywords: Scoliosis; Paediatric spinal surgery; Delayed infection; Postoperative complication

Introduction

Late deep infections after surgery of vertebral deformities in the pediatric population have been a subject of very few studies. Risk factors for this complication are not well known. When compared with early sepsis, late infections are considered rare, more difficult to establish diagnosis of the low virulence bacteria responsible for these infections. On the contrary, the prognosis is considered better, healing can be achieved after removal of the osteosynthesis material.

From our database a prospective study of the morbidity of surgical treatment for spinal deformities in children operated at, we compared our population operated in to late deep sepsis complications to those without any complications and to those with early infections.

Materials and Methods

All vertebral deformities, scoliosis or kyphosis in children or adolescents operated with spinal instrumentation in the Department of pediatric orthopedics at from 1983 till 2010 have been studied. Sometimes the surgeries were done in two stages, first anterior release without instrumentation and later posterior instrumentation. The second stage surgeries with complications (e.g. mechanical

complication, deterioration of the result, partial removal of implants or retightening a temporary instrumentation) were included. A minimum follow-up of 36 months was required.

Extensive data on the perioperative period was collected prospectively in a clinical database used since 1983 in the form of punched cards and then from 1993 on the Microsoft Access database. Data concerning the surgical site infection prevention were not included in our database but the infection prophylaxis approach in our department was almost the same from 1983 to 2010: iodine-based skin wash the day before the surgery, perioperative intravenous second-generation cephalosporine administered within 30 minutes

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prior to incision and no more than 48 hours, no wound irrigation and postoperative subcutaneous drainage.

The records of all patients reoperated for late deep sepsis were retrospectively reviewed in order to complete the missing data, in particular those of bacteriology or radiological imaging.

Those cases with deep infections after 3rd post-operative month were identified.

To determine whether there were significant differences between patients with late infection and those without any, we studied various factors like age, severity score ASA, etiology (idiopathic, cerebral palsy and other neuromuscular etiologies), the type of deformation (scoliosis, kyphosis and lordosis), the type of intervention (correction by posterior fusion with posterior instrumentation, anterior release and fusion, subcutaneous rod insertion, posterior fusion alone and revision surgery), the level of fusion, fusion up to sacrum or not, duration of surgery, intraoperative bleeding, whether or not any transfusion, any ICU stay, type of posterior material used in comparing titanium and steel, smooth rods or "diamond tip" rods, grafts (in-situ, bank, ceramic) graft, performing surgery by 1 or 2 teams.

The same factors collected prospectively were studied in an attempt to differentiate early and late infections. More specific search regarding clinical presentation, serology and radiological imaging, type of treatment and evolution in infectious control or monitoring of scoliosis, a retrospective study was conducted using medical records. The following elements were analyzed: clinical suspicion to diagnose infection (pain, fever, poor general condition, discharge, swelling), laboratory parameters (number of leukocytes, percentage of neutrophils, CRP, ESR), the contribution of medical imaging (conventional radiology, scintigraphy with technetium or gallium, ultrasound, CT, MRI), the type of bacteria isolated distinguishing them between those "classic" and those slow-growing, low virulence, type of treatment (surgical toilet drainage with or without irrigation, partial or total removal of material, the number of days of antibiotics, the development of infection after revision surgery or not, thereby the material has been retained or not, the evolution of spinal deviation in the frontal or sagittal plane.

Statistical testing was performed by a trained statistician. The Pearson's chi-squared test was used (Statistica 9.0), a very significant difference was noted for a value of $p < 0.01$.

Results

Between 1983 and 2010, a total of 1091 interventions had been performed and 9 cases with early sepsis occurred between the 8th and 33th postoperative day.

We have noted 16 cases with late sepsis occurring between 8 months to 22nd year post op with average onset at 4 years post op.

No infection occurred between 34th days and 8 months.

If we had stopped at 1 year follow up our postoperative sepsis rate would have been 0.8%, while actual late sepsis is 2.2%.

Comparison of late sepsis versus no infected cases (Tables 1 and 2).

We have found a significant statistic difference for surgeries with posterior instrumentation ($p=0.05$) compared to surgery without instrumentation especially when the instrumentation was used in a temporary way by insertion of subcutaneous growing rod ($p=0.00003$)

When instrumentation was used the risk is greater with steel implant than the titanium ($p=0.013$) and smooth rods than the diamond tip rods ($p=0.013$).

We have not found any significant statistic influence of the

Type of surgery	Number of cases	Sepsis tardif	p
Posterior fusion with posterior instrumentation	703	14	0.005
Subcutaneous rod insertion	13	2	0.00003
Anterior release and fusion	179	0	
Revision surgery	173	0	
Posterior fusion alone	23	0	

Table 1: Number of late sepsis in relation to the type of surgery.

	Number of cases		p
Steel implants	610	15	0.013
Titanium implants	219	1	
Smooth rods	466	8	0.013
"diamond tip" rods	279	8	

Table 2: Number of late sepsis in relation to the metal of the implants and the shape of the rods.

	Late sepsis	Early sepsis	p
	16	9	
Pain	14	4	0.006
Fever	7	9	0.004
Discharge	9	9	0.002
Average CRP	71	167	0.04
Average ESR	69	76	NS
Number and percentage of neutrophils	7207 (4732-19624) 69% (47-88%)	11840 (3861-26100) 72% (59-87%)	NS
Slow growing bacteria	6	0	0.003
Implants removal	15	2	0.0002
Favorable evolution after primary surgery	16	7	0.005

Table 3: Comparison of early versus late infections.

possible risk factor for infection as age, ASA score, etiology especially neuromuscular, type of deformity, and level of fusion especially long fusion to the pelvis, need of transfusion or bank grafting.

Comparison of early versus late infections (Table 3).

In late infections the most common symptom is pain. Compared to early infections pain is more frequent in late infections ($p=0.006$) whereas fever ($p=0.004$) and discharge ($p=0.002$) are found more commonly in early infections.

The average CRP was 71, with a range from 8 to 369, frankly abnormal (higher than 20 mg/l) in 11 of 16 cases. So it is less elevated than the early infection group ($p=0.04$).

The ESR frankly abnormal (higher than 30 mm/s) in 15 cases of late infections group, the number of neutrophils frankly abnormal (higher than 8000/mm³) in only 4 cases of late infection group were not very pertinent.

Gallium or Technetium scintigraphy were requested each time the diagnostic was uncertain. It was especially the case with patient having speech problem in neuromuscular scoliosis. Isotop was chosen mainly in function of its availability. Gallium scan was requested in 4 cases and was positive in all cases. Technetium scintigraphy was performed in only 9 cases, positive in 5 cases.

Among other tests requested an ultrasound was positive both times it was requested, MRI requested in 2 cases have not made any arguments with the diagnosis

The bacteriological diagnosis was made in 14 cases at the time of surgical intervention. The bacteria cultured were *staphylococcus aureus* (4 cases), *Staphylococcus epidermidis* in 3 cases, *Propionibacterium acnes* in 3 patients, *Escherichia coli* 2 times, once *Enterococcus* and *Staphylococcus capitis*. The slow-growing bacteria were most frequently involved in the late infection ($p=0.003$)

The treatment consisted of a thorough surgical lavage with removal of all implants and drainage (two irrigation-drainage) associated with antibiotic therapy started initially with broad spectrum and switched to specific antibiotic after the culture sensitivity for an average duration of 3 months (45 days to 6 months). The removal of material was always performed, significantly different from the approach in cases of early infection ($p=0.0002$).

The management plan for late sepsis was constantly favorable after surgical toilet and removal of implants and without reoperation which differs from the plan in the event of early infection ($p=0.05$).

The outcome of the curve in sagittal/angular plane was unfavourable in 6 cases. This was expected in two cases of correction without arthrodesis (one case of infantile scoliosis and one case of spinal muscular atrophy) when the subcutaneous rods were removed. These two cases will have to be re-instrumented, 21 and 23 months after the infectious episode, with no recurrence of infections noted.

In four others cases where spinal fusion was performed and where, despite a merger that seemed effective, an angular loss was noted (20° degrees in average), with a nonunion in one case proved by CT scan. At this time no further surgery was needed due to the absence of functional consequences

Discussion

In the few publications on late infections after surgery with instrumentation in the vertebral deformities of the child, the reported incidence varies from 0.2 to 5% [1].

They are not considered to be more frequent than early sepsis, for example in the series of the GES they occurred in 2.15% of cases against 2.6% for early sepsis [2]. On the other hand in our series, late infections occurred twice as frequently than early. It is possible that the length of follow-up, significant in our series had an influence.

Among the factors favoring the occurrence of these late infections we found a significant influence of the metal and the structure of rods used. Some publications have already cited the increased resistance of titanium to infection [3,4]. The role of corrosion, which is sometimes evident [5,6] may also be involved in the greater occurrence of late infection when used the so-called "diamond tipped" rods.

The diagnosis of late infections is more difficult than for early infections since it is caused by low virulence organisms [7,8]. Pain is the symptom most frequently encountered but there is nothing specific, biological anomalies are less pronounced in the case of early infection. Bone scan, especially gallium scintigraphy could give precious information in difficult cases. The surgical materials for culture should be kept for long as it is frequently slow-growing bacteria. In our series, 14 of the 16 late infections have been proven by positive culture.

The outcome of these late infections after removal of implant is usually good [4,9,10]. This was confirmed in our series with no recurrence of infection after the intervention of debridement. But the trend was less favorable as regards the maintenance of the correction of the curve. Despite good fusion that seemed satisfactory at the time of removal of material, degradation of the final outcome occurred in 6 of

16 cases, justifying some secondary instrumentation perhaps during the surgery at same time [11].

Conclusion

Late infections after surgical treatment of spinal deviations in children appear more frequent than early infections. They are individualized by the circumstances of particular findings when pain is dominant, a positive diagnosis not always easy, frequent evidence of low virulent organisms, a favorable outcome of infection control once the osteosynthesis material is removed. But the outcome of the curve progression is not as favorable after removal of the implant. Finally, we could demonstrate a relationship between late-onset infections and type of osteosynthesis material used. Only a prolonged patient monitoring and use of a prospective database on morbidity has allowed us to obtain statistically relevant results.

Conflict of Interest

No funds were received in support of this work

None of the author(s) has/have received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this manuscript

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