

# Postoperative Outcome in Children aged between 6 and 10 years in Major Abdominal Surgery, Neurosurgery and Orthopedic Surgery

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## Research Article

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# Abstract

## Background

Anticipating postoperative evolution in surgical patients is an important issue in our daily practice.

We have demonstrated in a previous study that predictors of postoperative outcome are multiple including American Society of Anesthesiologists status (ASA), transfusion, emergency, surgery and age. A detailed description of postoperative outcome was undertaken in children aged between 6 and 10 years included in the initial study.

## Objective

To describe postoperative outcome in children aged between 6 and 10 years included in the initial cohort in abdominal surgery, neurosurgery and orthopedics.

## Methods

Secondary analysis of postoperative outcome in children aged between 6 and 10 years included retrospectively in the initial study of 594 patients. The study was approved by the Ethics Committee.

## Results

There were 88 patients with a mean age of  $98.7 \pm 13.8$  months.

The most common surgical interventions were scoliosis in 23 patients (26.1%), femoral osteotomy 7 patients (7.9%), limb tumor resection 7 patients (7.9%), intracerebral tumor resection 6 patients (6.8%), intestinal resection 5 patients (5.6%), Chiari's malformation 4 patients (4.5%), pelvic osteotomy 4 patients (4.5%) and renal transplantation 4 patients (4.5%).

Most patients (45%) were American Society of Anesthesiologists grade 3 (ASA 3) and 13 (14.8%) were ASA grade 4.

22(25%) patients had intra-operative and or postoperative complications (organ dysfunction or sepsis). 2 patients (2.3%) had intra-operative hemorrhagic, 1 patient (1.1%) had an intra-operative difficult intubation and 1 patient experienced intra-operative anaphylaxis. 9 patients (10.2%) had postoperative neurologic failure and 2 (2.3%) postoperative cardio-circulatory failure. 3 patients (3.4%) had postoperative septicemia, 2 patients (2.3%) had postoperative pulmonary and urinary sepsis and 1 patient (1.1%) had postoperative abdominal sepsis. 3 patients (3.4%) had re-operations. 42(47.7%) patients had intra-operative transfusion.

There was 1 in-hospital death (1.1%). Median total length of hospital stay was 9 days [5-16].

## Conclusion

25% of the patients had intra-operative and or postoperative complications and most of them were ASA grade <sup>3</sup>3. Integrating goal directed therapies to optimize intra-operative management in these patients is a necessary implementation to improve postoperative outcome in surgical pediatric patients.

# Introduction

Postoperative outcome in surgical patients is an important issue in our daily practice.

Predictors of postoperative outcome are multifactorial among which American Society of Anesthesiologists status (ASA), transfusion, emergency, surgery and age were identified in previous studies (1, 2, 3, 4). Predictors of postoperative outcome in this study were not exhaustive which means that other non-identified factors may contribute in how patients evolve after surgery.

For a better postoperative outcome, anticipating patient's management optimization begins preoperatively, continues intra-operatively and postoperatively. Intra-operative patient optimization includes fluid and hemodynamic goal directed therapy with tools validated in children, blood patient transfusion protocols guided with point of care tests in hemorrhagic surgery and enhanced recovery after surgery protocols (5, 6, 7, 8, 9, 10, 11, 12, 13). These goal directed therapies have been shown in adults to improve postoperative outcome. In children, goal directed therapies are not well developed and are not in routine generalized practice.

The study presented here had the objective to describe postoperative outcome in children aged between 6 and 10 years who were included in the initial retrospective study (1). The aim was to emphasize how these patients in major surgery evolved and to propose improvement

implementation protocols.

## **Methods And Materials**

Secondary analysis of children between 6 and 10 years old included in the initial study (1).

The study was declared to the CNIL, National Commission for Computer Science and Liberties on 21 February 2017 under the registration number 2028257 v0. The Ethics Committee of Necker approved the study on 21 March 2017 under the registration number 2017-CK-5-R1. Patients were included retrospectively from 1 January 2014 to 17 May 2017.

Inclusion criteria were children aged between 6 and 10 years old.

Exclusion criteria were children aged less than 6 years old and older than 10 years.

Statistics were analyzed with XLSTAT 2020.4.1 software.

Continuous variables were described in means  $\pm$  standard deviation or medians with interquartile ranges. Categorical variables were described in proportions.

## **Results**

Table 1 illustrates the general characteristics.

Table 1  
General characteristics

Characteristics	N = 88
Mean age in months±standard deviation	98.7±13.8
Abdominal surgery n (%)	17(19.3)
Neurosurgery n (%)	26(29.5)
Orthopedic surgery n (%)	45(51.1)
Elective surgery n (%)	77(87.5)
Emergency surgery n (%)	11(12.5)
Re-surgery n (%)	3(3.4)
Patients with intra-operative and or postoperative complications (organ failure and or sepsis) n (%)	22(25)
Intra-operative hemorrhagic shock n (%)	2(2.3)
Intra-operative difficult intubation n (%)	1(1.1)
Intra-operative anaphylaxis n (%)	1(1.1)
Postoperative neurologic failure n (%)	9(10.2)
Postoperative cardio-circulatory failure n (%)	2(2.3)
Postoperative endocrinal failure n (%)	1(1.1)
Postoperative miscellaneous n (%)	1(1.1)
Postoperative multi-organ failure n (%)	1(1.1)
Postoperative septicemia n (%)	3(3.4)
Postoperative pulmonary sepsis n (%)	2(2.3)
Postoperative urinary sepsis n (%)	2(2.3)
Postoperative abdominal sepsis n (%)	1(1.1)
In hospital Mortality n (%)	1(1.1)
Transfusion n (%)	42(47.7)
Mean preoperative hemoglobin levels± standard deviation g/dL	11.6±1.9
Mean postoperative hemoglobin levels ± standard deviation g/dL	10.9±1.5
ASA I n (%)	3(3.4)
ASA II n (%)	31(35.2)
ASA III n (%)	40(45.5)
ASA IV n (%)	13(14.8)
ASA V n (%)	1(1.1)
Median length of intensive care unit stay in days [interquartile range]	4[1 - 6]
Median length of hospital stay in days [interquartile range]	6[3.7-10.2]
Median total length of hospital stay in days [interquartile range]	9[5 - 16]
Median length of mechanical ventilation (invasive or non-invasive) in days [interquartile range]	0[0-1]

There were 88 patients with a mean age of 98.7±13.8 months.

There were 17 patients (19.3%) in abdominal surgery, 26 (29.5%) in neurosurgery and 45 (51.1%) in orthopedic surgery. 11 patients (12.5%) had an emergency intervention.

Table 2 illustrates types of surgery.

Table 2  
Surgery

Surgery	Number of patients (%)
Basal skull schwannoma	3(3.4)
Brainstem lesion resection	1(1.1)
Cerebral aneurysm/Cerebral arterio-venous malformation angioembolization	1(1.1)
Cerebral cavernoma	1(1.1)
Chiari's malformation	4(4.5)
Craniosynostosis	3(3.4)
Epileptogenic lesion resection	1(1.1)
Femoral osteotomy	6(6.8)
Femoral prosthesis	1(1.1)
Hepatic tumor	1(1.1)
Interscapular thoracic desarticulation	2(2.2)
Intestinal resection	5(5.6)
Intracerebral tumor resection	6(6.8)
Knee prosthesis	1(1.1)
Laparotomy for volvulus	1(1.1)
Limb tumor resection	8(9.1)
Liver transplantation	3(3.4)
Neuroblastoma	1(1.1)
Orbital tumor	1(1.1)
Pelvic osteotomy	4(4.5)
Pelvic tumor	1(1.1)
Posterior fossa decompression	1(1.1)
Renal transplantation	4(4.5)
Scoliosis	23(26.1)
Splenectomy	1(1.1)
Ventriculostomy	1(1.1)
Vertebral laminectomy/Arthrodesis	3(3.4)

The most common surgical interventions were scoliosis in 23 patients (26.1%), femoral osteotomy in 6 patients (6.8%), limb tumor resection in 8 patients (9.1%), intracerebral tumor resection in 6 patients (6.8%), intestinal resection in 5 patients (5.6%), Chiari's malformation in 4 patients (4.5%), pelvic osteotomy in 4 patients (4.5%) and renal transplantation in 4 patients (4.5%).

Most patients (45%) were American Society of Anesthesiologists grade 3 (ASA 3) and 13 (14.8%) patients were ASA grade 4.

22(25%) patients had intra-operative and or postoperative complications (organ dysfunction or sepsis).

The most common intra-operative complication was hemorrhagic shock in 2 patients (2.3%) followed by difficult intubation and anaphylaxis in 1 patient (1.1%) respectively. The most common postoperative organ failure was neurologic in 9 patients (10.2%), followed by cardio-circulatory in 2 patients (2.3%). The most common postoperative infection was septicemia in 3 patients (3.4%) followed by pulmonary and urinary sepsis in 2 patients (2.3%) respectively and abdominal sepsis in 1 patient (1.1%). 3 patients (3.4%) had re-operations. 42(47.7%) patients had intra-operative transfusion. There was 1 in hospital death (1.1%) (Table 3).

Table 3  
patient with fatal outcome

Surgery	Age months	ASA score	Co-morbidities	Intra-operative complications	Postoperative outcome	Delay of in-hospital mortality in days	Emergency	Transfusion
Posterior fossa decompression	85	5	Sickle cell disease	0	Multiple organ failure and pulmonary sepsis	7	Yes	Yes

Median total length of hospital stay was 9 days [5–16].

Table 4 illustrates outcomes per surgery.

Table 4 outcomes per surgery

	Number of patients	Intra-operative anaphylaxis	Intra-operative difficult intubation	Intraoperative hemorrhagic shock	Postoperative cardio-circulatory failure	Postoperative endocrinal failure	Postoperative miscellaneous	Postoperative multiple organ failure	Postoperative neurologic failure	Postoperative abdominal sepsis	Postoperative pulmonary sepsis	Postoperative septicemia	Postoperative urinary sepsis	Re-operation	In-hospital mortality	Transfusion
meningioma resection	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
neurovascular decompression	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1
glioma resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
craniotomy	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
meningitis	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
epilepsy resection	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
craniotomy	6	0	0	1	0	0	0	0	1	0	0	0	0	0	0	3
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
brain tumor resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
epilepsy resection	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
epilepsy resection	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
epilepsy resection	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
epilepsy resection	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
epilepsy resection	3	0	0	0	1	0	1	0	0	1	0	0	0	1	0	3
epilepsy resection	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
epilepsy resection	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
epilepsy resection	1	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1
epilepsy resection	4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
epilepsy resection	23	0	0	1	1	0	0	0	3	0	0	2	0	1	0	9
epilepsy resection	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
epilepsy resection	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
epilepsy resection	3	0	0	0	0	0	0	0	1	0	0	1	0	1	0	2

Table 5 illustrates co-morbidities. The most common co-morbidities were intracerebral tumor in 7 patients (7.9%), Ewing's sarcoma in 5 patients (5.7%), psychomotor deficiency in 5 patients (5.7%), arthritis in 4 patients (4.5%), cerebral anoxic lesions in 4 patients (4.5%), chronic renal failure in 4 patients (4.5%), hepatic failure in 4 patients (4.5%) and poly-malformation syndrome in 4 patients (4.5%).

Table 5  
Co-morbidities

Co-morbidity	Number of cases (%)
Arachnoid cyst	1(1.1)
Arthritis	4(4.5)
Bronchodysplasia Sequelae	1(1.1)
Cancer	2(2.2)
Cerebral aneurysm/Cerebral arterio-venous malformation, Pulmonary hypertension	2(2.2)
Cerebral anoxic lesions	4(4.5)
Chiari's malformation	2(2.2)
Chronic renal failure	4(4.5)
Convulsive encephalopathy	1(1.1)
Crohn's disease	1(1.1)
Epilepsy	2(2.2)
Ewing's sarcoma	5(5.7)
Extradural hematoma	1(1.1)
Gorlin's syndrome	1(1.1)
Hepatic failure	4(4.5)
Intestinal pseudo-occlusion	1(1.1)
Intracerebral tumor	7(7.9)
Klippel-Feil Syndrome	1(1.1)
Larsen syndrome	1(1.1)
Morquio syndrome	1(1.1)
Myelomeningocele	2(2.2)
Necrotizing enterocolitis Sequelae	1(1.1)
Neurofibromatosis	3(3.4)
Pierre Robin syndrome	1(1.1)
Polymalformation syndrome	4(4.5)
Polytrauma	2(2.2)
Psychomotor deficiency	5(5.7)
Rachitism	1(1.1)
Sarcoidosis	1(1.1)
Sickle cell disease	1(1.1)
Crouzon syndrome	1(1.1)

## Discussion And Conclusion

The rate of patients with intra-operative and or postoperative complications in this cohort of 88 children between 6 and 10 years in major abdominal surgery, neurosurgery and orthopedics was 25%. These patients were in majority ASA grade 3 or more. As revealed in the initial studies (1, 2, 3, 4) postoperative outcome depends on multiple factors precisely ASA status, transfusion, age, emergency and surgery. Integrating goal directed therapies for intra-operative management in these patients is a necessary implementation to improve postoperative outcome in pediatric surgical patients. Goal directed therapies include intra-operative fluid and hemodynamic goal directed therapy with

validated tools in children, intra-operative transfusion goal directed protocols with point of care devices to guide blood product administration and enhanced recovery after surgery (5, 6, 7, 8, 9, 10, 11, 12, 13). All these therapies have the same aim which is to optimize intra-operative patient status which contributes to a favorable postoperative evolution. In our Hospital, goal directed therapies are not yet a routine generalized practice. It is time to reconsider integrating goal directed therapies in intra-operative patient management in high risk patients and surgery to improve postoperative outcome.

## Declarations

### Conflicts of Interest

The author declared no conflicts of interest

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