

Pre-term Infants in Major Abdominal Surgery and Postoperative Outcome

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Research Article

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Abstract

Background: A monocentric observational study was undertaken in pediatric surgical patients in neurosurgery, abdominal and orthopedic surgery to determine predictors of postoperative outcome. In this cohort of 594 patients with a mean age of 90.86 ± 71.80 months there were 25 pre-terms aged less than 37 weeks. A description of postoperative outcome was undertaken in these pre-term infants.

Objective: The objective of this study was to describe the characteristics in pre-term patients in this initial cohort.

Methods: Secondary analysis of pre-term patients included in the initial retrospective observational study. The Ethics Committee approved the study.

Results: 25 pre-terms aged <37 weeks were included with a mean weight of 2.43 ± 0.75 kg in major neonatal abdominal surgery. 9 patient presented postoperative complications among which 1 had an intra-operative cardiac arrest, 4 had postoperative respiratory failure, 2 had pulmonary sepsis, 1 had surgical wound sepsis, 1 had septicemia and 1 had multi-organ sepsis.

Conclusion: In this cohort of 25 critically ill pre-terms in major neonatal abdominal surgery, the most common postoperative complications concerned the respiratory system which included respiratory failure and pulmonary sepsis. There was no in-hospital mortality.

Introduction

In 2017, a monocentric observational retrospective study was undertaken in pediatric surgical patients in neurosurgery, abdominal and orthopedic surgery to determine predictors of postoperative outcome (1). In this cohort of 594 patients with a mean age of 90.86 ± 71.80 months, there were 25 pre-term infants aged less than 37 weeks. These were all admitted in the neonatal intensive care unit (NICU) and were scheduled for emergency and elective surgery. These pre-term patients were described in detail in this manuscript. The objective of this study was to describe the characteristics and postoperative outcome in these pre-term infants in this cohort.

Methods

Secondary analysis and description of pre-term patients included in the initial retrospective observational study from 1 January 2014 to 17 May 2017 (1). This study was declared to the CNIL, National Commission for Computer Science and Liberties on 21 February 2017 under the registration number 2028257 v0 and received approval from the Ethics Committee of Necker on 21 March 2017 under the registration number 2017-CK-5-R1 (1).

Inclusion criteria were patients aged less than 37 weeks included in the initial study.

Exclusion criteria were patients aged more than 37 weeks included in the initial study.

Statistics were analyzed with XLSTAT 2020.4.1 software.

Continuous variables were described in means with standard deviation or in medians with interquartile range. Categorical variables were described in proportions. Categorical variables were compared with Fischer's exact test.

Results:

General characteristics are illustrated in Table 1.

Table 1
General Characteristics of preterm infants admitted in NICU after abdominal surgery

Characteristics	N = 25
Age	< 37 weeks
Mean Weight ± standard deviation in kilograms	2.43±0.75
ASA III n (%)	20 (80)
ASA IV n (%)	5 (20)
Median LOSICU [interquartile range] in days	33[20-45]
Median LOS [interquartile range] in days	6[0 - 26]
Median TLOS [interquartile range] in days	45[32-54]
Median LMV [interquartile range] in days	4[3 - 8]
Median preoperative hemoglobin levels [interquartile range] in g/dL	16.5 [15-17.5]
Median postoperative hemoglobin levels [interquartile range] in g/dL	15.25[14.2– 18.2]
Postoperative mechanical ventilation n (%)	22 (88)
Emergency surgery n (%)	19 (76)
Elective surgery n (%)	6 (24)
Transfusion n (%)	0 (0)
Patients with postoperative complications n (%)	9 (36)
In-Hospital mortality n (%)	0 (0)
Re-surgery n (%)	4 (16)
Intra-operative cardiac arrest n (%)	1 (4)
Postoperative respiratory failure n (%)	4 (16)
Postoperative pulmonary sepsis n (%)	2 (8)
Postoperative surgical wound sepsis n (%)	1 (4)
Postoperative septicemia n (%)	1 (4)
Postoperative multi-organ sepsis n (%)	1 (4)
Intestinal Exeresis for enterocolitis n (%)	1 (4)
Exploratory laparotomy for volvulus n (%)	1 (4)
Exploratory Laparotomy n (%)	3 (12)
Gastroschisis n (%)	8 (32)
Omphalocele n (%)	4 (16)
Esophageal Atresia n (%)	8 (32)
N = total number of patients	
n = number of patients with the variable	

25 pre-terms aged < 37 weeks were included.

Mean weight was 2.43±0.75 kg. There were 20 ASA III and 5 ASA IV patients.

Surgery concerned 1 intestinal resection for enterocolitis, 1 exploratory laparotomy for volvulus, 3 exploratory laparotomies, 8 gastroschisis, 4 omphaloceles and 8 esophageal atresias.

19 patients underwent emergency surgery and 6 underwent elective surgery.

1 patient had a congenital heart disease and 1 had a right atrium thrombus.

4 patients had re-operations.

9 patients presented postoperative complications among which 1 had an intra-operative cardiac

arrest with favorable outcome, 4 had postoperative respiratory failure, 2 had pulmonary sepsis, 1

had surgical wound sepsis, 1 had septicemia, 1 had multi-organ sepsis.

There was no in-hospital mortality.

All were admitted in the NICU, 22 patients were under mechanical ventilation postoperatively and 3

did not require postoperative mechanical ventilation.

Median neonatal intensive care unit stay (LOSICU) was 33 days [20–45], median hospital length stay

(LOS) was 6 days [0–26], median total hospital length stay, TLOS (LOSICU + LOS) was 45 days[32-54]

and median length of mechanical ventilation (LMV) was 4 days [3–8].

None received transfusion.

Median preoperative and postoperative hemoglobin levels were 16.5 g/dL[15-17.5] and

15.25g/dL[14.2-18.2] respectively.

Table 2 illustrates complications in each surgical intervention and there was no difference among

Table 2
Outcomes per type of surgery

Surgery	Intra-operative cardiac arrest	Postoperative Respiratory failure	Postoperative Pulmonary sepsis	Postoperative Surgical wound sepsis	Postoperative Septicemia	Postoperative Multi-organ sepsis	Re-Surgery	Total complications (intra-operative, postoperative and re-surgery) per type of surgery
Intestinal exeresis for enterocolitis	1	0	0	0	0	0	0	0
Exploratory laparotomy for volvulus	1	0	0	0	0	0	0	0
Exploratory laparotomy	3	0	0	1	0	0	0	1
Gastroschisis	8	0	0	0	1	0	1	3
Omphalocele	4	0	1	1	0	1	0	1
Esophageal atresia	8	1	3	0	0	0	0	4
Total	25	1	4	2	1	1	1	4
p > 0.05, Fischer's exact test								

different types of surgery.

Discussion

The rate of patients with postoperative complications in this cohort is comparable to what has been

reported in neonatal infants in abdominal major surgery (2,3,4,5). There was no significant

difference in complication rates among different types of surgery. One patient presented intra-

operative cardiac arrest with favorable outcome which represented 4% of the complications. The

incidence of intra-operative cardiac arrest was 0.12% according to a recent study in a cohort of 5609

infants aged up to 60 weeks among which 35.7% were pre-terms (6). According to this same study,

the rate of patients with intra-operative critical events was 35.5% among which the majority were

commonly due to cardiovascular instability followed by hypoxemia; 16.3% of the patients had one or several postoperative critical events (6). In our study, intra-operative critical events concerned one patient who presented intra-operative cardiac arrest representing 4% of the patients. The rate of patients with postoperative complications until discharge from hospital was 36% in our cohort. Our study of 25 pre-terms in major abdominal surgery revealed that the most common postoperative complications concerned the respiratory system which included respiratory failure and pulmonary sepsis with an overall rate of 24%. According to previous studies in 198 infants with esophageal atresia and 44 pre-terms with gastroschisis, the rate of postoperative respiratory dysfunction varied between 11% and 52.8% (2,3). The second common postoperative complication in our cohort was re-operation (16%) followed by surgical wound sepsis (4%), septicemia (4%) and multi-organ sepsis (4%). Re-surgery rates varied from 5 to 11.7 % according to one study in 3479 infants with esophageal atresia (4). Sepsis after major surgery such as esophageal atresia has been reported to vary between 3.1–19.4% (2). In this cohort, the overall sepsis rate was 20% with pulmonary sepsis being the most common with a rate of 8%. The incidence of early onset sepsis (appearing after less than 3 days of life) in pre-terms varied from 0.5 to 2.5% according to one study (7) and the rate of late onset sepsis (appearing after 3 days of life) in pre-terms varied from 11–32% (8,9). Neonatal sepsis is a major etiology of morbi-mortality in pre-terms (7,8). Mortality rates due to sepsis in pre-terms can reach 20–30% (10). In our cohort, there was no mortality. Mortality rates reported in the literature in pre-terms scheduled for major neonatal abdominal surgery such as necrotizing enterocolitis, esophageal atresia, gastroschisis and omphalocele varied between 3.4 and 34 % (2,3,5,11,12,13,14). According to a study in 75 neonates with abdominal wall defects, mortality was higher in patients with associated congenital heart diseases and chromosomic disorders (14). In another study of 1554 premature infants in emergency abdominal operations, female gender, inotropic support, mechanical ventilation and ASA score III were predictors of 30 days mortality (15). In a study of 566 neonates with gastroschisis, the presence of a complex laparoschisis, pre-term age of < 37 weeks, very low birth weight of < 1500 grams were factors predicting morbi-mortality (16). According to the multicentric Nectarine study, overall mortality rate was 3.2%, with a 30-day mortality rate in neonates of 4.1% with sepsis and multi-organ failure being major causes of mortality in this subgroup (6). The Nectarine study which included patients aged up to 60 weeks admitted for different surgical interventions revealed that age, critical events including hypotension, hypoxemia and anemia were predictive of adverse outcome illustrated by morbi-mortality (6). In our pre-term cohort, none of the patients were anemic and none received transfusion. Our initial monocentric retrospective study of 594 patients admitted for neurosurgery, abdominal and orthopedic surgery with a mean age of 90.86±71.80 months from which this pre-term cohort sample was extracted evidenced that the general patient's status, precisely the ASA (American Society of Anesthesiologists) scores III, IV and V were predictive of mortality (1). All pre-term infants in this

cohort were ASA III or IV. This retrospective study revealed also that ASA score III or more, transfusion, emergency situations, age and the type of surgery were predictive of postoperative organ dysfunction (1). In this study (1), ASA score, transfusion, emergency, type of surgery and pre-term age were predictive of LOSICU and LMV. Median LOS, LOSICU and LMV in our study were comparable to what has been reported (16).

Median total hospital length of stay, TLOS (LOSIKU + LOS) was 45 days[32-54] and was comparable to what has been reported in the literature (13). In a study of 442 neonates with gastroschisis of more than 34 weeks of age (17), median LOS was higher in patients with staged closure than in primary closure, implying that LOS is a variable which depends on other factors. In our retrospective study, LOS was predicted by ASA score, transfusion, emergency and the type of surgery (1).

The results of our initial pediatric retrospective study (1), the results of the Nectarine study (6) and the results of previous studies in similar neonatal population (14,15,16,17) confirm that outcome in the surgical pediatric population is multifactorial. Identifying these multiple predictors of adverse evolution and applying preventive and improvement measures on each of them can optimize postoperative outcome in children. A meta-analysis in 3290 children aged less than 18 years old evidenced that mortality, organ dysfunction and LOS were lower in children who had optimal intra-operative or postoperative values of regional oxygen saturation, mixed central venous oxygen saturation and lactate levels (18). Regional oxygen saturation, mixed central venous oxygen saturation and lactate levels reflect tissular perfusion and alterations of these parameters can indicate tissular perfusion impairment which can cause organ dysfunction.

The results of this study confirm that the rate of postoperative complications in critically ill pre-term infants in major abdominal surgery remains high as reported by previous studies. This emphasizes optimizing intra-operative fluid and hemodynamic status to improve postoperative evolution in high-risk patients. However other factors which predict postoperative adverse outcome should be taken into account to improve outcome and intra-operative optimization is one among these predictors.

The limit of our study was the sample size.

The strength of our study was the homogeneity of the sample which included critically ill pre-term infants in major abdominal surgery thus a high-risk population.

Conclusion

In this study of 25 critically ill pre-term infants admitted in NICU after abdominal major surgery, the most common postoperative complications concerned the respiratory system which included respiratory failure and pulmonary sepsis; followed by re-surgery, wound sepsis, septicemia and multi-organ sepsis. There was no in-hospital mortality. Maintaining adequate tissular perfusion is necessary for optimal outcome in surgical pediatric patients. This aim can be achieved by intra-operative fluid and hemodynamic optimization by using means to monitor adequate tissular perfusion. These means should be adapted according to the context which includes patient status, age and surgery.

Declarations

Ethics approval and informed consent: This study received approval from the Ethics Committee of Necker on 21 March 2017 under the registration number 2017-CK-5-R1. The Ethics Committee of Necker waived the need for patient consent since this was a retrospective study.

Competing of interests: The author declared no conflict of interest

Author's contribution: Dr Claudine Kumba conceptualized and designed the study, drafted the initial and final manuscript. She designed the data collection instruments, collected data, carried out initial and final analyses

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Presentation of preliminary data: The abstract of this study has been accepted for presentation to the European Congress of Pediatric and Neonatal Intensive Care 15-18 June 2021.

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