



Analgesia in the management of paediatric and adolescent trauma during the resuscitative phase: The role of the pediatric trauma centre



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ABSTRACT

Background: The objective of this study was to evaluate the use of analgesia in the resuscitative phase of severely injured children and adolescents.

Methods: A retrospective cohort of paediatric (age < 18 years), severely injured (ISS ≥ 12) patients were identified from the London Health Sciences Centre's Trauma Registry from 2007 to 2010. Variables were compared between Analgesia and Non-analgesia groups with Pearson Chi-square and Mann-Whitney *U* tests. Resuscitative analgesia use was assessed through multivariable logistic regression controlling for age, gender, mechanism, arrival and Trauma Team Activation (TTA).

Results: Analgesia was used in 32% of cases. Univariate analysis did not reveal any differences in gender, age, injury type, injury profile and arrival patterns. Significant differences were found with analgesia used more frequently in patients injured in a motor vehicle collision (58% vs. 42%, $p = 0.026$) and having parents in the resuscitation room (17% vs. 6%, $p = 0.01$). Analgesia patients were more injured (median ISS 22 vs. 17, $p = 0.027$) and had 2.25 times more TTA (39% vs. 17%). Logistic regression revealed patients arriving directly to a trauma centre had a higher incidence of receiving analgesia (OR 2.01, 95% CI: 1.03–3.93), as did TTA (OR 2.18, 95% CI: 1.01–4.73) and having parents in resuscitation room (3.56, 95% CI: 1.23–10.33). Narcotics were most commonly used (85%), followed by benzodiazepines (16%), with 66% given during the primary survey.

Conclusion: Use of analgesia is important in the acute management of paediatric trauma. Direct presentation to a level I trauma centre, TTA and the presence of parents lead to higher appropriate use of analgesia in paediatric trauma resuscitation.

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Introduction

Trauma is the leading cause of morbidity and mortality among children under the age of fifteen years in North America [1,2], with significant social and economic implications [3,4]. Despite significant evidence about the benefits of early and adequate control of injury-related pain [5–8], the underuse of analgesics and sedatives in paediatric trauma patients remains pervasive [7,9–12]: children are given analgesics less often than adults for similar conditions, and they are often prescribed a fraction of the weight-based equivalent of analgesics [9]. Reasons for the low usage of pain control in paediatric trauma include poor judgement of pain

severity in children by both clinicians and parents [13], parental concerns about the risks and benefits of pain medications [14], and a potential lack of comfort among physicians treating paediatric patients [8]. The objective of our study was to investigate the use of analgesia during the early resuscitative phase in severely injured paediatric trauma patients managed at our pediatric trauma centre.

Methods

After obtaining institutional review board approval, we conducted a retrospective analysis from our trauma registry of all paediatric (age < 18 years old) trauma admissions to the Children's Hospital, London Health Sciences Centre (LHSC), between January 2007 and December 2010. The Children's Hospital (LHSC) is a Trauma Association of Canada (TAC)-certified level I pediatric trauma centre (PTC) in Southwestern Ontario. All trauma deaths in the paediatric emergency room (ER) were

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included in the database for this study. Deaths on arrival (DOAs; 3 patients) were excluded. An Injury Severity Score (ISS) was assigned to each patient retrospectively after identification of all injuries [15,16], and all patients whose ISS was greater than or equal to 12 were included. An ISS \geq 12 is also the inclusion criteria for the Comprehensive Data Set of the Ontario Trauma Registry for severe or major injury treated at trauma centres in the province of Ontario. We excluded two patients, who were admitted directly to the Pediatric Critical Care Unit (PCCU) without resuscitation in the ER, and five patients whose resuscitation forms were incomplete either at our institution or the peripheral hospital from which they were transferred. The registry was reviewed with respect to patient age, gender, mechanism, intensive care unit (ICU) admission, need for operative intervention, ISS, maximum abbreviated injury scale (MAIS) by body region, analgesia use, and mortality. A retrospective chart review was also performed on all included patients to determine the type and amount of analgesia administered during the primary and secondary survey of the initial resuscitation based on ER records and Trauma Team notes. Given the large size discrepancy among the paediatric and adolescent population, the adequacy of analgesia dosage was calculated based on whether the patient received the appropriate weight-based dose of medication. Although developmental stage can also affect the adequacy of analgesia use [11], we were unable to accurately obtain this information for all patients; consequently, we could not evaluate its significance in the context of this study.

Continuous data were expressed as median (interquartile range; IQR; 25–75 percentile), and categorical variables were reported as frequencies and percentages. Continuously-distributed variables were compared using the Mann–Whitney *U* test, as the data were non-normally distributed, while categorical variables were compared using the Pearson chi-square test, or Fisher's exact test (when small cell sizes were present). In univariate analysis, we evaluated the association of the use or non-use of analgesia or sedation with other independent variables: age, gender, mechanism of trauma, method of arrival (either directly to the PTC or transfer from a referral hospital), and Trauma Team Activation (TTA).

Multivariable analysis was performed using a logistic regression model to estimate the odds ratio (OR) and the 95% CI of administering analgesia to severely injured paediatric patients during the early resuscitative phase. Calibration of the logistic

model was assessed using the Hosmer–Lemeshow goodness-of-fit test [17] to evaluate the importance of the discrepancy between the observed and expected usage of analgesia. All statistical analyses were performed using Predictive Analytics SoftWare (PASW) Statistics 18 (SPSS, Chicago, IL). *p* values less than 0.05 were considered significant.

Results

There were 203 patients meeting our inclusion criteria (Table 1), with 64 patients (32%) and 139 patients (68%) in the analgesia and non-analgesia groups respectively. Both groups were similar with respect to age, gender distribution, comorbidities, and method of arrival at the trauma centre (Table 1). However, the mechanism of trauma, the proportion of Trauma Team Activation (TTA), and the presence of parents in the resuscitation room, differed significantly between the two groups: MVCs accounted for 58% of the group receiving analgesia, but only 42% of the non-analgesia group ($p = 0.026$, $\chi^2_c = 9.29$), whereas falls comprised only 9% and 27% of the analgesia and non-analgesia groups respectively ($p = 0.026$, $\chi^2_c = 9.29$). TTA occurred in 39% of the analgesia group, but only in 17% of the non-analgesia group ($p = 0.001$, $\chi^2_c = 14.9$). Parents were present in 17% of resuscitations in the analgesia group, compared to 6% in the non-analgesia group ($p = 0.010$). The analgesia group had a higher median ISS compared to the non-analgesia group (22 vs. 17 in the non-analgesia group, $p = 0.027$). When the injuries were scored according to the maximum abbreviated injury scale (MAIS) for each body region, there were no statistically significant differences (Table 1), with the exception of external skin injuries. With respect to the latter, there was a statistical difference ($p = 0.002$), even though the median MAIS score was 1 for both groups. There was also a statistical ($p = 0.012$), but not clinical, difference in GCS on arrival to the trauma centre, with a median score of 15 for both groups.

Among those who received analgesia, 43 patients (67%) were given pain control during the primary survey while 21 patients (33%) received analgesia during the secondary survey. A distribution of the types of analgesia administered during resuscitation is presented in Fig. 1. The use of the non-analgesic sedatives etomidate and propofol among all patients was 4% and 5% respectively: 14% of patients receiving analgesia also received

Table 1
Univariate analysis comparing analgesia and non-analgesia groups of severely injured paediatric patients treated at LHSC between 2007 and 2010.

Variable	Analgesia (n = 64)	Non-analgesia (n = 139)	<i>p</i> value
Median age, years (IQR ^a)	14 (4–16)	11 (5–16)	0.273
Male gender, n (%)	44 (69)	105 (76)	0.309
Mechanism, n (%)			0.026
MVC	37 (58)	58 (42)	
Falls	6 (9)	38 (27)	
Intentional	5 (8)	13 (9)	
Other	16 (25)	30 (22)	
Direct arrival	28 (44)	45 (33)	0.156
Trauma Team Activation (TTA)	25 (39)	24 (17)	0.001
Parents in resuscitation room	11 (17)	8 (6)	0.010
Co-morbidities	21 (33)	34 (25)	0.213
Median ISS (IQR ^a)	22 (16–29)	17 (16–25)	0.027
Median MAIS score by region (IQR ^a)			
Head	4 (3–5)	4 (4–5)	0.840
Face	2 (1–3)	1 (1–2)	0.142
Chest	3 (3–3)	3 (3–4)	0.202
Abdomen	3 (2–4)	4 (3–4)	0.068
Extremities	3 (2–3)	3 (2–3)	0.692
External	1 (1–3)	1 (1–1)	0.002
Median Glasgow Coma Scale on arrival at trauma centre (IQR ^a)	15 (13–15)	15 (15–15)	0.012

The *p* values for statistically significant comparisons are highlighted in bold.

^a Inter-quartile range (25–75%).

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