

Does referral to a paediatric trauma unit affect outcome?

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Abstract

Background: There has been much debate in international literature about whether it is better to treat trauma patients at the injury site, at a nearby facility, or to transport them to a specialized emergency health care facility. Previous studies comparing directly admitted and referred patients showed contradicting results and very few studies focused on children. The aim of this research was to obtain an overview of the potential differences in outcome between directly admitted and referred patients in the setting of the Red Cross War Memorial Children's Hospital, Cape Town, South Africa.

Methods: A 5-year retrospective medical folder audit was conducted of 209 children admitted to the Red Cross War Memorial Children's Hospital with an abbreviated injury score of three or four. We compared outcomes between directly admitted patients and patients referred from other health institutions.

Results: There was no difference in mortality or length of stay of the patients in the Red Cross War Memorial Children's Hospital. Directly admitted patients reached the hospital within a median of 60 minutes (interquartile range, IQR, 52 to 84) compared to 185 minutes (IQR 120 to 302) for referred patients ($p < 0.01$).

Conclusions: To shorten delay time for referred patients, the on-field triage system needs to be improved. Also, ambulance personnel need to be trained to perform treatments on site, to replace an initial non-trauma hospital, and transport patients directly to a specialized emergency health care facility.

Citation: Boddé E, Van Dijk M, Van As AB (2018) Does referral to a paediatric trauma unit affect outcome? *Adv Pediatr Res* 5:4. doi:10.12715/apr.2018.5.4

Received: June 29, 2017; **Accepted:** October 17, 2017; **Published:** February 28, 2017

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Competing interests: The authors have declared that no competing interests exist.

Sources of funding: None to report

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Introduction

Regarding current trauma management, there has been fierce debate in international literature about whether it is better to treat trauma patients at the closest healthcare facility or to transport them to a dedicated and specialized emergency health care facility. Few studies indicated that mortality may be higher among transferred patients [1, 2]. The first, an American paediatric trauma centre analysed the differences in mortality and length of stay between patients admitted by inter-hospital transfer and patients admitted directly from the injury scene.

Patients that were transferred had a 7-fold higher unadjusted incident rate of death and stayed longer in the hospital than patients that were admitted directly [2]. A second study, focussing on patients older than 16 years, also demonstrated higher mortality in patients that were initially referred to a non-trauma centre. Critical factors identified at the initial non-trauma centres were over-administration of resuscitative crystalloid fluids as well as blood transfusions [1].

Both these studies have contributed to the overall opinion that inter-hospital referred patients have a poorer outcome than directly admitted patients.

The poorer outcome has been explained by either selection bias (only the most critically ill patients are referred) or the time delay caused by the initially inappropriate referral. However, not all studies found a higher mortality among referred patients. In a systematic review reported in 2011 by Hill et al., no significant difference in mortality or length of stay (LOS) were found between directly admitted and referred patients [3]. A retrospective cohort study by London et al. in 2006 (focusing on patients over 15 years) even revealed lower hospital mortality in transferred patients, in spite of a longer hospital admission [4].

Six of the seven studies comparing outcome in transferred and directly admitted patients were conducted in the United States [1, 2, 4-7] with only one focusing specifically on children under the age of 17 [2]. The only reported study involving paediatric referrals showed a significant higher mortality rate and longer length of stay among transferred patients.

The outcome of trauma patients is determined by access to and the quality of the regional trauma system [8]. A study performed by Fatovich et al. in Western Australia reported a large difference in the time interval from injury to definite health care and mortality between trauma patients from metropolitan areas and rural areas [9]. The difference in the mortality and length of stay are likely to be influenced by factors such as the geographical region, health care systems as well as the transport time per country or area [8].

The contradicting results of previous reported studies and paucity of data on referrals of young children were the main motivation behind our study. Potential differences in process as well as outcome between transferred and directly admitted patients to the trauma unit of the Red Cross War Memorial Children's Hospital (RXH) in Cape Town, South Africa were analysed.

The RXH is a relatively large hospital. In 2015, a total of 7750 patients were seen in the hospital. Most of the children referred to the RXH come from

smaller, regional hospitals. Although these hospitals provide good care under the supervision of doctors, they are not specialized in advanced paediatric life support. Besides this, they do not have the resources required for paediatric traumatic life support.

A multi-centric, clear referral guide was formulated in the Western Cape, and last adjusted in 2012, containing clear guidelines on when to refer a paediatric polytrauma to the RXH. Such situations include all children with trauma requiring a ventilator (ICU) who should be referred to the RXH.

Most of the current literature focusing on the issue of whether to treat at the closest health care centre to the scene or transport patients to the nearest tertiary level health centre refers to the context of small geographic areas and high densities of facilities. This does not apply to the Western Cape where the RXH is located. There is currently insufficient information about the prognosis of transferred patients compared to directly admitted patients in our setting.

Therefore, we set up this study with the aim of obtaining an overview of the differences in outcome between directly admitted and referred patients to the paediatric trauma unit of the RXH.

Materials and methods

Study design

The Red Cross War Memorial Children's Hospital only treats children up to the age of 13 years. Focussing on severely injured children, a 5-year retrospective medical folder audit was conducted of all patients that attended the trauma unit from January 2009 until December 2013 with an abbreviated injury score (AIS) of three or four [10].

Ethics

The University of Cape Town ethics and research committee approved the study. The Childsafe South Africa Surveillance System, located at the RXH, was utilised to identify these patients.

Procedure

Folders were searched for information on mortality, length of stay in hospital, length of intensive care admission, severe head injury and compared between the directly admitted and referred patients. On arrival at the trauma unit, patients were examined for signs of unconsciousness, shock and the resuscitation requirements. Information on these variables was gathered from the medical records. Besides these variables, the study also focused on the time interval from the injury to definite care at the Red Cross War Memorial Children's Hospital. In the directly admitted patients this was determined as the time interval between injury and arrival at the Trauma Unit at the RXH. For patients referred from other hospitals this time interval included the time from injury to initial health institution, the length of stay in this initial hospital and the transport time from initial health institution until arriving at the trauma unit of the RXH.

A comparison between Glasgow Coma Scale (GCS) scores at arrival was also performed. Children under the age of three were scored on the paediatric GCS with a maximum of 11, while children above the age of three were scored on the regular GCS from 3 to 15. A score between 3 and 8 was considered as severe [11].

On arrival in the Trauma Unit, patients were scored according to the type of resuscitation they received. They were categorized into three groups: (1) patients who did not receive any form of resuscitation; (2) patients who received simple resuscitation, including providing oxygen by face mask, intravenous fluid therapy and analgesia; and (3) patients that received complex resuscitation, including cardiopulmonary resuscitation and/or intravenous blood transfusions.

Statistical analyses

Normally distributed data were presented as the mean value (standard deviation) and non-normally distributed variables as the median value (interquartile range). The Fisher exact test was used to compare direct and transferred patients on categorical variables such as mortality, number of patients admitted to the intensive care, the number

of patients who arrived unconscious, the number of patients in shock, the number of patients who received different types of resuscitation at arrival at the trauma unit and to compare the different time periods patients arrived at the trauma unit. To compare the length of stay at the trauma unit of the RXH, hours spend in the paediatric intensive care unit (PICU), the delay in time to definite care and the Glasgow coma scores at arrival between direct and transferred patients, the Mann-Whitney U test was used. The Pearson product moment correlation coefficient was used to determine the linear association between delay time and the distance from the referred health institution from the Red Cross hospital.

Results

Of the 685 patients provided by the Childsafe South Africa database, 288 matched an abbreviated injury score of three or four. Patients whose folders were missing (72) or incomplete (7) were excluded. Of the 209 patients included in this study, 66 patients (31.6%) presented to the RXH directly, while 143 patients (68.4%) were referred from other health institutions. Most referred patients were initially seen at primary level health institutions (71 patients, 49.6% of referred patients) while 68 patients were referred from secondary level institutions (47.5%) and 4 from tertiary level hospitals (2.8%). The median age of the children was 5.4 years (IQR 2.6 to 8.2).

As shown in Table 1, there was a significant difference ($p < 0.01$) in age between direct and referred children. Referred patients were significantly younger than patients who attended the trauma unit directly.

Nine patients (4.3%) died at RXH; 2 (3.0%) of the directly admitted patients and 7 (4.9%) of the referred patients ($p = 0.72$).

More than half (55.5%) of the patients were admitted to the PICU at the RXH; 54.5% of the directly admitted patients were referred to the PICU versus 55.9% of the referred patients ($p = 0.88$). There was no significant difference in length of stay on the intensive care unit for direct patients compared to referred patients ($p = 0.40$).

There was a significant difference between the two patient groups regarding the time interval from injury to definite care. Directly admitted patients reached the hospital within a median of 60 minutes (IQR 52 to 84) as compared to a median of 185 minutes (IQR 120 to 302) for referred patients.

Furthermore, a trend was identified with regard to the level of consciousness of the patients at arrival; while thirty-three (56.9%) of the direct patients arrived unconscious at the trauma unit, 55 (43.0%) of the referred patients were unconscious ($p=0.084$) at arrival.

Table 1. Patient characteristics for total sample and broken down by referral type

	Total (n=209)	Direct (n=66)	Referred (n=143)	P-value
Age, median (IQR)	5.4 (2.6–8.2)	7.4 (3.4–10.4)	4.9 (2.3–7.0)	0.001
Children < 3 years, n (%)	58 (27.8%)	12 (18.2%)	46 (32.2%)	0.05
Gender Male, n (%)	126 (60.3%)	39 (59.1%)	87 (60.8%)	0.88
Diagnosis group, n (%)				
Isolated head injuries	79 (37.8%)	26 (39.4%)	53 (37.1%)	0.36
Polytrauma	75 (35.9%)	27 (40.9%)	48 (33.6%)	
Burns	36 (17.2%)	7 (10.6%)	29 (20.3%)	
Isolated other injuries	19 (9.1%)	6 (9.1%)	13 (9.1%)	
Mortality, n (%)	9 (4.3%)	2 (3.0%)	7 (4.9%)	0.72
LOS, median (IQR)	9 (5–18)	9 (5–17.5)	9 (5–18)	0.93
ICU Admissions, n (%)	116 (55.5%)	36 (54.5%)	80 (55.9%)	0.88
ICU Time in Hours, median (IQR)	88 (36–184)	69 (35–157)	96 (36–215)	0.40
Shock at arrival, n (%)	33 (17.8%)	12 (21.4%)	21 (16.3%)	0.41
Unconscious at arrival, n (%)	88 (47.3%)	33 (56.9%)	55 (43.0%)	0.084
Severe head injury* <3yr, n (%)	21 (51.2%)	3 (37.5%)	18 (54.5%)	0.45
Severe head injury* >3yr, n (%)	78 (56.5%)	31 (58.5%)	47 (55.3%)	0.73
Delay [†] in arrival at RXH, median (IQR)	133 (6–232)	60 (52–84)	185 (120–302)	<0.001

Abbreviations: IQR, interquartile range; LOS, length of stay in days

* Glasgow coma score under 9

[†] Delay in minutes from time of injury until the time of admission at the trauma unit

Information on type of resuscitation on arrival was available for 186 out of the 209 patients. Table 2 shows that almost half of the patients received simple resuscitation on arrival at the trauma unit; 50.9 % of the direct vs 47.3% of referred patients. The type of resuscitation used was not significantly different between the direct and referred patients ($p=0.39$).

Besides previous results, Table 2 also gives the arrival times at the trauma unit of both groups, which tended to differ ($p=0.07$). Referred patients arrived more often during night time and less often during daytime, compared to directly admitted patients.

Table 2. Type of resuscitation and arrival time at trauma unit for direct and referred admissions

Type of resuscitation, n (%)	Type of admission		Total	p-value
	Direct n=(57)	Referred (n=129)		
None	9 (15.8%)	32 (24.8%)	41 (22.0%)	0.39
Simple	29 (50.9%)	61 (47.3%)	90 (48.4%)	
Complex	19 (33.3%)	36 (27.9%)	55 (29.6%)	

Time of day, n (%)	Type of admission		Total	p-value
	Direct n=(65)	Referred (n=141)		
08:00 AM-17:00 PM	31 (47.7%)	50 (35.5%)	81 (39.3%)	0.07
17:00 PM-23:00 PM	30 (46.2%)	68 (48.2%)	98 (47.6%)	
23:00 PM-08:00 AM	4 (6.2%)	23 (16.3%)	27 (13.1%)	

There was a significant longer delay in the time to definite care at the Red Cross hospital for referred patients compared to direct admitted patients ($p < 0.01$). The distance from the referring institution to the Red Cross Hospital was significantly correlated with the delay in time to definite care ($r = 0.38$, 95% CI 0.045 to 0.86), although this information was only reported in 33 patients.

Discussion

The primary focus of this study was to compare the differences in outcome between patients who arrived at the trauma unit of the RXH directly and those transferred from other health care institutions.

In accordance with previous reported studies [3, 5, 6, 8], we did not find any significant difference in mortality between directed admitted and referred patient groups, nor did we find any difference in length of stay.

A significant difference in the time interval from injury to definite care at the RXH between direct and referred patients was identified, with the median time of referred patients to arrive at the RXH trauma unit was more than three times longer than the median time for directly admitted patients. This result can be explained by the fact that referred

patients are primarily assessed and often receive initial medical treatment at the referring health institution that can be time consuming. Delay in presentation may also explain the higher percentage of unconscious patients in the referred patient group.

A national Canadian study on the outcome of trauma reported that the risk of death was lower if treatment took place at a trauma centre as compared to treatment at a non-trauma centre [12]. Outcomes of trauma patients may improve by bypassing the nearest hospital to get to the trauma centre, as was demonstrated and reported in an American study [7].

However, comparison of this study with other populations groups may be fraught with difficulties. Transferred patients in a reported study (performed in Oklahoma, USA) had a mean time interval from injury to Level 1 health care of 310 minutes, while in our population the median time for transferred patients was 185 minutes [7]. However, there was no significant difference in the time from injury to health care in the directly admitted patient groups. Therefore, different outcomes for referred patients can be expected.

A field triage system may be indicated to determine which paediatric trauma patients are in need of

direct referral to our centre in order to avoid unnecessary referrals [8]. Some injuries occur at such a great distance from the hospital or some patients are in such a critical condition that they require stabilization before their transportation to a trauma centre.

Significant debate has arisen on the contentious issue of the preferred site of stabilization [13]. There are two main schools of thought on field assessment of trauma patients. First is the “stay and play” approach, which consists of performing invasive treatments, such as intubation, on site. The second is the “scoop and run” approach, which indicates a quick initial stabilization and resuscitation management in the field, without causing any unnecessary delays, before transporting the patient to a trauma centre [1, 13]. A meta-analysis showed that basic life support is associated with almost a 3-fold lower mortality risk than advanced life support on site, proving the relevance of a “scoop and run” approach in a trauma setting [14]. This mortality risk is intricately associated with receiving support within a time period of 60 minutes, the golden hour, as longer pre-hospital time is associated with a statistically significant relative odds of dying [15].

Promising trauma classification systems are being developed, such as the pre-hospital paediatric trauma classification (PHPTC). This system provides a rapid and effective tool for the triage and adequate prediction of trauma severity in paediatric trauma patients. Classification systems, such as this one, should be evaluated in the context of the Western Cape, South Africa.

A significant limitation of our hospital-based study is that we were unable to determine what interventions were performed by the transferring health institutions. It would be important to see to what extent initial hospitals performed life-saving interventions that otherwise could not have been performed by ambulance personnel in the field. If initial medical treatment was limited to basic life support with simple fluid therapy, it would be worth considering educating ambulance personnel to perform these procedures at the site of injury. That would then render the initial medical care (at a non-trauma centre) unnecessary and reduce the time

interval between injury and definite medical care. More research is required as to clarify what interventions are performed by the initial medical centres and to what extent these interventions can be performed by ambulance personnel at the injury site.

A further limitation of this study is the fact that it was a retrospective study that depended on the quality of the reports in the patients’ medical records.

Conclusions

Paediatric trauma patients referred to our hospital had a three-fold longer time interval from injury to definite care compared to directly admitted patients but did not show a worse outcome in terms of mortality or length of stay.

A triage system should be implemented to determine which patients are in need of treatment at a dedicated trauma centre and which patients can be treated at a nearby (non-trauma) health institution.

Ethical approval

This article has been approved by the ethics committee of the Red Cross War Memorial Children’s Hospital, Cape Town.

Author’s Contribution

All authors made a substantial contribution to the conceptualization, data analysis and writing of this article. All authors read and approved the final manuscript.

Acknowledgments

The authors thank the Red Cross War Memorial Children’s Hospital, Cape Town, for providing all the necessary data in order to conduct this study.

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