RESEARCH BRIEF

Transport-related Adverse Events in Critically-ill Children: The Role of a Dedicated Transport Team

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ABSTRACT

Objective: To compare the frequency of transport-related adverse events in children during specialized, non-specialized or unassisted transports.

Methods: Patients were grouped based on transport team involved – specialized (Group-1); non-specialized (Group-2); unassisted transport (Group-3). Demographics, events during transport and condition on arrival were recorded.

Results: Group-1 children had a lower incidence of adverse events compared to Group-2 and Group-3 (4.3%, 82.6% and 85.4% respectively; *P*<0.001). At arrival, children in Group-1 had a lower incidence of respiratory distress and airway compromise (*P*< 0.001).

Conclusion: Transport of critically ill children by a specialized transport team is associated with fewer transport-related adverse events.

Keywords: Airway compromise, Emergency care, Intubation, Respiratory failure

INTRODUCTION

Medical transport is a key element in the chain of survival for critically ill children, especially in resource-limited settings where critical care services are scarce. The challenges in pediatric transports differ considerably from those in adults. Limited training with pediatric patients may restrict the ability of general transport teams to transfer seriously ill children. Evidence shows that children transported by specialized teams have fewer transport-related adverse events (TRAEs), a more stable physiology upon arrival, and lower in-hospital mortality [1-5]. In India, specialized pediatric transport teams are few [6], and data on transport practices are scarce [7]. We conducted this study to determine whether inter-hospital transport by specialized transport teams reduces the incidence of TRAEs in children in comparison to non-specialized teams and unassisted transports.

METHODS

This prospective observational study was conducted at a tertiary care children's referral hospital in Chennai, India from February 2014 to September 2014. Approval was obtained from the Hospital Ethics Committee.

All patients aged between 1 month and 18 years who were transported to the hospital's Emergency Room (ER) and required Pediatric intensive care unit (PICU) admission were included. Depending on the mode of transportation, they were assigned to one of three groups: Group-1: transported by a specialized pediatric transport team; Group-2: transported by a general transport team; or Group-3: brought by caregivers without medical assistance. A specialized team was defined as one which: (*i*) was attached to a hospital having a dedicated children's transport team; (*ii*) had a doctor trained or undergoing training in pediatrics, pediatric anesthesia or pediatric critical care, and skilled in airway management and cardiopulmonary resuscitation; (*iii*) had a nurse with pediatric experience; and (*iv*) had an ambulance equipped for emergency airway management, vascular access, oxygen, drug delivery and a multi-parameter monitor. Transport teams not meeting all these criteria were considered general transport teams.

Data on demographics, transport-related adverse events, interventions during transport, condition and interventions at arrival to ER were collected. The primary outcome measured was the occurrence of TRAEs. A TRAE included hypoxia, airway compromise requiring intervention, pneumothorax, tachycardia, bradycardia, hypotension, cardiac arrest or hypoglycemia (all defined as per PALS guidelines [8]), which were recognized during transport or immediately after arrival in ER. The secondary outcomes measured were PICU length of stay and mortality. Severity of illness was assessed by the Pediatric Risk of Mortality (PRISM) III score.

Statistical analysis: Continuous variables were expressed as mean (± standard deviation) or median (interquartile range) while categorical variables were expressed as numbers (percentage). Students' t test was used for parametric data and Kruskal-Wallis test for non-parametric data. Fisher's exact test was used for categorical variables. Variables significant on univariate analysis were further analysed by logistic regression. A two-tailed p value of <0.05 was considered significant.

RESULTS

We included, 204 children: 46 (22.5%) in Group-1; 39 (19.1%) in Group-2; and 119 (58.3%) in Group-3. In Group-2, 9 (23.1%) patients were accompanied by a doctor while 30 (76.9%) were accompanied by paramedical staff. In Group-3, 15 (12.6%) children were brought by ambulance without paramedical staff while the other 104 (87.4%) were brought by private vehicles.

Children who were younger (P=0.003), had a respiratory problem (P=0.03), or required transportation over distances less than 5 km (P=0.01) were more often transported by specialized teams than non-specialized ones (***Table* I**).

TRAEs occurred in 142 (69.6%) children (***Table* II**). Group-1 children had a significantly lower incidence of TRAEs compared to Group-2 and Group-3 (4.3%, 82.6% and 85.4% respectively, P<0.001). Airway compromise, hypoxia and tachycardia were less common in Group-1 compared to Group-2 and Group-3 (P <0.001).

Group-1 children had a lower incidence of respiratory distress (P<0.001), requirement of oxygen support (P<0.001) and emergency intubation (P<0.001) upon arrival to ER. The length of stay and mortality were not significantly different between the three groups.

On univariate analysis, neurological problems, transport distance >5 km, non-specialized/unassisted transport and transport time >3 hours were identified as risk factors for TRAEs. On multivariate logistic regression, transport time >3 hours (P=0.002) and non-specialized/ unassisted transport (P<0.001) were independent risk factors for TRAEs. The relative risk of TRAEs with non-specialised/unassisted transport was 20.4.

DISCUSSION

In this observational study, we observed that the large majority of pediatric transports occurred unassisted or by non-specialized teams wherein the risks of airway compromise, respiratory distress and tachycardia were higher.

Having no prior data on existing transport practices, we could not calculate a sample size; therefore the study duration and patient recruitment was arbitrary. The unavailability of pre-transport clinical details was a major limitation. Also, the large difference in the number of patients per group resulting from recruitment of consecutive patients presenting to the ER may well have affected statistical analysis. This difference largely reflects the prevalent referral practices in the region.

Systematic information on pediatric transport practices in India is scarce. A recent study from Delhi reported that the majority of children referred to the ER from another facility arrived by ambulance unassisted [7]. A retrospective analysis of records in neonates showed nearly 45% of the babies were transported by paramedical or non-medical persons [9]. In another study, only 29% of neonates were transported by ambulance, the others being brought by private vehicles or public transport [10].

Worldwide, data on pediatric transport are mainly available from countries with established emergency transport systems. North American studies have shown that adverse events were less when children were accompanied by a tertiary-care physician and higher when team members had no pediatric transport training [2,3]. Transportation by non-specialized teams was associated with more unplanned events and higher mortality [5,11,12]. We did not find any difference in mortality in our study.

Kumar, *et al.* [13] documented that distance or duration of transport did not affect the risk of adverse events and outcomes in neonates transported by a qualified transport team [13]. In our study, the greater risk associated with longer durations likely reflects the fact that most long distance transports were unassisted or done by non-specialized teams.

In conclusion, utilizing specialized pediatric transport teams can reduce the incidence of adverse effects during transport. Further large-scale and multicentric studies are necessary to determine whether this translates to reduced morbidity and mortality.

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WHAT IS ALREADY KNOWN?

- Transport by specialized transport teams results in fewer adverse events and better patient stability in neonates and critically ill adults.

WHAT THIS STUDY ADDS?

- Utilizing specialized pediatric transport teams results in fewer transport-related adverse events in critically-ill children.

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TABLE I CHARACTERISTICS OF CHILDREN INCLUDED IN STUDY

	Total (N= 204)	*Group-1 (n= 46)*	*Group-2 (n= 39)*	*Group-3 (n= 119)*	*P value*
Age* (months)	19.5 (9- 69.2)	12 (5.2- 25.8)	30 (10-92)	24 (9- 72)	0.003
Females	80 (39.2)	18 (39)	14 (35.9)	48 (40.3)	0.88
PRSIM III score*	3 (0.75- 6)	3 (0- 7)	3 (2- 6)	3 (1.5- 5.5)	0.98
Indication for transport					
Neurological	76 (37.3)	14 (30.4)	20 (51.3)	42 (35.3)	0.03
Respiratory	85 (41.7)	23 (50)	14 (35.9)	48 (40.3)	
Metabolic	18 (8.8)	0 (0)	1 (2.6)	17 (14.3)	
Shock	12 (5.9)	4 (8.7)	1 (2.6)	7 (5.9)	
Trauma	13 (6.4)	5 (10.9)	3 (7.6)	5 (4.2)	
Distance (km)					
<5	28 (13.7)	12 (26.1)	2 (5.1)	14 (11.8)	0.01
5- 10	59 (28.9)	8 (17.4)	8 (20.5)	43 (36.1)	
10- 20	30 (14.7)	7 (15.2)	6 (15.4)	17 (14.3)	
>20	87 (42.6)	19 (41.3)	23 (58.9)	45 (37.8)	
Transport support					
Private vehicle	105 (51.5)	0 (0)	0 (0)	104 (87.4)	
Ambulance	99 (48.5)	46 (100)	39 (100)	15 (12.6)	
Doctor	55 (26.9)	46 (100)	9 (23.1)	0 (0)	
Paramedic	76 (37.3)	46 (100)	30 (76.9)	0 (0)	

*Group-1: transport by specialised teams; Group-2: transport by general/unspecialised teams teams; Group-3: unassisted transport. Variables are expressed as *median (IQR) or numbers (percentage); PRISM: Pediatric Risk of Mortality*

TABLE II TRANSPORT-RELATED ADVERSE EVENT, EMERGENCY INTERVENTIONS AND OUTCOME IN STUDY CHILDREN

TRAEs	*Total (N= 204)*	*Group-1 (n= 46)*	*Group-2 (n= 39)*	*Group-3 (n= 119)*	*P value*
At least 1 TRAE	142 (69.6)	2 (4.3)	38 (97.4)	102 (85.7)	<0.001
Hypoxia	81 (39.7)	0 (0)	24 (61.5)	57 (47.9)	<0.001
Hypotension	14 (6.9)	1 (2.2)	3 (7.7)	10 (8.4)	0.36
Tachycardia	100 (49)	0 (0)	26 (66.6)	74 (62.2)	<0.001
Hypoglycemia	3 (1.5)	1 (2.2)	1 (2.6)	1 (0.84)	0.67
Airway compromise	53 (25.9)	0 (0)	19 (48.7)	34 (28.6)	<0.001
Condition at arrival					
Shock	47 (23)	11 (23.9)	6 (15.4)	30 (25.2)	0.44
Respiratory distress	79 (38.7)	4 (8.7)	23 (58.9)	52 (43.7)	<0.001
Low GCS(<8/15)	40 (19.6)	6 (13)	10 (25.6)	24 (20.2)	0.34
Emergency interventions at arrival					
Oxygen	92 (45.1)	5 (10.9)	16 (41)	71 (59.7)	<0.001
Intubation/ re-intubation	49 (24)	1 (2.2)	17 (43.6)	31 (26.1)	<0.001
Fluid bolus	68 (33.3)	12 (26.1)	9 (23.1)	47 (39.5)	0.09
Inotropes	20 (9.8)	6 (13)	4 (10.3)	10 (8.4)	0.58
Outcome					
PICU LOS	4 (3- 6)	4 (2- 7)	5 (3- 7)	4 (3- 5)	0.24
Death	35 (17.1)	8 (17.4)	9 (23.1)	18 (15.1)	0.52

*Group-1: transport by specialised teams; Group-2: transport by general/unspecialised teams; Group-3: unassisted transport. Variables are expressed as numbers (percentage) or *median (IQR);TRAE: transport-related adverse event; GCS: Glasgow Coma Scale; LOS: Length of stay*