

Impact of pre-hospital care on the outcome of children arriving with agonal breathing to a pediatric emergency service in South India

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ABSTRACT

Background: Data on the prehospital interventions received by critically ill children at arrival to Paediatric Emergency Services (PES) is limited in developing countries. This study aims to describe the pre-hospital care scenario, transport and their impact on outcome in non-traumatic, acutely ill children presenting in PES with agonal breathing. **Methods:** Prospective observational study done on children aged below 15 years arriving in PES with agonal breathing due to non-trauma related causes. **Results:** Out of 75 children studied, 69% were infants. The duration of illness among 65% of them (75) was less than 3 days. Majority of them (81%) had received treatment prior to arrival. Government sector physicians (72%), half of them (51%) being pediatricians were the major treating doctors. 37% of the children had arrived to the Emergency in an ambulance. Cardiopulmonary Resuscitation (CPR) was given to 27% on arrival in PES. Other interventions included fluid boluses to correct shock (92%) and inotrope infusion (56%). Sepsis (24%) and pneumonia (24%) were the most common diagnoses. Out of 75, 57 (76%) children who were stabilized and shifted to PICU and among them 27 (47%) survived to discharge. Normal blood pressure ($p=0.0410$) and non-requirement of CPR (0.0047) and inotropic infusion (0.0459) in PES were associated with a higher chance of survival. **Conclusion:** 36% (27/75) of children who arrived to our PES with agonal breathing survived to hospital discharge. Survival was significantly better among those who did not need CPR.

Keywords: Agonal breathing, children, intubation, pediatric emergency service, resuscitation

Introduction

Most cardiac arrests in infants and children result from progressive respiratory failure, shock, or both. Cardiac arrests occurring without warning are less common among children.^[1] Life-threatening conditions leading to cardiorespiratory failure and arrest among children are more likely to commence outside the hospital. Hence, interventions to provide adequate oxygenation and correction of shock may have to be instituted in the prehospital setting to save life.^[1] The provision of an

effective prehospital emergency medical service (EMS) is an important element in reducing childhood mortality.^[2] It has been shown to improve outcomes among adult trauma victims.^[3]

In countries with established pediatric EMS, the health-care personnel are trained for interventions such as bag-valve-mask ventilation, intravenous/intraosseous access placement, and provision of life-saving medications, endotracheal intubation, and defibrillation if needed.^[4-6] In developing countries, due to the varied topography, financial constraints and lack of appropriate health infrastructure assistance by a time-sensitive emergency medical service (EMS) are often not provided to critically ill children.

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Ambulance services run by government, police, fire brigades, hospitals, and private agencies are increasingly available, but there is little coordination among them. These ambulances are often just about transport vehicles equipped with only a bed and an oxygen supply, manned by personnel staff with minimal or no medical training. Due to lack of any categorization of hospitals, sick children are often taken to the nearest facility, to treat that particular emergency. A nation led agency to coordinate various components of a prehospital care system and mechanisms for accreditation of services and professionals are the need of the hour.

In our setting, it was not uncommon for critically ill children to be brought to the pediatric emergency service (PES) with agonal breathing. Data on prehospital care in children with impending cardiorespiratory arrest from rural/semi-urban areas in transitional countries are limited. This study attempted to look into the prehospital care settings, clinical profile, transport, and treatment required on arrival along with the final outcome of the sick nontraumatic children presenting in PES in agonal breathing.

Methods

This prospective observational cohort study was conducted in PES of a large tertiary care center in South India over a 1-year period from June 2010 to May 2011. The PES has 21 beds, 8 of which are dedicated for resuscitation and admitting around 25,000 children below 15 years annually including newborns. Children with trauma are attended to in the Adult Accident and Emergency Department as per the hospital's policy.

All children arriving in PES are received and triaged by the triage nurse. If any of the airway, breathing, circulation components were unstable, stabilization was carried out according to the guidelines given by the pediatric advanced life support (PALS) course including cardiopulmonary resuscitation (CPR). Isotonic fluid boluses and inotropic infusions were given to correct shock. After stabilization, patients are shifted to the Pediatric Intensive Care Unit (PICU) for further management.

All the children who were included in the study were closely followed up in PES, PICU, and the pediatric wards until the time of their discharge from the hospital. The information related to demography, prehospital interventions, clinical profile, emergency room interventions, and outcomes was carefully documented in a pro forma for final analysis.

Parent's consent was obtained to use the data for analysis, and the study was carried out under the supervision of the Ethics Board.

The instruments used were as follows:

- Questionnaire
- Referral letters
- Telephonic interview
- Hospital records.

The outcomes that came about in these children were death in the PES/PICU, discharge home at parental request against medical advice, or survival to hospital discharge.

The details from the pro forma were entered into a Microsoft Excel® sheet and analyzed using the Statistical Package for the Social Sciences (IBM, New York, United States). Demographic variables were described using mean, standard deviation, and proportions as appropriate. Risk factors and final outcome were evaluated by Chi-square test to calculate *P* values.

Results

Children attended

Seventy-five children who arrived with agonal breathing were recruited for the study. Their demography and the clinical characteristics are shown in Table 1. Among them, 69% of them were infants, one-third being <2 months of age. The mean

Table 1: Demography, clinical profile, prehospital care, and transport of children (n=75)

	n (%)
Age (months)	
1-2	27/75 (36)
3-12	25/75 (33.33)
13-60	16/75 (21.33)
>60	7/75 (9.33)
Sex	
Male	45/75 (60)
Female	30/75 (40)
Duration of illness (days)	
1-3	49/75 (65.33)
4-7	17/75 (22.66)
8-14	6/75 (8)
>14	3/75 (4)
Prehospital treatment: Yes	61/75 (81.33)
Private sector	17/61 (27.9)
Government sector	44/61 (72.1)
General physician	30/61 (49.2)
Pediatrician	31/61 (50.8)
Treated in OPD	25/61 (41)
Treated as inpatient	36/61 (59)
Transport	
Ambulance	28/75 (37.3)
Private	22/28 (78.6)
Government	6/28 (21.4)
Accompanying Person in ambulance (n=28)	
Family members only	7/28 (25)
Nonmedical	8/28 (28.6)
Paramedic/nurse	4/28 (14.3)
Doctors	9/28 (32.1)
Taxi/car-rental/owned	14/75 (18.7)
Auto rickshaw	10/75 (13.3)
Public transport bus	7/75 (9.3)
Motorcycle	2/75 (2.7)
Carried by parents by foot	1/75 (1.3)
Missing information	18/75 (24)

OPD: Outpatient department

age was 24.67 ± 40.34 months. A greater proportion of the patients (60%) were boys. The duration of illness was ≤ 3 days in 65%, 4–7 days in 23%, and >7 days in 12% of the children. Only 19% came directly to the PES; 81% of them had received medical treatment prior to arrival.

Government sector doctors were the major contributors (72%) for treating our sick children prior to their arrival to our PES. Among them, 51% were pediatricians and 49% were nonspecialist medical doctors. Thirty-six (59%) had been hospitalized prior to their arrival to our PES.

Information related to the details of transport was available in 57 (76%) children. While 28 (37%) children availed ambulance facility (private [22, 79%] and government [6, 21%]), a significant proportion came by taxi/car (14 [19%]), auto-rickshaws (10 [13%]), public bus (7 [9%]), and even two-wheelers (2 [3%]). One child was carried by the parents to the PES by foot. Among the 28 children who were transported by ambulance, a medical doctor had accompanied the patient in 9 (32%), paramedic/nurse in 4 (14%), and nonmedical personnel without basic life support (BLS) training in 8 (29%) children. The remaining 7 (25%) were transported accompanied only by members of their family.

The vital signs on arrival, the emergency room interventions, and critical events during stabilization of the children are shown in Table 2. All the 75 children who arrived with agonal breaths were intubated in PES and 20 (27%) received CPR. In 25 (33%) children, there was no recordable blood pressure. It was low for age in 41 (55%) and normal for age in 9 (12%) children. For stabilization, 69 (92%) children were given fluid resuscitation and 42 (56%) were commenced on inotropic infusion in the PES.

Table 3 shows the final diagnoses made in the group. Sepsis (18, 24%) and pneumonia (18, 24%) were the most common diagnoses, followed by central nervous system (CNS) infection (6, 8%), congenital heart disease (6, 8%), and poisoning (4, 5%) in that order. Other diagnoses were neonatal hypoxic ischemic encephalopathy (1, 1.3%), acute gastroenteritis (3, 4%), acute lung injury 3 (4%), inborn errors of metabolism (2, 3%), myocarditis (3, 4%), envenomation (1, 1.3%), and foreign body aspiration (1, 1.3%). There were 3 (4%) children with late hemorrhagic disease of the newborn (HDN) due to Vitamin K deficiency which continues to be seen in our geographic area and had all presented with intracranial bleed.

Outcomes

Twenty received CPR in PES of which 2 (10%) survived to discharge from hospital, whereas from among the remaining 55 children who did not require CPR at arrival in PES, 25 (45%) survived to hospital discharge, $P = 0.0047$ [Figures 1, 2 and Table 4].

The final outcome of the 75 children in relation to their diagnoses is shown in Table 3. Survival in patients with acute gastroenteritis and acute respiratory distress syndrome was 67% whereas among

Table 2: Vitals and initial treatment of sick children at arrival to pediatric emergency service (n=75)

	n (%)
Vitals and initial treatment	
Blood pressure - normal	9/75 (12)
Hypotension	41/75 (54.7)
Unrecordable	25/75 (33.3)
Treatment at arrival in PES (n=75)	
CPR	20/75 (26.7)
Fluid bolus	69/75 (92)
Inotrope infusion	42/75 (56)

PES: Pediatric emergency service; CPR: Cardiopulmonary resuscitation

Table 3: Final diagnosis and outcome (n=75)

Diagnosis	Total	Percentage Alive	Percentage Died/ DAMA	Percentage DAMA
Envenomation	1	1.3	1	100.0
Foreign body aspiration	1	1.3	1	100.0
Status epilepticus	3	4.0	3	100.0
HIE	1	1.3	1	100.0
Hepatic encephalopathy	1	1.3	1	100.0
AGE	3	4.0	2	66.7
ARDS	3	4.0	2	66.7
Poisoning	4	5.3	2	50.0
Pneumonia	18	24.0	7	38.9
HDN	3	4.0	1	33.3
Sepsis	18	24.0	5	27.8
CNS infection	6	8.0	1	16.7
Congenital heart disease	6	8.0	0.0	6
IEM	2	2.7	0.0	2
Myocarditis	3	4.0	0.0	3
Others	2	2.7	0.0	2
Grand total	75		27	48

HIE: Hypoxic-ischemic encephalopathy; ARDS: Acute respiratory distress syndrome; DAMA: Discharge against medical advice; CNS: Central nervous system; HDN: Hemorrhagic disease of the newborn; IEM: Inborn errors of metabolism, AGE: Acute gastroenteritis

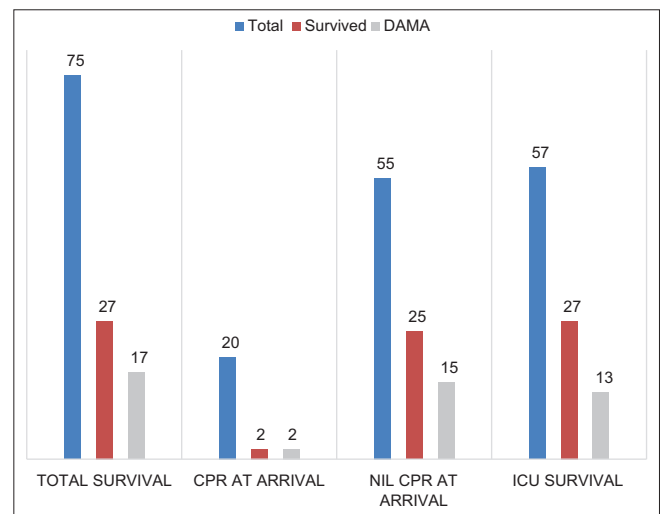


Figure 1: Survival among the children arriving at the pediatric emergency service with agonal breathing

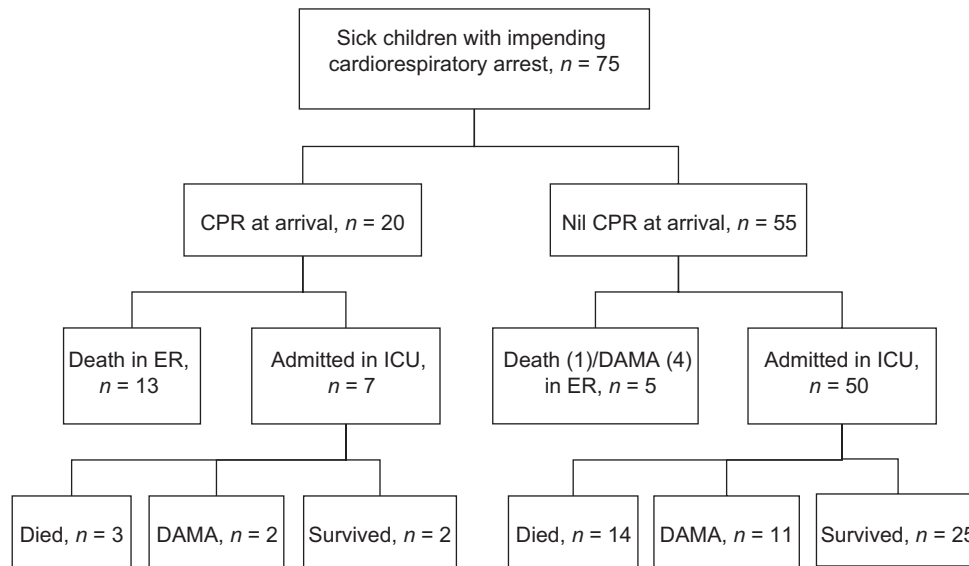


Figure 2: Outcome of 75 children arriving at the pediatric emergency service with agonal breathing

those with poisoning 50% survived. Of the 18 children with pneumonia, 7 (39%) survived. Survival was low among children with late HDN (25%), sepsis (24%), CNS infection (17%), and congenital heart disease (8%). Survival among the single child each with envenomation, foreign body aspiration, hepatic encephalopathy, and newborn with birth asphyxia and the three children with status epilepticus was 100%.

Table 4 shows the outcome in relation to the variables of demography, clinical features, prehospital care, transport, and treatment in PES. It shows that the survival was significantly higher among those children who had normal blood pressure at arrival ($P = 0.041$) and who did not require treatment with inotropic infusion ($P = 0.045$) or CPR ($P = 0.004$) in PES. Prior treatment, history adversely affected the survival ($P = 0.002$) but not the type of doctor ($P = 0.536$). Treatment as inpatients or outpatients also did not affect the outcome ($P = 0.984$).

Discussion

Our data provide insight into the accessibility of health care facilities for families of sick children from rural/semi-urban parts of Southern India. Agonal breathing is the respiratory pattern prior to terminal apnea and an abnormal brainstem reflex.^[7] It is easy to recognize and usually results in terminal apnea unless resuscitated. However, elective intubation and immediate transfer of patients are not a common practice among primary health-care providers.

Large portions (69%) of the study population were infants. The duration of illness was below 72 h in 65% of these children giving their families little time to think and prepare access toward medical care.

Despite the difficulties, 81% of the children received treatment prior to presenting in the PES, 51% from pediatricians and 59% had been in patients. One-third had been transported by ambulance,

accompanied by doctors (32%) or paramedics/nurses (14%). None of these factors affected the outcome of these children favorably. This reflects that outcomes cannot be different unless an organized and trained emergency medical system is available at the secondary hospital level to provide time-appropriate care and safely transfer the critically ill child to a higher center for continued care.

As was expected, sepsis (24%) and pneumonia (24%), the important causes of infant mortality, were the most common underlying conditions that showed low survival (28% and 39%, respectively). Among the remaining disease conditions, acute gastroenteritis (AGE) had a survival of 67%. According to the United Nations Children's Fund, the infant mortality rate (IMR) decreased from 44 deaths for every 1000 live births in 2011 to 42 deaths for every 1000 live in 2013 in India. One of the important causes for this plateauing in the IMR is lack of a robust prehospital care in rural and semi-urban areas.^[8]

Survival to hospital discharge following prehospital cardiac arrest in children is low, with the reported percentages of 2–9%.^[9–13] Even those children who arrive at the hospital pulseless or apneic have poor outcome.^[14–16] When encountered with children who arrive in the hospital with agonal breathing, emergency and intensive care physicians are often at a dilemma whether to resuscitate or not as the outcome of these children is uncertain. Our experience has shown that 36% of the 75 children who arrived agonal breathing had survived to discharge from hospital. Clearly, the decision to “not to treat” should be taken cautiously in the emergency room setting even within the constraints of resource limitations after carefully considering various factors that might not be known immediately on arrival.

The only factor that favored survival was normal blood pressure at arrival ($P = 0.041$). Other factors that significantly favored survival to hospital discharge were not requiring chest compression, normal blood pressure, not requiring inotropic

Table 4: Association of various factors with survival to hospital discharge (n=75)

Variable	n	Alive	Percentage	Dead	Percentage	P
Referral						
Yes	46	13	28.3	33	71.7	0.0786
No	29	14	48.3	15	51.7	
Age (infant vs. children)						
Infant	52	18	34.6	34	65.4	0.7072
Children	23	9	39.1	14	60.9	
Sex						
Male	45	18	40.0	27	60.0	0.3768
Female	30	9	30.0	21	70.0	
Duration of illness (days)						
1-3	49	20	40.8	29	59.2	0.2329
>3	26	7	26.9	19	73.1	
Prior Rx history						
Yes	61	17	27.9	44	72.1	0.0022
No	14	10	71.4	4	28.6	
Source of doctor (n=61)						
Private	45	14	31.1	31	68.9	0.0073
Government	16	10	62.5	6	37.5	
Type of doctors (n=61)						
Pediatricians	32	10	31.3	22	68.8	0.5361
Others	29	7	24.1	22	75.9	
Survival among admitted versus nonadmitted (n=91)						
Inpatient	36	10	27.8	26	72.2	0.9848
Outpatient	25	7	28.0	18	72.0	
Transport (Ambu vs. others)						
Ambu	28	7	25.0	21	75.0	0.1256
Others	47	20	42.6	27	57.4	
Ambulance (n=28)						
Private	22	5	22.7	17	77.3	0.5949
Government	6	2	33.3	4	66.7	
Accompanying person in the ambulance (medical vs. nonmedical) (n=28)						
Medical	13	4	30.8	9	69.2	0.5116
Nonmedical	15	3	20.0	12	80.0	
Circulation (blood pressure)						
Normal	9	6	66.7	3	33.3	0.0410
Low	66	21	31.8	45	68.2	
Fluid resuscitation						
Yes	69	25	36.2	44	63.8	0.8872
No	6	2	33.3	4	66.7	
Inotropic infusion						
Yes	42	11	26.2	31	73.8	0.0459
No	33	16	48.5	17	51.5	
CPR in PES						
Yes	20	2	10.0	18	90.0	0.0047
No	55	25	45.5	30	54.5	
Blood culture (n=60)						
Positive	10	4	40.0	6	60.0	0.9068
Negative	50	21	42.0	29	58.0	

PES: Pediatric emergency service; CPR: Cardiopulmonary resuscitation

infusion at arrival. These highlight the importance of simple, timely interventions such as provision of oxygen and correction of shock for improving outcomes from a critical condition.

This study was limited to only medical emergencies as the unit did not receive children with trauma, and being a tertiary care

center, the results of this study may not be applicable to remote environments or even to rural health system.

Our study highlights the need for early provision of oxygenation, fluid resuscitation, and monitoring without which even the best care will only be a futile exercise. Although pediatric

emergencies may not be common occurrence in primary-care setting, numerous studies have shown that a significant number of children present to primary-care physicians (PCPs) office with variety of urgent or emergency problems.^[17] PCPs play a vital role in the recognition of emergencies, providing life support, and supervised transport to a center with emergency and intensive care services and to educate families about prevention.^[18] As PCPs have a critical role to advocate high-quality care to their first contact, consequences of being unprepared are serious.^[19] Various studies have shown that PCPs trained with BLS, PALS, likely to use resuscitation equipment in their office practice and their training will improve the chance of survival of sick children, especially the chance of survival among the children who experience cardiac arrest.^[20] Our study underscores the need for such training for health-care professionals so that acutely ill children arriving in the ER in a pulseless or apneic state which is obviously associated with a poor outcome can be prevented.

Further research exploring the feasibility and safety of endotracheal intubation by the referring center/doctor before transferring as against transfer with bag and mask ventilation on patient outcomes are required.

Conclusion

A significant proportion of the children who arrived with agonal breaths to our PES survived to hospital discharge. Survival was significantly better if children reached the PES before cardiac arrest. As sepsis and pneumonia were the most common diagnoses encountered in our study, giving the first dose of antibiotic might be an appropriate intervention prior to transferring the sick children to a higher center. Sick children should be transported by ambulance trained medical/paramedical personnel, along with provisions to monitor oxygen saturation and vital signs during their transport to a higher center.

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Conflicts of interest

There are no conflicts of interest.

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