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Pradeep Kumar Sharma

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### Editorial

**Pediatric in-Hospital Cardiac Arrest**

Pradeep Kumar Sharma  
Senior Consultant and Head, Pediatric Critical Care and Pulmonology,  
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### Original Articles

**Profile of LAMA (Left Against Medical Advice) Patients from a Pediatric Emergency Room: A two year experience from a tertiary care children's hospital**

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Lotus Hospitals for Women & Children, Hyderabad

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East Carolina University in Greenville, North Carolina, USA and Vidant Medical Center in Greenville, North Carolina, USA

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Department of Paediatric Intensive Care, Manipal Hospital, Bangalore

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Dear Colleagues and readers

It gives me a great pleasure to announce the commencement of new Journal “Critical care Pediatrics”, a journal dedicated to Pediatric critical care by the College of Pediatric critical care, India

On behalf of College of Pediatric Critical care I would like to extend a warm welcome to the new editorial team of the Critical Care Pediatrics. It is planned to be an open access online journal with first few years publication of hard copy print issues.

Highlights of this issue include original articles from USA, India, and Pakistan

An important study “Should Radiographs Be Mandatory After Placement of Femoral Venous Catheters?” is published by William E. Novotny, Catherine Brailer, Suzanne Hudson, Vanessa Workman, Matthew Ledoux, Cynthia Keel, Irma Fiordalisi from East Carolina University in Greenville, North Carolina, USA and Vidant Medical Center in Greenville, North Carolina, USA.

Another important study is regarding Profile of LAMA (Left Against Medical Advice) patients from a Pediatric Emergency Room by Dr Prasad et al from Lotus Hospitals for Women & Children Hyderabad.

An important study regarding Short term outcome of in Hospital Pediatric cardiac arrest (IH- PCA) from Tertiary Care Center is published by Ali Akhtar Nuhrio, et al from Karachi Pakistan.

An important novel therapy regarding Intravenous ketamine in management of refractory bronchospam in preterm neonates is published by Jenisha Jain, et al from Department of Neonatology at Mehta Children’s Hospital Chetpet, Chennai.

Rarest of rare case reports are a prominent highlight of CCP. Refer to case reports on Fatal H1N1 Infection Presenting as Bilateral Pneumothorax. Fulminant Hemophagocytic Lymphohistocytosis, Unusual Complication of Common Dyselectrolytemia – Rhabdomyolysis, Necrotising enterocolitis in full term infants from various centres from India.

Original research articles are welcome from the Asian subcontinent as well as from different regions of India.

While hard copy will continue to be published for the subscribers, CCP will also be published online and in E format to have a wider outreach.

As regular features Journal scan and short PICU Quiz remain an integral part of the journal.

Happy reading

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Short communications: Brief accounts of descriptive, observational studies, epidemiological assessments, and surveys are published as short communications. Text should be divided into following sections: Abstract, Introduction, Material and Methods, Results, Discussion, References, Tables and Figure legends Abstract should be limited to 150 words, and structured using the following headings: Objective, Methods, Results, and Conclusions. Provide 2-3 key words, selected from the MESH option of PubMed. The text should contain no more than 2000 words, 2 illustrations/tables and up to 20 recent references.

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Letter to editor: Letters commenting upon recent articles in CCP are welcome. Such letters should be received...
within 3 months of the article’s publication. Letters commenting on ‘Case Reports’ and ‘Correspondence’, are generally not preferred. At the Editorial board’s discretion, the letter may be sent to the authors for reply and the letter alone or letter and reply together may be published after appropriate review. Letters should not have more than 1000 words, and 10 most recent references. The text need not be divided into sections. The number of authors should not exceed two.

**Reporting Guideline for specific study designs**

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**References**

Authors need to be accurate in citing and quoting references. References should be numbered consecutively in the order in which they are first mentioned in the text. Identify references in text, tables, and legends by Arabic numerals in superscript [CCP1] after punctuation. References cited only in tables or in legends to figures should be numbered in accordance with the sequence established by the first identification in the text of the particular table or figure. Use the style of the examples below. The titles of journals should be abbreviated according to the style used in Index Medicus. Do not use unpublished observations and personal communications as references. The Uniform Requirements style (the Vancouver style) is based largely on an American National Standards Institute (ANSI) standard style adapted by the NLM for its databases. Avoid using abstracts as references.

**Standard Journal Articles**


**Conference paper:** Christensen S, Oppacher F. An analysis of Koza’s computational effort statistic for genetic


Acknowledgements: Acknowledgements as well as information regarding funding sources should be provided.

Tables: Each table should be typed on a separate page, numbered in sequence with the body of the text. Tables should be headed with a short, descriptive caption. They should be formatted with horizontal lines only; vertical ruled lines are not required. Footnotes to tables should be indicated with a), b), c) etc. and typed on the same page as the table.

Figures: Should be on separate pages but not inserted with in the text. All figures must be referred to in the text and numbered with Arabic numerals in the sequence in which they are cited. Each figure must be accompanied by a legend explaining the contents of the figure. Graphs and bar diagrams should preferably be prepared using Microsoft Excel and submitted as Excel graph pasted in Word.

Alternatively photographs can be submitted as JPEG images. Keys to symbols, abbreviations, arrows, numbers or letters used in the illustrations should not be written on the illustration itself but should be clearly explained in the legend. Avoid inserting a box with key to symbols, in the figure or below the figure. All Tables and Figures captions and legends should be typed on a separate page.

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As part of the submission process, authors are required to check off their submission’s compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

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2. All the contents of the manuscript are written in English. The text is double-spaced; uses a 12-point, Times New Roman font. The text adheres to the requirements outlined in the “Instructions for Authors”. Two separate files are being submitted for Title page and Blinded article fie.

3. Title page contains full title, running title, authors’ full name, designation and affiliation, corresponding Author’s details, word counts, acknowledgement, declaration of conflict of interests, and authors’ contribution details etc.

4. Blinded article fie does not contain any authors name or institutions’ name and the text should be in
following order -abstract (structured/unstructured), keywords, introduction, material & methods, results, discussion, conclusion, and references.

5. Each figure is saved and uploaded in JPG or TIFF format as a single file, not embedded in the main text Word file. Figure files are properly labelled and important findings are highlighted in figures e.g. by arrows. Figure legends are placed at the end of the text.

6. References are written in Vancouver style. Journal’s abbreviations are according the index medicus.

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8. Each author has reviewed the final version of the manuscript and approves it for publication.

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In-hospital Cardiac Arrest (IHCA) occurs in 2–6% of all pediatric intensive care unit admissions.¹ The outcome has improved vastly from 9% in 1980s to 50% in 2009.² This may be due to strategies promoted through guidelines like early recognition and management of at-risk patients, greater emphasis on quality of resuscitation (e.g., high-quality chest compressions with minimal interruptions) and quality post-resuscitation care. Also with improving care the neurological favorable survival is seen in almost three fourth of the survivors. There is a cardiac arrest registry in majority of developed countries, which not only provide trends regarding the survival but also helps to formulate future guidelines. With advent of advance pediatric critical care services the survival of IHCA is also improving in developing countries. However, the data regarding pediatric IHCA from developing countries is limited mainly to single center studies.

In this issue of CCP Nuhrio et al.³ demonstrated Return of Spontaneous Circulation (ROSC) in 51.7% of patients and final survival to hospital discharge in 28%. In addition, the authors showed significant improvement in survival at discharge (11% to 28%) from the previous study from same center reported in 2011. In this study, they found that cardiopulmonary resuscitation (CPR) was needed for 1% of admissions and majority were infants (40%). Most common precipitating event was found to be circulatory shock (84%) followed by respiratory failure. Underlying diagnoses included cardiac illness being the most common (25.8%), followed by pulmonary (22.5 %) and sepsis (21.3%). CPR duration of less than 20 minutes was predictor of good outcome and survival discharge. One of the major findings of the study was significant improvement in survival from 11% reported previously from same center to 28% in this study after introduction of Pediatric Advance Life Support (PALS) education training. Another important observation of the study was that most common initial rhythm was pulseless electrical activity (PEA), which has also been observed in a recent study by Girotra et al.⁴ Recent studies revealing PEA as most common initial rhythm, rather than asystole and bradycardia reported in earlier studies, may be due to the fact that most patients in hospital setting are now located in monitored unit which may have allowed earlier recognition of PEA as a cause of cardiopulmonary compromise. The outcome of IHCA depends on multiple factors. Pre-existing illness (hematologic, oncologic, immunologic, genetic or metabolic disorders), presence of an endotracheal tube prior to arrest; use of sodium bicarbonate or calcium gluconate during arrest; electrolyte imbalance as an etiology of arrest, and longer duration of CPR were associated with increased mortality. Asphyxia as a cause of arrest, shorter duration of CPR, less epinephrine dose requirements, lesser degree of post-arrest acidosis and pupillary responsiveness were associated with decreased mortality.¹-⁴

The improving survival rate of IHCA in past decade is quiet encouraging but still the survival rate in developing countries is significantly lower compared to western world. The reasons are delayed referral, inadequate health care infrastructure and lack of qualified human resources. As shown by Nuhrio et al³ and Sodhi et al⁵ there is significant improvement in survival after introduction of structured training programmes such as PALS and Advanced cardiac life support (ACLS). Education and training remains the most cost effective measure to bring out change in the outcomes of life threatening diseases. In our country critical care societies like Indian Society of Critical Care Medicine and College of Pediatric Critical Care through their fellowship, educational and training programmes for all health care professionals are creating a positive environment for improved survival of critically ill patients.
References


How to cite this article
Sharma PK. Pediatric In-Hospital Cardiac Arrest. Crit care Pediatr. 2018;1(1):16-17

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Introduction
The term LAMA (Leaving Against Medical Advice) is utilized when a patient is discharged from hospital without the consent and agreement of the treating physician, and commonly observed in the pediatric population: LAMA is at request of the caretaker.\(^1\)\(^\text{to}^4\)
Consequences of LAMA increases the risk associated with inadequately treated medical conditions, sometimes with the loss of life.\(^4\)\(^\text{to}^7\)

Pediatric admissions into a children’s hospital both in the public sector and the private sector are usually emergencies brought into the Emergency Room. A reasonable number of admissions are also routed from outpatient departments - as some parents might perceive their child’s illness as minor and seek a regular visit to the doctor’s office. Elective and planned admissions are usually surgical as well as medical into specialized services such as hematology – oncology, endocrinology, etc, often for scheduled medical / surgical procedures as well as for diagnostic evaluation. Many factors affect the decision making process of parents for admission of their wards. In many LAMA patients, the affected children are not fit for discharge, but the treating paediatrician often finds it very difficult to oppose the wish of caretakers. The perception that their child is better / personal reasons / and financial insecurity are some of the reasons for LAMA reported in the literature.\(^8\)

This study is a retrospective analysis of two years at a tertiary care children’s hospital in the private sector, located at Hyderabad.

**ABSTRACT**

**Objective:** Most children admitted to a children’s hospital for minimum of 24 hours as inpatients are usually from the Pediatric Emergency Room. Non critical admissions as well as elective medical and surgical admissions are routed from busy outpatient departments. We studied the profile of patients who were not admitted and left against medical advice (LAMA) from a busy Pediatric Emergency room over a two year period.

**Methods:** A cross-sectional retrospective study on LAMA was conducted from May 2015 to August 2017 in pediatric emergency of Lotus Hospital for Women and Children, Hyderabad.

**Results:** Out of a total of 263 patients who refused to get admitted for inpatient care after meticulous examination by a senior resident or fellow in pediatric intensive care / emergency care with usage of Pediatric Primary Assessment Triangle and Categorization of Illness, the majority were male patients (62%) over one year of age and sought professional help between 6 pm - 12 am.

**Conclusion:** Unaffordability, which is regarded as the only reason for refusal to admit, was actually noticed only in 52% patients. Human factors pertaining to caretakers and care providers is also an important cause for LAMA.

**Keywords:** Pediatric emergency service, Refusal of admission, Human factors

**Original Article**

Profile of LAMA (Left against Medical Advice)

Patients from a Pediatric Emergency Room: A two year experience from a tertiary care children’s hospital

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Materials and Methods
Data was obtained from the Emergency Room records of Lotus Hospitals for Women & Children over a two year period: from May 2015 to April 2017 of all children who were evaluated on a twenty four hour basis and advised admission based on the clinical assessment: Pediatric Assessment Triangle by the resident pediatrician / fellow from the PICU / Consultant, of those children who did not secure admission into the hospital. All data was retrospective in nature. The inpatient billing department fills in a form for all refused admissions with reasons for refusal for each 24 hour period and submits the forms to the administration.

Results
A total of 263 children had not been admitted to hospital from the Emergency Room over the study period. Boys numbered 162 versus 101 girls.

The vast majority of failed admissions in a 24 hour period occurred between 6 PM to 12 AM, throughout the working day week as well as weekends and public holidays (99), with the next large number happening between 12 PM to 6 PM (73). Patients outside these periods, i.e. 12 AM to 6 AM numbered 49, and 42 between 6 AM to 12 PM.

Majority of refusals for admission were due to financial reasons (52%, n = 139). Second cause leading to refusal for admission was human factors (29% n=77). Out of these 77 children, 61 % (47) were refused admission as caretakers(parents/guardians) wish to wait and observe irrespective of understanding clinical condition of child, for 39%(30) children counselling for admission by careprovider (PEM fellow / Pediatrician) was not adequate to make caretakers understand need of admission and thus admission was declined. Lack of health insurance cover was another reason for refusal of admission (n = 36). A small fraction of patients (n = 9) refused admission due to other causes like unavailability of diagnostic / medical equipment at Lotus Hospitals (e.g dialysis equipment, etc),and parents wanted to consult their primary care physicians and revert if they suggested an admission.

<table>
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<td>6 AM TO 12 PM</td>
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<td>12 PM TO 6 PM</td>
<td>47</td>
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<td>6 PM TO 12 AM</td>
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Fig 3: Time of Visit to ER in LAMA patients

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<td>Counseling</td>
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<td>Health insurance</td>
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<td>Other causes</td>
<td>9</td>
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Fig 4: Causes for LAMA.
Incomplete documentation with regards to LAMA data was noticed in our analysis in a few patients not included in this study, such poor documentation was also reported by Al sadoon et al in 57.9% of LAMA cases. To reduce the prevalence of LAMA in pediatric patients, these findings make it imperative for all physicians, researchers, decision-makers and healthcare planners to ensure thorough recordkeeping.

Discussion
Consent for admission to a hospital is a complex process, especially for children since the parent/caregiver assumes this responsibility as this category of patients are minor in age. Many factors play a crucial role, and one of these happens to be the parents’ own perception of the critical nature of their wards’ illness. In busy Emergency Rooms, wherein multiple sick patients are often triaged and managed simultaneously, human factors of the lack of sufficient time for proper counselling of the parents might affect the decision making process. The personality/seniority of the doctor advising admission as well as communication skills with the right body language in conveying the right amount of information with the right intensity and focus might also play a role. In this study, it was seen that about 30 children of the 263 could not be admitted due to this factor alone. In a similar study conducted in Turkey in 2014, wherein 215 patients were studied over a two-year period at a Hematology–Oncology Pediatric service, the vast majority of refusals were due to the hospital’s policies with restrictions on family companions for staying with the patient. The patients’ socioeconomic status, the physical condition of the hospital, as well as lack of confidence/information were among the main reasons for refusal of admission.

In our study, lack of confidence or insufficient information accounted for about a third of the patients not getting admitted. In the Turkish study, refusal of treatment (lumbar puncture and vascular access) accounted for 20% of the cases. Of importance to note in this study, is that all of them were exclusively pediatric haematology/oncology patients, whereas in our study, the spectrum of diseases which afflicted the patients were of a very general nature, including pediatric medical and surgical emergencies. In our study the major reason for refusal of admission has been due to financial reasons whereas in the Turkish study the financial factor was not considered owing to their better government health insurance policies, which provide free of cost treatment for emergency admissions.

However in the majority of studies, financial problems were observed to be the major reason for refusal of admission; but most of them were conducted in a group of patients with chronic conditions such as cancer especially acute lymphoblastic leukemia. A single pilot study was conducted with a sample size of 30 at Ankara Dışkapı Children Education and Research Hospital which observed that parents’ socio-economic status, hospital’s physical conditions, the lack of confidence on the treatment being and counselling patients and parents on the treatment protocols were the important factors for treatment refusal.

Limitations in the current study include a lack of a control group to compare illnesses between patients who were discharged with the recommendation of the physician and those who left against medical advice; a lack of follow-up of the discharged children; and unavailability of documentation in many cases.

Conclusion
We propose that it would be of great value to conduct this study with a bigger sample size and in pediatric institutions with multiple sub-specialities to assess the reasons for leaving against medical advice and thereby focus on possible remedial solutions for such patients and provide optimal levels of medical care to them.

Conflict of Interest: None
Source of Funding: None

References:


Original Article

Radiographs should be Mandatory after Placement of Femoral Venous Catheters

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ABSTRACT:
Objective: We sought to determine 1) the usefulness of radiographic imaging after placement of femoral central venous catheters (FCVC) in children; 2) the utility of anterior-posterior (APR) versus cross-table lateral (XTLR) views and 3) to compare radiograph interpretations among four pediatric intensivists versus a vascular interventional radiologist (VIR).

Methods: Consecutively placed FCVCs were imaged by two views: XTLR and APR. Of these, 200 pairs were chosen randomly; each XTLR was interpreted independently by a VIR and four intensivists using four empiric categories: “too short to be of concern,” “acceptable,” “concerning” or “unacceptable.” After the first reading of XTLRs, a second analysis of each XTLR was performed using a reference illustration to standardize the categorization initially chosen. APRs were then assessed for evidence of angulation toward the spinal cord. Agreement between VIR and intensivists was assessed using values of Cohen’s kappa.

Results: Of 200 pairs of images studied, an “unacceptable position” of the catheter on XTLRs was identified by the VIR in 14/100 (14%) and 10/100 (10%) of left and right-sided FCVCs, respectively. Agreement between the VIR and the intensivists was only modest without use of a reference diagram, but improved substantially when a reference illustration was introduced for guidance. APRs were not useful in identifying concerning or unacceptable catheter positions.

Conclusion: XTLRs are useful to determine safety of FCVC position, and accuracy of interpretation was enhanced by use of a reference illustration. Catheters in a “concerning” or “unacceptable” position should be withdrawn to a safe depth or removed.

Keywords: Femoral Central Venous Catheter, Complications, Radiographs, Children

Introduction
Cannulation of femoral site is commonly used for percutaneous central venous catheter insertion in critically ill children.1 The appropriate imaging after placement of femoral central venous catheters (FCVC) as well as the most useful radiographic view(s) is not well described in literature. Even some practitioners do not obtain a radiograph after FCVC insertion if there is blood return from all ports.2 The FCVC tip ideally should be in the distal inferior vena cava (IVC).3 The misdirection of the catheter tip dorsally may result from FCVC entry into the ascending lumbar vein (ALV) via the iliac vein or via the IVC into a segmental vein and then into the ALV.

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such malposition risks spinal cord injury, perforation into the retroperitoneal or intra-abdominal spaces, and death.\textsuperscript{4,5} If the catheter tip is displaced into the epidural venous plexus then venous stasis, thrombosis, vasculitis, increased pressure in the spinal canal and perforation into the subarachnoid space may result. Radiographs obtained after FCVC placement delineate the catheter course and therefore should help determine the safety of its position.

**Materials and Methods**

After insertion of a FCVC prior to 2010, it was our clinical practice to obtain cross-table lateral (XTLR) and anterior-posterior (APR) abdominal radiographs after blood return from all ports was demonstrated to confirm safety of catheter position. Radiographs were obtained at bedside per Department of Radiology protocol for XTLR of the pelvis. Copies of these films (routinely sent to the Pediatric Intensive Care Unit) were collected before disposal, paired and then de-identified. Prior to de-identification, if a patient had more than one catheter placed, the film depicting the longest catheter (i.e. the FCVC most likely to reveal malposition) was chosen. From these de-identified images, radiographs of 100 left-sided and 100 right-sided catheters were chosen randomly. Four pediatric intensivists and one vascular interventional radiologist (VIR), all of whom were blinded to the readings of others (including any prior interpretations), comprised the study group. Each member of the study group provided an independent interpretation of each of 200 XTLR and each APR. The reading of the VIR was considered “the gold standard.” The first reading involved interpretation of XTLR only. This initial reading of catheter positions was assigned to one of four empiric categories: 1) “too short” to reach the IVC; 2) “acceptable” (the catheter tip terminates ventral to vertebral bodies); 3) concerning” (FCVC tip projects marginally over the ventral edge of a vertebral body); 4) “unacceptable” (FCVC overlies a vertebral body). A second reading was then performed by each study group member with the aid of a reference illustration (Figure 3) to help standardize readings of the catheter tip location on XTLR view and to determine if agreement between VIR and intensivists could be improved. Interpretations of XTLRs by the VIR and each intensivist were assessed for percentages of agreement and compared using values of Cohen’s kappa. Fisher’s Exact Test was used to compare sidedness of the insertion site with termination in an unacceptable position. AP views were then assessed specifically for the presence of medial angulation of the catheter tip toward the spinal canal. FCVCs that were too short or in acceptable positions were considered “safe” and FCVC positions in a concerning or unacceptable position were considered potentially “unsafe.” The University and Medical Center Institutional Review Board of East Carolina University approved this retrospective minimal risk study.

**Results**

Interpretations of the study group from the first reading of XTLRs (prior to introduction of reference Figure 3) revealed intensivist agreement with the
With Figure 3 as a reference guide, the VIR interpreted all XTLRs \((n=200)\) as follows: 37/200 \((18.5\%)\) were “too short” to cause concern; 114/200 \((57\%)\) were in “acceptable” position; 25/200 \((12.5\%)\) were in a “concerning” position and 24/200 \((12\%)\) were identified as “unacceptable.”

This second interpretation of XTLRs resulted in agreement between each of the four intensivists and the radiologist ranging from 75.5% to 82.5% with Cohen’s kappa values ranging from 0.594 to 0.716, respectively. This represented a substantial improvement in agreement among study physicians. The intensivists’ interpretations were most likely to agree with the VIR’s interpretation when the latter was “acceptable” \((86.8\%\) agreement\) followed by “too short” \((83.1\%\) agreement\). However, when these two safe categories were combined, agreement increased to 94.4%. When the VIR’s interpretation was “concerning” \((25/200)\) or “unacceptable” \((24/200)\) the intensivists agreed with the radiologist 48% and 63.5% of the time, respectively. A combined comparison of potentially unsafe positions resulted in 73.5% agreement between VIR and intensivists. Overall, when comparing safe to unsafe FCVC positions the intensivists agreed with the radiologist 89.6% of the time and the values of kappa ranged between 0.692 and 0.750.

This series of 200 pairs of XTLRs and APRs included 12 XTLRs in which contrast material had been injected via the catheter in question. Two such enhanced XTLRs revealed the lumbar venous system in an infant and in an older child (Figure 5). Based on readings by the VIR, 4/200 \((2\%)\) XTLRs demonstrated the catheter tip to terminate dorsal to the vertebral body in the territory overlying the ALV, intervertebral veins and epidural plexus (Figures 1, 2, 5). In all four instances, the insertion site was via the left femoral vein. In another four radiographs the catheter tip was visualized to extend over half the width of the vertebral body; in 2/4 of these instances the catheter had been inserted on the left side. However, no significant difference was found in the total number of “unacceptable” positions of FCVC whether the insertion site was left \((14/100)\) or right \((10/100)\) -sided \((p = 0.515)\). In none of these 200 radiographs did the corresponding AP radiograph
demonstrate catheter tip deviation medially toward the epidural spinal venous plexus via an intervertebral vein (Figures 2 and 3).

**Discussion**

Abdominal radiographs are not routinely obtained after placing FCVCs if there is blood return from all ports. The incidence of malposition of FCVCs with adequate blood return is uncertain, although in this series, malposition appears to have been present despite demonstrable blood return. Cross-table lateral abdominal radiographs of catheter trajectory were used in this study to assess the catheter position. Catheters deemed “too short” to reach a worrisome position were likely in external iliac veins. An “unacceptable” or “concerning” catheter tip position was present on almost one quarter of XTLRs. When diagnostic catheterizations via the left vs. right femoral veins are compared, inadvertent cannulation of the ALV occurs ten times more frequently when the left side is cannulated.6 It has been speculated that this is due to angulation of the origin of the ALV from the left common iliac vein. Our series appears to corroborate this tendency. Of 200 XTLRs selected, 2% of attempted FCVC placements resulted in cannulation of the ALV and all were attempted from the left side. However, taken as a percentage of all right and left-sided catheters inserted, an “unacceptable catheter position” was similar in right and left-sided catheters. This supports the need for imaging of catheters inserted either on the right or on left side. Catheters in an “unacceptable” position on XTLRs should be presumed to represent 1) inadvertent cannulation of the segmental veins which deviate sharply in the dorsal direction from the IVC (Figure 3) or 2) direct access into the ALV from the left common iliac vein. Use of Figure 3 enhanced agreement between VIR and intensivists substantially when considering FCVC position in the safe category. Using this illustration did not help increase agreement in the unsafe group. If catheter malposition is suspected by either the radiologist or the intensivist, a careful assessment should be made regarding need for catheter position adjustment, injection of contrast, or catheter removal. It has been suggested that APRs are helpful in identification of accidental cannulation of veins located dorsal to the common iliac vein.4 In our series, the APRs provided no insight regarding catheter malposition.

No complications from FCVCs insertion were reported in any of our children. The relative dangers of FCVCs assigned to various categories was not assessed because heretofore reported complications of malpositioned FCVCs suggest that catheters in “unsafe” positions be removed or retracted.-By protocol, the radiographic beam of a cross-table lateral film was directed parallel to the floor underlying the child. If children were not appropriately aligned with the floor, the projection of the FCVC with respect to the spinal column may have underestimated or overestimated the risk of catheter placement. Further study may elucidate risk regarding FCVCs tips located in a “concerning” position by injection of radiocontrast to more completely demonstrate catheter tip location. This study was also limited by its retrospective design; future prospective studies may provide further insight into “safe” and “unsafe” catheter positions.

**Conclusions**

After placement of a FCVC an XTLR appears to be helpful in detecting a concerning or unacceptable position of the catheter tip and should be obtained routinely. A FCVC should be considered sub-optimally positioned on XTLR if: 1] the catheter tip projects over any portion of a vertebral body or, 2] the catheter overlies the spinal cord. If warranted, injection of the catheter with radiocontrast media should be considered to confirm location of the catheter tip. Catheters so positioned should be retracted or replaced even if blood return is demonstrable from all ports.

**Conflict of Interest:** None

**Source of Funding:** The study received grant from East Carolina University, Brody School of Medicine, Department of Pediatrics for illustrations.

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percutaneous central venous line insertion. Pediatr Neurol 2001; 24:65-68

How to cite this article:

How to cite this URL:
Original Article

Short-term Outcome of in Hospital Pediatric Cardiac Arrest (IH-PCA): Result from tertiary care center in Pakistan

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ABSTRACT

Objective: Limited data is available regarding in-hospital pediatric CPR from developing countries. We describe short-term outcome of Pediatric CPR and impact of CPR training by comparing with our previous results.

Methods: Prospective record review conducted at Aga Khan University Hospital, Karachi from July 2013 to December 2015. Children between 1 month to 16 years of age, who developed in hospital cardiac arrest (IHCA) and require CPR, were enrolled. Data collection described according to Utstein style. Outcome were sustained return of spontaneous circulation (ROSC) (initial survival) and alive on hospital discharge (final survival).

Results: Eighty nine patients fulfilled the inclusion criteria. Mean age was 49 ± 52 months, 52 % were males and 40.4% were infants. Forty three children (48%) couldn’t survive. Return of Spontaneous Circulation (ROSC) observed in 46 patients (51.7%). Final survival (alive on discharge) was 28% (n=25). When comparing to previous reporting from our center, there was significant improvement in survival at discharge from 11% to 28 % (p-value 0.001, Odds Ratio-4.6)

Conclusion: Survival until hospital discharge after CPR at our institution was higher in post training period. We emphasize on maintaining central registry as well as implementation of CPR training program in developing countries.

Key words: In-hospital, CPR, Pediatrics, survival

Introduction

Every year, thousands of children suffer cardiac arrest either in an in-hospital or out-of-hospital. Reported incidence of Pediatric Cardiopulmonary arrest (CPA) is 8–20/100,000 in the out-of hospital setting and 1.06 per 1000 in hospital in-patients.¹ It is one of the most stressful clinical experiences for both health care providers and families. Successful resuscitation following cardiac arrest necessitates early recognition of cardiac arrest, rapid initiation of trained responders, timely beginning of BLS, and early PALS.

During the recent years, cardiopulmonary resuscitation (CPR) has received much attention. Various internationally and nationally accepted guidelines and protocols for CPR have been published, and formal training programs based on these recommendations are being conducted by certified training centers.² Purpose of these training courses is to impart both cognitive knowledge and psychomotor skills of CPR and to provide a standardized care. Studies have shown that In-hospital CPA outcomes are better and improving. Return of spontaneous circulation (ROSC) is seen in approximately 66% of patients with survival to discharge varying from 16% to 44%.³-⁴ Over the last 25 years, survival to hospital discharge has improved to children after in-hospital cardiac arrest, and most survive with favorable neurologic outcomes.⁴,⁵

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Data regarding pediatric in-hospital cardiopulmonary resuscitation (CPR) have been limited from developing countries like Pakistan. We conducted prospective observational study to see incidence and outcome of in–hospital CPR in children.

**Materials and Methods**

A prospective observational study was done at Aga Khan University Hospital, Karachi from July 2013 to December 2015. Institutional ethics committee review board’s approval obtained (ERC- 2710- Ped-ERC-13). All children from 1 month to 16 years who suffered from cardiopulmonary arrest and received CPR in hospital were enrolled. Data collected for all CPR carried out at pediatric wards, special care unit with monitored beds, procedure rooms and multidisciplinary pediatric and cardiac intensive care unit. For patients with multiple arrest events, only the first event was described. We excluded patients aged less than 1 month and those patients who had an advance directive of a “do not resuscitate” order. Definition of cardiac arrest was same as described in Utstein style, i.e. “cessation of cardiac mechanical activity, established by the absence of detectable pulse, unresponsiveness, and /or apnea or agonal breathing.6

In our hospital for all cases of cardiac arrest and requirement of CPR, rush call is generated. Response to in patient cardiopulmonary arrest is immediate and CPR is carried out using standard BLS and PALS protocols. CPR is provided by on call team of pediatric physicians and nurses. All are BLS and PALS certified. PALS courses are first introduced in our institute in year 2008 and since 2011 we are following American heart association (AHA) format. Successful resuscitation is defined as return of spontaneous circulation at completion of resuscitative efforts. Duration of CPR is calculated from time, code blue was announced till end of CPR. For data collection patient’s medical records, including the CPR-sheet were reviewed. Data reporting done according to Utstein style which is accordance with consensus guidelines for uniform reporting of data from out-of-hospital cardiac arrests and in-hospital resuscitation.6 Outcome variables were survival at end of CPR and survival at discharge from hospital.

We also compared our outcome result of CPR in this study from previous study done in same centre prior to implement of PALS training program. Statistical analysis was performed using (SPSS, Version 20).

**Results**

A total of 8721 children were admitted during the study period and 89 required CPR making CPR rate of 1% of all the admissions. Mean age was 49 ± 52 months (Median 25 months) and 52 % were males. 40.4% (n=36) children were infants age group. Fifty-three CPR (59.6 %) were performed in pediatric intensive care unit, 14 (15.7%) in pediatric general wards and 22 (24.7 %) in Pediatric special care units. Mean duration of CPR was 122 ± 62 seconds (median duration 60 seconds). The characteristics of the study population and outcomes are described in (Table 1). Total forty-three children (48%) could not survive and died

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number/(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47 (52.8)</td>
</tr>
<tr>
<td>Female</td>
<td>42 (47.2)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>Less than 12 months</td>
<td>36 (40.4)</td>
</tr>
<tr>
<td>12-60 months</td>
<td>22 (24.7)</td>
</tr>
<tr>
<td>&gt;60 months</td>
<td>31 (34.8)</td>
</tr>
<tr>
<td><strong>Location of CPR</strong></td>
<td></td>
</tr>
<tr>
<td>Pediatrics ICU/ CICU</td>
<td>53 (59.6)</td>
</tr>
<tr>
<td>Pediatric general ward</td>
<td>14 (15.7)</td>
</tr>
<tr>
<td>Pediatric special care unit</td>
<td>22 (24.7)</td>
</tr>
<tr>
<td><strong>Diagnosis category</strong></td>
<td></td>
</tr>
<tr>
<td>Cardiac</td>
<td>23 (25.8)</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>20 (22.5)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>19 (21.3)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>7 (7.9)</td>
</tr>
<tr>
<td>Chronic infections</td>
<td>3 (3.4)</td>
</tr>
<tr>
<td>Renal</td>
<td>4 (4.5)</td>
</tr>
<tr>
<td>Malignancy</td>
<td>3 (3.4)</td>
</tr>
<tr>
<td>Rheumatology</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>Endocrine</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>Road traffic accident</td>
<td>3 (3.4)</td>
</tr>
<tr>
<td>Others</td>
<td>3(3.4)</td>
</tr>
<tr>
<td><strong>CPR intervention</strong></td>
<td></td>
</tr>
<tr>
<td>Epinephrine injection</td>
<td>89 (100)</td>
</tr>
<tr>
<td>Shock therapy</td>
<td>6 (6.7)</td>
</tr>
</tbody>
</table>

ICU= intensive care unit, CICU= cardiac intensive care unit, CPR= cardiopulmonary resuscitation,
after CPR event. Return of Spontaneous Circulation (ROSC) was observed in 46 patients (51.7%) while final survival (alive on discharge) was 28% (n=25). others (Table 1). Precipitating events most commonly observed were shock (mainly circulatory) in (84%) of our patients and respiratory in 14 patients. The results have been depicted in Utstein Style (Figure 1). Initial documented cardiac rhythm was pulse less electrical activity (PEA) in 47% (n=42), ventricular tachycardia in 6% (n=3), and supraventricular tachycardia in 3% (n=1) cases while asystole was documented in 42.6% (n=38). Chest compressions, intubation and epinephrine administration was done in all patients. Seven percent (n=6) patients also required shock therapy. Multivariable logistic regression identified CPR of less than 20 minutes as independent predictors of better outcome in terms of sustained ROSC and survival at discharge. (p<0.001) (Table 2). There was significant improvement in survival at discharge from 11% to 28% (p-value 0.001, Odds Ratio-4.64) (Table 2).

**Fig 1:** Pediatric Utstein style template for recording outcome of in-hospital CPR.

<table>
<thead>
<tr>
<th>Total admissions, n = 8721</th>
<th>CPR attempted, n=89</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory, n =14</td>
<td>Shock, n=75</td>
</tr>
<tr>
<td>(Circulatory 69, cardiac 6)</td>
<td>Assisted ventilation, n= 89</td>
</tr>
<tr>
<td>ROSC never achieved, n =43</td>
<td>Chest compression, n= 89</td>
</tr>
<tr>
<td>Died in hospital, No ROSC,n=43</td>
<td>Defibrillation, n= 6</td>
</tr>
<tr>
<td></td>
<td>Epinephrine, n= 89</td>
</tr>
<tr>
<td></td>
<td>Sodium bicarbonate, n=28</td>
</tr>
<tr>
<td></td>
<td>Sodium Bicarbonate</td>
</tr>
<tr>
<td>Immediate outcome</td>
<td>Final survival</td>
</tr>
<tr>
<td>Sustained ROSC, n= 46</td>
<td>Alive on discharge, n= 25</td>
</tr>
</tbody>
</table>

**Table 2:** Comparison of Outcome of Cardiopulmonary resuscitation before and after Pediatric Advance Life Support training

<table>
<thead>
<tr>
<th>Time period</th>
<th>Pre-PALS training</th>
<th>Post PALS training</th>
<th>p-value</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of CPR</td>
<td>102</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence rate per total admission (%)</td>
<td>0.40</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROSC</td>
<td>58 (55%)</td>
<td>46 (51.7)</td>
<td>0.23</td>
<td>25.54 (20-120)</td>
</tr>
<tr>
<td>Survival at discharge</td>
<td>12 (11%)</td>
<td>25 (28%)</td>
<td>0.001</td>
<td>4.64 (0.27-8.35)</td>
</tr>
</tbody>
</table>

**Discussion**

In-hospital cardiac arrest is an emergency situation that needs teamwork and the appropriate sequential measures and high quality CPR to rescue the patients. Numerous recent well-designed in-hospital pediatric cardiopulmonary resuscitation (CPR) studies have established that pediatric CPR and advance life support can be remarkably effective. It is the result of most commonly implemented guidelines for CPR, which is practical, simple and effective. The American Heart Association (AHA) and the International Liaison Committee on Resuscitation (ILCOR) and International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science (COSTR) published the most complete review of resuscitation science to date in 2017. It has shown that pediatric patients have a favourable outcome after resuscitation since they have better general health and principally the absence of ischemic heart disease, also because of compliant chest wall of small children.

Various internationally and nationally accepted guidelines exist for CPR and formal training programs have been incorporated to train front line physicians regarding the same. In recent review of literature on in hospital Cardiac Arrest (IH-CA), the ROSC is seen in approximately 66% of patients with survival to discharge varying from 16% to 44%. Over the
last 2 decades, survival has improved to children after in-hospital cardiac arrest, and most survive with favorable neurologic outcomes. In our study the rate of ROSC is 44%, while survival to discharge is 28%. Wilmshurst reported that from developed countries following in hospital cardiac arrest, 66% children showed signs of return of spontaneous circulation and 16-44% survival at discharge. When compared to study conducted at a local center from India, our study population had better outcome in form of ROSC and discharge.

In our report, most children who underwent CPR were under 12 months. Most of the resuscitations (73%) were performed in ICU setting, however, no significant difference was observed in outcome based on age of patient and location of event. The most common initial documented cardiac rhythm was pulseless electrical activity during the collapse. This observation is different from most studies, where ventricular fibrillation or ventricular tachycardia has been reported as the most common initial rhythm, occurring during 25% of in-hospital pediatric cardiac arrests and at least 7% of out-of-hospital pediatric cardiac arrests. Survival to hospital discharge is much more likely after arrests with a first-documented rhythm of VF or VT than after pulseless electric activity (PEA) and asystole. However, our study results show good survival rates in patients with (PEA). Duration of CPR (less than 20 minutes) was found to be a statistically significant association (p value=0.006) with regards to survival outcomes. This result of ours is comparable with the existing literature. A review of the literature identified six previous studies in which the duration of resuscitation after a Paediatric Cardiopulmonary arrest (CPA) had been assessed. Zaritsky et al. noted that all survivors of CPA, inside or outside the hospital, underwent CPR for less than 10 minutes. Gillis et al. found no survivors if CPR after an in-hospital cardiac arrest lasted more than 15 minutes. Innes et al. found that no patients survived if CPR after an in-hospital or out-of-hospital CPA lasted more than 30 minutes. Schindler et al. found no survivors if CPR after an out-of-hospital CPA lasted more than 20 minutes. As in the abovementioned studies, we found that duration of resuscitation was a strong predictor of survival. Following the initial successful CPR by providing high quality CPR, a continuous PICU support is usually needed to maintain tissue perfusion and prevent secondary injuries especially to heart and brain. Although life support courses are widely advocated, their effectiveness has been little studied. Few studies are available in the literature on comparative CPR outcomes after formal resuscitation training. A study from India shows a significant improvement in outcome of CPR after formal training. Another study by Moretti et al also report that CPR trained staff provide an independent contribution to increased survival rate. We also compared our outcome result of CPR in this study from previous study done in same center prior to implement of PALS training program. CPR was attempted in 102 patients during pre-PALS training period and in 89 patients in post PALS training period. Rates of survival until hospital discharge in this study found to be significantly higher than previous study. We can comment that although after implementation of resuscitation training program in our institute there was no difference in attaining return of spontaneous circulation, but we achieved significant increase in survival till discharge from hospital which may be secondary to good post ROSC care. Our study was conducted at a private hospital where quality care, proper cardiac monitor facility is available and staff is trained for PALS, therefore it may not be a true reflection of the population of Pakistan. Our study still supports that training of medical staff and doctors is necessary to improve the outcomes of CPR.

Conclusions
There are many factors involved in good clinical outcomes following in hospital cardiac arrests, which need to be researched further. Post arrest care is a key component of resuscitation care. More effort should be geared towards educating the hospital nurses and doctors. In a developing country like Pakistan, there is high need to implement organized CPR training according to BLS and PALS guidelines to improve survival outcomes for pediatric cardiac arrest.

Conflict of Interest: None
Source of Funding: None
REFERENCES


How to cite this article

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Case Report

Fatal H1N1 Infection Presenting as Bilateral Pneumothorax - A case report

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ABSTRACT

Pneumothorax is the accumulation of extra pulmonary air within the pleural space, most commonly from leakage of air from within the lungs. It is termed as spontaneous pneumothorax when it occurs without any history of trauma. Spontaneous pneumothorax again termed as primary when there is no obvious underlying lung pathology or secondary when the pneumothorax is arising as a complication of underlying lung disorder most commonly staphylococcal necrotizing pneumonia. Here we present a case of an 18 month old girl child who presented with left sided pneumothorax followed by the right side and later proved to be a case of secondary spontaneous pneumothorax due to underlying H1N1 infection. She required chest drains on both sides along with mechanical ventilation during hospital stay. However, the child developed ARDS as well as secondary septicemia and ultimately succumbed after 12 days of PICU stay.

Keywords: H1N1, Fatal, Bilateral Pneumothorax

Introduction

H1N1 influenza was responsible for a global pandemic in the year 2009. This novel virus has spread worldwide and has caused about 17,000 deaths by the start of 2010. Although the incidence of swine flu has decreased, there are still sporadic cases.¹ In most cases H1N1 is a self-limiting illness with fever, cough, sore throat, headache and tiredness. However, in a small number of cases the disease has a rapid progression leading to severe illness with unfavorable outcome especially in the extremes of ages.² From April 2017 to August 2017 we have had 10 cases of severe H1N1 infection at our hospital, needed PICU care with 3 mortalities. One of them presented with spontaneous pneumothorax, an extremely rare presenting feature of H1N1³

Case Report

Our index case, an 18 month old girl presented to our emergency department with history of high grade fever for the last two days associated with cough and cold and respiratory distress since the last few hours. On admission, the child was lethargic with severe respiratory distress. The respiratory and heart rate was 70/min and 138/min respectively. Saturation was 80% even with 8 liters of oxygen through facemask. On auscultation, there was significant decreased air entry in the left side of the chest. Immediate chest X-ray (CXR) was done showing left sided pneumothorax (Figure 1) following which a wide bore needle drain was given. The child responded to this and improved. An intercostal chest tube (ICT) was inserted on the left side and suspecting staphylococcal infection injection cloxacillin was started. The child improved and now had normal saturation with 2 liters of oxygen. Blood reports showed a CRP- 38mg/L (Normal<6mg/L). On day 2 of admission, the child again deteriorated with increased respiratory efforts. Repeat CXR showed hyperlucency of the right side (Figure 2). An ICT was placed on the right side. Repeat CRP showed an increasing trend- 261mg/L. Antibiotics were upgraded to injection linezolid. The child further deteriorated, intubated, and mechanically ventilated due to mixed respiratory failure. Suspecting H1N1 infection due to the rapidly progressive course,

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Vol. 1 - No.1; January - March, 2018

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nasopharyngeal swab was sent on the 2nd day of admission, which came out to be positive. Syrup oseltamivir was started but the child did not show any signs of improvement. Bronchoalveolar lavage and blood culture was sterile. The child again developed left sided pneumothorax despite presence of the left sided ICT (Figure 3). A 3rd ICT was placed in left side. Repeat CXR revealed further worsening of lung parenchyma (Figure 4). Multiple efforts were made to wean the child off ventilator without any success. The condition of the child worsened further with development of warm shock requiring inotropes. Blood reports showed a procalcitonin of more than 100ng/L and CXR showed newly appeared bilateral patchy opacities with extensive air leaks. Suspecting ventilator-associated pneumonia a repeat bronchoalveolar lavage was sent but no organisms could be isolated. Pus culture from chest drain site showed growth of multidrug resistant Enterobacter and Pseudomonas species after which intravenous meropenem and colistin were added. Inspite of our best efforts the child expired on day 12 of admission.

Discussion

H1N1 is transmitted from person to person by infected droplet inhalation. It attaches via its haemaglutinin (H1) surface protein to the respiratory epithelial cells. Following internalization, the virus replicates rapidly. Neuraminidase (N1) enables the release of new virions by causing lytic destruction of the host cells. In most severe affected individuals, the respiratory epithelial lining can be rendered ineffective for gas exchange for up to four weeks. H1N1 infection-related viral pneumonia was been associated with focal to extensive diffuse alveolar damage, marked hyaline membrane formation, pulmonary edema and acute pulmonary haemorrhage.

H1N1 resolves spontaneously except in cases with chronic cardiac and respiratory disease. The red flag signs in a patient with H1N1 infection are somnolence, high and persistent fever, inability to feed well, convulsions and difficulty in breathing. Various factors have been identified for the occurrence of this severe illness, like pregnancy, health status of the patient prior to illness, co morbid conditions, and secondary bacterial infections. In our case, though there was no underlying medical illness and co morbid conditions, secondary bacterial infections might have played a role in worsening the disease. The diagnosis is confirmed by RT-PCR done on nasopharyngeal swab. Oseltamivir and Zanamivir are the recommended antivirals for treatment. Use of pharmacological agent is the key to reduce mortality in seasonal influenza. There is no need for prophylactic therapy. Spontaneous pneumothorax is an extremely rare complication in H1N1 infection unless the patient develops ARDS requiring mechanical ventilation.
This is because the lung becomes stiff due to alveolar and interstitial edema and there is rupture of bullae or over distended alveoli leading to pneumothorax when subjected to positive pressure ventilation. Pneumatocoeles associated with complete infarction may also form independent of mechanical ventilation, a characteristic that suggests a mechanism for the spontaneous pneumothorax observed in victims of the 1918 pandemic. Diffuse alveolar damage, subpleural and intrapulmonary air cysts might occur in influenza-related ARDS and may lead to spontaneous pneumothorax. However, spontaneous pneumothorax as a presenting feature is extremely rare. Singh et al reported a case of spontaneous pneumo-mediastinum and subcutaneous emphysema as an unusual presentation of H1N1 influenza in adult Udupa et al. In their study reported three cases of H1N1 influenza developing spontaneous pneumo-mediastinum and subcutaneous emphysema. All three children were previously diagnosed asthmatic undergoing treatment, whereas our patient did not have any preexisting lung disease. As per the literature review H1N1 influenza presenting as primary pneumothorax is extremely rare. Our index case not only presented as pneumothorax, but also had repeated air leak syndromes before she was commenced to positive pressure ventilation. In an endemic region or during an epidemic H1N1 pneumonia should be kept as differential diagnosis of necrotizing pneumonia with or without pneumothorax as early intervention with Oseltamivir can be beneficial and lifesaving.

Conflict of Interest: None
Source of Funding: None

References
Introduction
Dyselectrolytemia is a common reason for admission to Pediatric Intensive Care Unit (PICU). Both hypo and hypernatremia are very common dyselectrolytemias in PICU. Common complications associated with these electrolyte disturbances happen to be seizures, encephalopathy, raised intracranial pressure and intracranial bleeds. We report our experience with a 10-year-old child with rhabdomyolysis, as a very unusual complication, triggered by acute hypernatremic dehydration, following adeno-tonsillectomy.

Case Report
A 10-year-old boy underwent adeno-tonsillectomy on 12/05/2016 in a medical college hospital, for chronic adeno-tonsillitis. After an uneventful surgery and postoperative course, he was discharged home, where he suffered severe dysphagia and odynophagia. He had multiple episodes of altered bloody vomiting and required admission after 7 days of surgery in the same hospital. He had generalized seizure lasting for 2 minutes along with altered sensorium. In addition, he was dehydrated and was in hypotensive shock. He was managed with normal saline bolus (20ml/kg), lorazepam and fosphenytoin for seizure control.

He was also started on empirical antibiotics. Throat examination revealed operative site having clotted blood without any active bleeding. Initial lab work-up revealed Hemoglobin (Hb)-11gm/dl, Total leucocyte count (TLC)-14650/mm³, C-reactive protein (CRP)-8 mg/dl, Blood urea nitrogen (BUN)-150mg/dl, creatinine (Cr)-1.4mg/dl, Aspartate Transaminase AST-207 U/L, Alanine Transaminase (ALT) -112U/L, sodium (Na⁺)-180 meq/L and potassium (K⁺)-3.8meq/L. Blood culture and cerebrospinal fluid analysis were negative. Leptospira IgM, Malaria Ag test, Weil–felix test done at previous center were also came negative. Computed Tomography and Magnetic Resonance Imaging of brain were normal. The child was given 0.45% Normal saline (NS) for 48h, 0.3% NS for next 24h, and then 0.2 % NS for hypernatremia, which caused wide fluctuation of sodium level. After 3 days child was referred to our hospital for persistently altered sensorium, progressive deterioration in renal function & refractory hypernatremia.

At our PICU, we started him on NS followed by 0.45NS along with salt free nasogastric tube feeds. Correction of hypernatremia was regulated not to exceed 0.5meq/l/hr. Laboratory work up revealed-Hb-11.2gm/dl, TLC-19680/mm³, platelet count-86 X 10³/mm³, Na⁺-170meq/l, K⁺-3.6meq/L, BUN-21mg/dl, Cr-0.7mg/dl, AST-2607 U/L, ALT-877 U/l, albumin-3.2 g/dl, LDH-4676 mg/dl, serum osmolality -356mosm/L and urine osmolarity-980mosm/L. Urine routine examination revealed 4-5 red blood cell

ABSTRACT
Hypernatremia can have rare complications causing mortality and morbidity. We report our experience with a 10-year-old child with rhabdomyolysis, as a very unusual complication, triggered by acute hypernatremic dehydration, following adeno-tonsillectomy. He responded to appropriate fluids and recovered well. This case highlights the importance of looking out for rhabdomyolysis as a rare life threatening complication of hypernatremia.

Key words: Rhabdomyolysis, Hypernatremic dehydration, AKI.

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in every high power field and urinary protein was 3+. He was passing dark red color urine (Fig.1). Further analysis of urine was positive for myoglobin. Total Creatine phosphokinase (CPK) level was 192743 U/L. He was started on hyper-hydration therapy with total fluid of 3L/m2/day targeting urine output >2ml/kg/hr. we used 0.45% NS and salt free nasogastric feeds to restore normal sodium. His sodium level and CPK level were normalized in subsequent 5 days as presented in (Table 1 & Fig 2). His sensorium gradually improved and at discharge, he was alert and conscious.

Discussion
Rhabdomyolysis is rare condition characterized by acute destruction of muscle tissue with release of myoglobin in blood. Immediate consequences of muscle destruction include hyperkalemia, hypocalcaemia and acute renal failure. In children, it is commonly caused by infection, trauma, anesthetic complications and inherited disorders, electrolyte imbalances.1-3

Hypernatremia as a cause of rhabdomyolysis is rarely reported, particularly in children.1-7 Hypokalemia, hypophosphatemia, and hyponatremia are more commonly associated with rhabdomyolysis. The mechanism of rhabdomyolysis associated with hypernatremia is not well established; however, one theory implies that it could be associated with inhibition of electrogenic sodium pumps due to hyperosmolar state. This will impair sodium calcium transport. Increased intracellular calcium can damage the myocyte via several pathways including persistent contraction, activation of phospholipase and free radical mediated injury.1,6 Tzu yang et al reported rhabdomyolysis in a 12 year old neurologically impaired child with hypernatremia associated with diarrhea and dehydration.5 Another case of hypernatremia induced rhabdomyolysis was reported in a 5 year old girl with hypodipsia-hypernatremic syndrome associated with holoprosencephaly.1 Recently a case of rhabdomyolysis associated with severe hypernatremia after an episode of acute gastro-enteritis in an 1 year old girl was reported.4 Severe hypernatremia contributes to hyper-osmolality and causes cellular dehydration. It may lead to cerebral demyelination, and clinical manifestations ranging from irritability and lethargy to coma apart

Table 1: Laboratory parameters during the course in hospital

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
<th>Day 8</th>
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</thead>
<tbody>
<tr>
<td>Na+(meq/L)</td>
<td>165</td>
<td>180-150</td>
<td>170-166</td>
<td>165, 167, 165</td>
<td>164, 161, 162</td>
<td>153, 158</td>
<td>148, 144</td>
<td>141</td>
</tr>
<tr>
<td>K+(meq/L)</td>
<td>3.8</td>
<td>3.6</td>
<td>3.7</td>
<td>3</td>
<td>2.8</td>
<td>3.5</td>
<td>3.5</td>
<td>3</td>
</tr>
<tr>
<td>BUN(mg/dl)</td>
<td>165</td>
<td>150</td>
<td>59</td>
<td>21</td>
<td>16</td>
<td>11</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Creatinine(mg/dl)</td>
<td>1.6</td>
<td>1.4</td>
<td>1</td>
<td>0.7</td>
<td>0.6</td>
<td>0.5</td>
<td></td>
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</tr>
<tr>
<td>CPK (U/L)</td>
<td>192743</td>
<td>151000</td>
<td>100400</td>
<td>45000</td>
<td>12278</td>
<td>5199</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDH(mg/dl)</td>
<td>4676</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>654</td>
<td></td>
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<tr>
<td>AST/ALT(U/L)</td>
<td>2607/877</td>
<td>1922/360</td>
<td>909/762</td>
<td>70/54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plasma osmolality (mosm/Kg)</td>
<td>356</td>
<td>352</td>
<td>335</td>
<td>310</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
from the common symptoms like fever, tachypnea high-pitched cry, changes in skin turgor.8-10 We, initially could not explain the elevated LDH and transaminases in our child and subsequently looking at color of urine we considered rhabdomyolysis. Our child had severe hypernatremia, rhabdomyolysis, myoglobinuria and acute kidney injury (AKI). The hypernatremia and circulatory shock was probably secondary to poor oral intake following the surgery due to severe throat pain coupled with repeated vomiting. The AKI was probably a combination of pre-renal and pigment induced renal dysfunction. Around 10–40% of cases of rhabdomyolysis leads to AKI. Kidney injury in rhabdomyolysis is multifactorial including mechanisms like renal vasoconstriction, ischemia, and renal tubular obstruction by cast formation and direct tubular injury by myoglobin. AKI related to myoglobinuria may respond to fluid therapy, alkalinization, and diuretics however, if conservative therapy fails, hemodialysis is the modality of choice.3, 12-14 Our case responded to appropriate fluid and electrolyte management, and did not required dialysis. We could not find any cause apart from hypernatremia for rhabdomyolysis in our child.

**Conclusion**

Although rare, rhabdomyolysis is a known complication of hypernatremia. It is worthwhile to anticipate this rare complication with hypernatremia and hyperosmolar states because of its life threatening consequences.

**Conflict of Interest:** None

**Source of Funding:** None

**References**

**Case Report**

Intravenous ketamine in Management of Refractory Bronchospasm in Preterm Neonates

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**ABSTRACT**

Premature infants are at increased risk of recurrent respiratory morbidity. Although ketamine has been used in adults and children for refractory bronchospasm, its use in infants, specifically preterm babies, has not been reported. We report successful management of refractory bronchospasm in preterm twins with intravenous infusion of ketamine.

**Keywords:** Bronchospasm, respiration, prematurity

**Introduction**

Premature infants are at increased risk of recurrent respiratory morbidity in the form of recurrent hospitalizations due to respiratory tract infections. Most of these episodes are caused by bronchiolitis, which leads to wheezing. Management of these events poses a major challenge, as response to bronchodilators is variable. Ketamine has been used in adults and children for refractory bronchospasm. However, its use in infants, specifically preterm babies, has not been reported. We report successful management of refractory bronchospasm in preterm twins with intravenous infusion of ketamine.

**Case Report**

**Case 1**

An extremely preterm (27 weeks + day) male, first of the twins presented on day 62 (Post Menstrual Age of 35 weeks +6 days) with cough, cold and apneic episodes. Previously child was discharged from neonatal intensive care on postnatal 43rd day. Birth weight was 940 gram and weight at present admission was 2.08Kg. The baby had multiple episodes of apnea with desaturation and bradycardia requiring intubation and ventilation for 16 hours. Later, he was extubated and started on oxygen via nasal prongs. His respiratory distress worsened over next 36 hours and he was put on high flow nasal cannula with a flow of 5L/min and FiO2 30%, which was continued for 20 hours. Then, he had acute worsening of respiratory distress with marked subcostal retractions and decreased air entry bilaterally. Baby was re-ventilated on SIMV-PC mode with PEEP/PIP of 5/15, FiO2 - 50%, Rate - 40/min. Baby was monitored clinically and serial arterial blood gases (ABG) were done. Chest x-ray showed normal volume lungs with bilateral heterogeneous opacities. ABG showed hypoxemia and 2D echo revealed a patent foramen ovale with left - right shunt, mild pulmonary artery hypertension and normal biventricular function. His throat swab real time polymerase chain reaction (RT-PCR) for H1N1 and respiratory syncytial virus (RSV) were negative. Pertussis was not tested, as there was no history of contact. Despite being on adequate antibiotics (Piperacillin-tazobactum and amikacin) and fentanyl infusion (2mcg/kg/hour), he developed recurrent episodes of bronchospasm associated with desaturation and bradycardia and evidence of hypoxemia in arterial blood gas. To counter this rapidly worsening clinical scenario, the baby was started on ketamine infusion (0.5mg/kg/hr). This led to improvement in his clinical condition (Figure 1). There were increased tracheobronchial secretions noted during ketamine infusion which were controlled with intravenous glycopyrrolate in the dose of 4 microgram/kg/dose every 4th hourly. Ketamine infusion was continued for 96 hours and extubation to high flow nasal cannula was done after 137 hours of ventilation. The baby was discharged seven days later.

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The second twin was admitted for recurrent episodes of apnea on day 70 of life (Post Menstrual Age 37 weeks +0 days). He also had a NICU of stay until 43 days from birth. Birth weight was 1.06 kg and weight at present admission was 2.2 kg. In view of recurrent apneas, baby was intubated and mechanically ventilated in assist control mode. He was also started on fentanyl infusion at 2 mcg/kg/hr. His throat swabs real time polymerase chain reaction for RSV and H1N1 were negative. However, he continued to have bronchospasm episodes leading to desaturation, bradycardia and increased ventilator requirement. He was started on ketamine continuous infusion at 0.5 mg/kg/hr, following which there was a marked improvement in clinical, blood gas and ventilator parameters (Figure 1). He also had excessive tracheobronchial secretions following ketamine infusion which were managed with intravenous glycopyrrolate at a dose of 4 microgram per kg/dose every 4th hourly. Ketamine infusion was stopped after 78 hours. He received inj Piperacillin-tazobactum and inj Amikacin for 5 days. He was extubated after 4 days to high flow nasal cannula and weaned to room air on day 76 of life. He was discharged home on day 78 of life.

Discussion
Management of persistent or recurrent bronchospasm in preterm infants poses a major clinical challenge. Despite adequate ventilation, antibiotics and supportive management, it is sometimes difficult to control refractory bronchospasm. In these two cases, we successfully treated bronchospasm with ketamine infusion with marked improvement in ventilator and oxygenation parameters. Although the use of ketamine has been described in children with refractory bronchospasm, its use in preterm infants is undocumented. Ketamine is a potent anesthetic agent of phencyclidine family. It was first approved for clinical use in 1970. Ketamine causes bronchodilatation by catecholamine release. The commonly used dose in children is 0.15-2.5 mg/kg/hr with no major side effects. The common side effects include increased salivation and tracheobronchial secretions, hypertension and increased intraocular pressure. Increased tracheobronchial secretions were noted in our cases too. This was managed using intravenous glycopyrrolate. Though ketamine is used for procedural anesthesia and analgesia, concerns regarding dose dependent neurodegeneration have limited its use in clinical practice. Neonatal pertussis may have a similar clinical presentation as described above, however, it was not suspected in these two cases as there was no history of contact and mother was healthy.

Conclusion
The present cases support the use of intravenous ketamine as an effective temporizing measure for preterm infants experiencing severe bronchospasm refractory to conventional therapy.

Conflict of Interest: None
Source of Funding: None

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CASE REPORT

Intravenous ketamine in Management of Refractory Bronchospasm in Preterm Neonates


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Case Report

Adenovirus - A Rare Cause of Fulminant Hemophagocytic Lymphohistocytosis - A case report

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ABSTRACT

Hemophagocytic Lymphohistiocytosis (HLH) secondary to adenovirus infection is a rare entity. Mortality due to adenovirus infection in immunocompetent host is rarely reported, though cases of severe symptomatic disease have been reported in immunocompromised hosts. We present a case of five-year old girl who presented with fever, pain abdomen, vomiting and throat pain whose condition gradually worsened and required ventilator and ionotropic support. During the course of her illness, she was diagnosed to have hemophagocytic lymphohistiocytosis secondary to adenovirus infection without any previous history suggestive of immunodeficiency. She eventually succumbed to her illness, on day 13 of admission, inspite of the best possible management. In conclusion, in this case study, we report a rare severe manifestation of adenovirus infection causing HLH in an immunocompetent child.

Keywords: Hemophagocytic lymphohistiocytosis, Adenovirus infection, Immunocompetent host

Introduction

Adenoviruses are a common cause of acute febrile respiratory infection in children and are generally self-limiting.1 Apart from lung involvement; these pathogenic organisms are known to be associated with gastrointestinal disturbances. However, case fatalities from adenovirus are rare particularly in immunocompetent children. This could be either due to low virulence of the virus or under diagnosis, especially in the resource-limited regions. Severe symptomatic manifestations have been reported in immunocompromised hosts. Hemophagocytic Lymphohistiocytosis (HLH) induced by adenovirus infection is a rare entity.2 We report a case of previously healthy girl with disseminated adenovirus infection with secondary HLH.

Case Report

A five-year-old apparently healthy girl presented with seven days history of fever, pain abdomen, vomiting, five days of throat pain and one day of decreased oral intake and lethargy. She had received seven days of intravenous antibiotics at an outlying hospital. Her clinical condition gradually worsened requiring vasopressors and mechanical ventilation in view of refractory shock. Thereafter she was referred, to our centre.

On admission to our hospital, she was on mechanical ventilation and vasopressors. Her heart rate was 132/min, blood pressure 102/56mmHg, temperature 37.4°C and warm peripheries. Eye examination revealed sub-conjunctival haemorrhages. There was erythema and a white membrane, with petechial spots over posterior pharyngeal wall. There was no history of hoarseness of voice or significant lymphadenopathy on examination. She was continued on mechanical ventilation, vasopressors (dopamine@10mcg/kg/min, norepinephrine@0.1mcg/kg/min) and intravenous antibiotics (Meropenem and teicoplanin). Initial laboratory results showed ABG-pH 7.32, pCO2 34mmHg, pO2 102mmHg, HCO3 18mEq/L, marked leukopenia, White Blood Cell (WBC) count-300/mm3 with an absolute neutrophil...
count of 19/mm³, Hemoglobin 9.8g/dL, platelet 220 X 10³/μl. C-reactive protein was 235mg/L (normal value ≤ 10mg/L) and procalcitonin was 334ng/ml (normal value ≤ 0.15ng/ml). Pharyngeal swab Culture was negative for Corynbacterium dipheriae on Albert stain. Serological investigations: Typhidot IgM (rapid diagnostic ELISA kit), scrub typhus IgM (ELISA), leptospira IgM (ELISA), Epstein bar virus Polymerase Chain Reaction (PCR) assay, Ricketsiae (weil-felix), and HIV (ELISA) were negative. On day 4 of admission, she had worsening of clinical parameters, and laboratory revealed haemoglobin 8.2g/dL, platelets 78 X 10³/μl. Blood culture, nasal swab culture were sterile. Immunological profile revealed low levels of IgG (228.9mg/dl). Empirical antifungal therapy (Inj. Fluconazole), intravenous immunoglobulin (IVIG) were started. Nasal swab came out positive for adenovirus (Real time qualitative PCR). Adenovirus PCR revealed twenty-three million copies/ml (500 to 10¹⁰ copies/ml) in blood. On day 6 of admission, the general condition of patient continued to be critical, she was on ventilatory and inotropic support, fever was persisting along with leucopenia and thrombocytopenia, we continued the treatment and further investigations were sent which showed high serum ferritin (3433.8ng/ml) and low fibrinogen (1.39g/L) levels with bone marrow aspiration suggestive of severe hemophagocytosis. In view of hemophagocytic lymphohistiocytosis, dexamethasone and Etoposide as per HLH 2004 protocol were started. Inj.cidofovir was added the next day. Other supportive therapy along with blood component continued. Gene mutations sent for familial HLH came out to be negative. Although we were able to reduce the viral load after specific therapy, this was not sufficient to alter the outcome. Hence, clinical interpretation of adenovirus viral load determinations is still controversial. One study showed significantly higher viral load in peripheral blood mononuclear cells from symptomatic than from asymptomatic patients. However, there was no significant correlation between clinical presentation, disease severity, and quantitation of viral load in blood in another study. Present case highlights

Discussion

In immunocompetent children adenovirus infection causes self-limited illness. Severity of infection may vary from benign, in healthy children, to fulminant, in immunocompromised children with colitis, pneumonitis, pancreatitis, nephritis, encephalitis and hemophagocytic lymphohistiocytosis (HLH). Although infection associated HLH is rare in viral illnesses, many viruses have been reported as culprit, like, Epstein-Barr virus, human immunodeficiency virus, parvovirus, hepatitis virus apart from adenovirus. Adenoviruses have various mechanisms for evading host immune responses, such as inhibition of interferon functions. T-cell mediated immunity is crucial for recovery after an acute attack, so it is fatal in immunocompromised patients. The humoral response also plays an important role in controlling adenovirus infection, as demonstrated by rise in serotype-specific antibodies in stem cell transplant recipients, after clearing the infection.

Virus-associated HLH is rare, no definitive treatment protocol has been described, however in limited case reports of adenovirus induced HLH, IVIG, clarithromycin, dexamethasone and cyclosporine, or pulse methylprednisolone have been used successfully, although efficacy of these drugs is not established. Also drugs such as ganciclovir, vidarabine, ribavirin and cidofovir have been used. Cidofovir through its active metabolite inhibits viral replication by selectively inhibiting viral DNA polymerases. It also incorporates itself into viral DNA hence inhibiting viral DNA synthesis during reproduction.

In the present case report, we had a previously healthy child with severe adenovirus infection complicating into HLH. Our child did not respond to various therapeutic modalities- IVIG, high dose steroids, immunosuppressant drugs, anti-viral drugs and colony stimulating factors. Although we were able to reduce the viral load after specific therapy, this was not sufficient to alter the outcome. Hence, clinical interpretation of adenovirus viral load determinations is still controversial. One study showed significantly higher viral load in peripheral blood mononuclear cells from symptomatic than from asymptomatic patients. However, there was no significant correlation between clinical presentation, disease severity, and quantitation of viral load in blood in another study. Present case highlights
the importance of early suspicion, diagnosis and initiation of specific therapy for a potential benefit in order to prevent such a remote but fatal complication of this common virus.

**Conclusion**

We herein present a rare case of an immunocompetent child presenting with fulminant secondary HLH due to adenovirus infection. Despite of the rarity, the clinicians needs to be aware of this propensity and should have high index of suspicion as adenovirus can be a trigger of HLH even in an immunocompetent child, and can result in severe multi-organ dysfunction.

**Conflict of Interest:** None  
**Source of Funding:** None

**References**


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**How to cite this URL:**  
Available from: http://www.criticalcarepediatrics.in
Articles Reviewed

1. **Tight glycemic control in critically ill pediatric patients: a systematic review and meta-analysis.**

Background
Hyperglycemia is prevalent in patients in the pediatric intensive care unit. The purpose of this study was to describe the benefits and risks of tight glucose control (TGC) in critically ill children.

Methods
A systemic review and meta-analysis of the literature was carried out on randomized controlled trials of TGC in critically ill children admitted to the pediatric intensive care unit. The databases searched were Medline, Embase, and CENTRAL databases until May 1, 2017. Paired reviewers independently screened citations, assessed risk of bias of included studies, and extracted data. A random-effects model was used to report all outcomes. The Grading of Recommendations Assessment, Development and Evaluation system was used to quantify absolute effects and quality of evidence. The primary outcome was hospital mortality. The secondary outcomes were hypoglycemia (any, severe), sepsis, new need for dialysis, and seizures.

Results
A total of 4030 patients were included from six studies. All six studies were rated as at low risk of bias. Our meta-analysis showed that TGC did not result in a decrease in risk of hospital mortality (odds ratio (OR), 0.95; 95% confidence interval (CI), 0.62–1.45; I² = 40%; moderate quality), sepsis (OR, 0.82; 95% CI, 0.63–1.08), or seizures (OR, 0.98; 95% CI, 0.59–1.63). TGC was associated with a decrease in new need for dialysis (OR, 0.63; 95% CI, 0.45–0.86). However, TGC was associated with a significant increase in any hypoglycemia (OR, 4.39; 95% CI, 2.39–8.06) and severe hypoglycemia (OR, 4.11; 95% CI, 2.67–6.32).

Conclusions
Among critically ill children with hyperglycemia, TGC does not result in a decrease in hospital mortality, but appears to reduce a new need for dialysis. However, TGC is associated with higher incidence of hypoglycemia.

Reviewer’s Comments
Stress induced hyperglycemia is defined as “transient hyperglycaemia during acute illness – usually restricted to patients without prior evidence of diabetes which resolves with resolution of the underlying critical illness.” It is caused by stress induced increased endogenous glucose production (by excessive gluconeogenesis and glycogenolysis) and peripheral insulin resistance. Mild to moderate stress hyperglycemia and insulin resistance are thought to be beneficial to the host and help them to survive during periods of severe stress. Stress hyperglycemia results in a new glucose balance, allowing a higher blood glucose diffusion gradient that maximizes cellular glucose uptake in the face of maldistributed microvascular flow. Insulin resistance leads to redistribution of glucose away from peripheral tissues (skeletal muscles) towards tissues that are noninsulin dependent (brain and immune system). However, at what threshold this evolutionary response becomes disadvantageous is unclear. Severe stress hyperglycemia promotes inflammatory response, impairs leucocyte function, increases risk of infection...
and causes osmotic diuresis. It is associated with organ failure and increased mortality. In adults tight glucose control was in vogue following the Leuven surgical and medical trials, but this was overturned by the subsequent definitive NICE-SUGAR trial (glycemic target <180 mg/dL).

This systematic review and meta-analysis included 4030 pediatric patients (age <16 years) from six randomized control trials. It was found that tight glycemic control (glucose goal < 140 mg/dL) does not reduce hospital mortality, seizures or sepsis in critically ill children. However the risk of hypoglycemia is significantly increased if one targets very tight control (glucose goal < 110mg/dL) or moderately tight glucose control (glucose goal 110–140 mg/dL). \( \text{OR}, 9.35; 95\% \text{CI}, 1.49–58.83 \) and \( \text{OR}, 3.00; 95\% \text{CI}, 2.07–4.34 \) respectively. Tight glycemic control is therefore not recommended in critically ill children. As per the reviewer’s experience, insulin therapy should be started when the blood sugar levels are persistently above 180 mg/dL and should be stopped when blood sugar levels fall below 150 mg/dL. However further studies are required to know whether targeting an even more tolerant level between 180 and 220 mg/dL would be better (or worse).

2. A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis.

Background
High-flow oxygen therapy through a nasal cannula has been increasingly used in infants with bronchiolitis, despite limited high-quality evidence of its efficacy. The efficacy of high-flow oxygen therapy through a nasal cannula in settings other than intensive care units (ICUs) is unclear.

Methods
In this multicenter, randomized, controlled trial, we assigned infants younger than 12 months of age who had bronchiolitis and a need for supplemental oxygen therapy to receive either high-flow oxygen therapy (high-flow group) or standard oxygen therapy (standard-therapy group). Infants in the standard-therapy group could receive rescue high-flow oxygen therapy if their condition met criteria for treatment failure. The primary outcome was escalation of care due to treatment failure (defined as meeting \( \geq 3 \) of 4 clinical criteria: persistent tachycardia, tachypnea, hypoxemia, and medical review triggered by a hospital early-warning tool). Secondary outcomes included duration of hospital stay, duration of oxygen therapy, and rates of transfer to a tertiary hospital, ICU admission, intubation, and adverse events.

Results
The analyses included 1472 patients. The percentage of infants receiving escalation of care was 12% (87 of 739 infants) in the high-flow group, as compared with 23% (167 of 733) in the standard-therapy group (risk difference, –11 percentage points; 95% confidence interval, –15 to –7; \( P<0.001 \)). No significant differences were observed in the duration of hospital stay or the duration of oxygen therapy. In each group, one case of pneumothorax (<1% of infants) occurred. Among the 167 infants in the standard-therapy group who had treatment failure, 102 (61%) had a response to high-flow rescue therapy.

Conclusions
Among infants with bronchiolitis who were treated outside an ICU, those who received high-flow oxygen therapy had significantly lower rates of escalation of care due to treatment failure than those in the group that received standard oxygen therapy.

Reviewer’s Comments
Bronchiolitis is one of the most common cause of hospitalization in first 12 months of life. The American Academy of Pediatrics guidelines recommend only supportive therapy such as oxygen for hypoxemia, respiratory support and maintenance of hydration. Use of salbutamol, epinephrine and steroids is not recommended. High flow oxygen therapy through a nasal cannula has emerged as a new method of respiratory support for bronchiolitis patients, which can be initiated in ICU as well as non-ICU settings.

Heated Humidified High flow nasal cannula (HFNC) is a emerging as a promising noninvasive respiratory support device in children because of excellent patient...
tolerance and ease of administration. HFNC device consists of a specially designed nasal cannula, a flow generator, an air oxygen blender and a respiratory gas humidifier. It delivers heated and humidified oxygen – air mixture at flows that exceed patient’s spontaneous inspiratory demand. HFNC acts by multiple mechanisms: (1) It facilitates CO₂ removal by washout of nasopharyngeal dead space, (2) It reduces upper airway resistance by stenting the upper airways and (3) It helps in alveolar recruitment by providing PEEP.

Most protocols use flow rates of 2 L/kg for first 10 kg body weight and additional 0.5 L/Kg for each Kg above 10 Kg. Fi02 is set to achieve saturation greater than 92%. Success or failure of HFNC is determined by close clinical observation of vital parameters. Responders show a decrease in respiratory rate, heart rate and work of breathing within 90 minutes of initiation of therapy.

This multicenter, randomized controlled trial was conducted in 1472 hospitalized infants who were treated for bronchiolitis in non ICU settings. Critically ill infants who had an immediate need for respiratory support and ICU admission were excluded from the study. It was found that infants with bronchiolitis and hypoxemia showed a significantly lower rate of escalation of care due to treatment failure (12% vs 23%, p<0.001) when early high flow oxygen therapy was used during the hospital admission than when standard oxygen therapy was used. High flow oxygen therapy thus promises to be an important respiratory support device for the management of severe bronchiolitis patients both in and outside the ICUs.


Background
The World Health Organization guidelines provide suggestions on early recognition and treatment of severe dengue (SD); however, mortality in this group can be high and is related both to disease severity and the treatment complications.

Subjects and Methods
In this prospective observational study, we report our results where standard therapy (ST) was enhanced by Intensive Care Unit (ICU) supportive measures that have proven beneficial in other conditions that share similar pathophysiology of capillary leak and fluid overload. These include early albumin for crystalloid refractory shock, proactive monitoring for symptomatic abdominal compartment syndrome (ACS), application of a high risk intubation management protocol, and other therapies. We compared outcomes in a matched retrospective cohort who received ST.

Results
We found improved outcomes using these interventions in patients with the most devastating forms of dengue (ST+ group). We could demonstrate decreased positive fluid balance on days 1–3 and less symptomatic ACS that necessitated invasive percutaneous drainage (7.7% in ST+ group vs. 30% in ST group, P = 0.025). Other benefits in ST+ group included lower intubation and positive pressure ventilation requirements (18.4% in ST+ vs. 53.3% in ST, P = 0.003), lower incidence of major hemorrhage and acute kidney injury, and reduced pediatric ICU stays and mortality (2.6% in ST+ group vs. 26% in ST group, P = 0.004).

Conclusion
Children with SD with refractory shock are at extremely high mortality risk. We describe the proactive application of several targeted ICU supportive interventions in addition to ST and could show that these interventions resulted in decreased resuscitation morbidity and improved outcomes in SD.

Reviewer’s Comments
Severe dengue is a leading cause of mortality among Indian children. Mortality in severe dengue shock can be as high as 44% -72% with fluid overload and malignant edema due to capillary leak being major contributors. Refractory shock in severe dengue patients can be due to dengue myocarditis, concealed hemorrhage, abdominal compartment syndrome or superimposed sepsis.

This prospective observational study was done in children aged 2 months to 16 years who had severe
dengue and were in critical phase of illness. Children in the standard therapy (ST) group (September 2009-September 2011) were treated as per WHO guidelines. Children treated from October 2011 to November 2015 (ST+ group) received one or more targeted interventions in addition to standard therapy.

Several targeted interventions that were carried out in patients with severe dengue and high mortality risk are described below.

1. **Restrictive resuscitation and colloid rescue in severe shock using albumin:** Patients who remained in shock (with no bleed) despite 30 ml/kg crystalloid in first 3 hours were given 1 gm/kg of albumin as an infusion over 4 to 6 hours, in addition to crystalloids, total volume of which were titrated to maintain perfusion targets. Early use of “albumin rescue” makes sense as its use can reduce large volume requirements. Moreover albumin is devoid of the side effects associated with other synthetic colloids such as coagulopathy and renal failure.

2. **Fluid overload and Intra-abdominal hypertension:** In the ST+ group, rather than waiting for clinically obvious abdominal distension or tense ascitis to develop, intra-abdominal pressure (IAP) was measured proactively every 2 hourly through an indwelling Foleys catheter, in all patients with unresolved shock who had received > 30 ml/kg fluid in initial 3 hours. Medical measures to reduce IAP such as fluid restriction, consideration of diuretic, sedation, gastrointestinal decompression, minimization of PEEP as tolerated were undertaken. For patients having established abdominal compartment syndrome an atraumatic catheter (pig-tail) was inserted with ultrasound guidance, with prior administration of appropriate blood products if at bleeding risk. The fluid was drained slowly in a controlled manner as rapid decompression may temporarily improve hemodynamics, but has a high risk of hemodynamic instability and hemorrhage.

3. **Respiratory support:** Noninvasive positive pressure ventilation (NIPPV) was the preferred initial means of respiratory support. Intubation and positive pressure ventilation were initiated for failed NIPPV and for patients who presented in extremis. A high risk intubation management protocol to prevent peri-intubation cardiorespiratory decompensation was used. This included preference for low dose ketamine, avoidance of benzodiazepines, pre-intubation continuous positive airway pressure (CPAP) and vasoactive infusions in all cases prior to induction.

4. **Prevention and management of major hemorrhage:** Central lines and arterial line were considered only in fluid refractory shock, and were inserted under ultrasound guidance with a preference for compressible sites. Nasal tubes were avoided. Efforts were taken to minimise the “lethal triad” of coagulopathy, hypothermia and acidosis. Fresh whole blood was preferred over individual blood components. Tranexamic acid infusion was used in patients who were actively bleeding.

5. **Fluid removal and renal replacement therapy:** Diuretics were used once shock/plasma leak was under control. Sustained low efficiency dialysis (SLED) was preferentially used for patients with diuretic resistant fluid overload/AKI.

It was found that proactive application of targeted ICU supportive interventions resulted in less positive fluid balance on day 1-3, less requirement for positive pressure ventilation, less symptomatic abdominal compartment syndrome, lower incidence of major hemorrhage and acute kidney injury and reduced pediatric ICU stays and mortality. Incorporating these targeted ICU supportive measures along with the WHO recommendations will help in reducing the morbidity and mortality associated with severe dengue.

4. **A Methodological Study to Develop a Standard Operational Protocol for Nurses on Central Line Catheter Care of Patients in Selected Intensive Care Units**


**Aim**

This study aims to develop a standard operational protocol (SOP) for central line catheter care for nurses.
**Materials and Methods**

A preliminary draft of protocol based on extensive review of the literature was developed. The current practices of the nurses regarding central line catheter care were observed. Focus group discussions (FGD) were conducted with the nurses to identify the problems encountered by them during care of central line. Four rounds of Delphi were conducted to validate the protocol. The protocol was found to be feasible in terms of understanding, clarity and easy implementation after conducting a pilot study. An observation checklist was developed from the final draft of the protocol. The nurses were taught regarding the central line catheter care as per the protocol. 30 nurses were observed during central line catheter care by the researcher. After implementation of the protocol, feedback of the nurses was taken by conducting FGDs.

**Results**

Content validity index of each item in the protocol was acceptable. The overall Cronbach’s alpha value of the checklist was 0.75. It was concluded that the checklist is reliable and each item has a contribution in the checklist.

**Conclusion**

This protocol addresses interventions to enable staff to provide proper care of the central line catheter to prevent CLABSI.

**Reviewer’s comments**

Central venous catheter (CVC) insertion is one of the most common procedures done in critically ill children. It provides an access through which various life supporting medicines can be given, as well as blood sampling can be done. Central line-associated blood stream infections (CLABSI) are one of the most significant complications of CVC placement, which can increase the mortality, morbidity as well as the hospital cost. Educating and training the nursing staff can play a significant role in decreasing the incidence of CLABSI. SOPs are written procedure prescribed for repetitive use as a practice, in accordance with agreed upon specifications. In an institute, SOP helps in creating an environment of efficiency as well as consistency. This study addresses interventions to enable staff to provide care of the catheter in order to prevent central line associated blood stream infection.

The present study was carried out in five phases. In the preparation phase, review of literature was done to assess the burden of central line related complications worldwide, recent advances in central line care, guidelines for central line care as well as SOPs for central line care. To know the regular practices of central line care the current practices of nurses were observed during morning and evening shifts. To understand the problems they encounter during the procedure and the possible suggestions, a series of FGDs were conducted. On the basis of literature, current practices and the themes of FGD, a preliminary draft was formulated. For validation of the preliminary draft Delphi technique was employed. To ensure heterogeneity of the panel of experts nine members from various fields of medical and nursing science were selected. Four rounds of Delphi were taken to reach a common consensus and to develop standard operational protocol for central line care. Analysis of content validity was done using content validity index (CVI) of the developed protocol. Nurses were trained according to developed SOP for central line catheter care with the help of demonstration, posters, and booklets. Feedback of all bedside nurses regarding the protocol was evaluated by conducting five FGDs for further recommendations. The final draft of SOP on central line catheter care was submitted to all selected ICUs in the form of booklet and posters of SOPs.

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**How to cite this article**


**How to cite this URL**

1. A 2-year-old boy with a known ventricular septal defect and congestive cardiac failure was admitted with bilateral pneumonia. On admission, he had severe hypoxemia and the chest X-ray showed bilateral infiltrates. The cardiac silhouette was markedly enlarged. He was intubated and put on pressure control with a PEEP of 10 cm H₂O, FiO₂ 0.7. This provided a PaO₂ of 55 torr, pH 7.25 and PaCO₂ of 60 torr. HCO₃ 18. Diuresis and antibiotics were also started. What changes would you consider?

A. No changes. These values are acceptable in this situation
B. Hypoxemia needs to be tackled as it can lead to cardiac arrhythmias
C. Hypoxemia and respiratory acidosis both need to be tackled as both can cause arrhythmias
D. There is no metabolic acidosis so the pH is acceptable.

2. A 12-year-old boy sustained a penetrating wound to the abdomen. At laparotomy, during repair of injuries to the jejunum and transverse colon, an inadvertent laceration of the inferior vena cava resulted in massive blood loss and hypotension, which were eventually controlled. Extensive edema of the bowel wall and omentum was noted at the conclusion of the operation, and the abdomen was closed with some difficulty. The patient received 18 units of transfused blood and 22 L of crystalloid before being transferred to the surgical intensive care unit. Now, 18 hours after surgery, the patient is receiving synchronized intermittent mandatory ventilation (SIMV) with a tidal volume of 400mL, mandatory rate of 16 breaths/min, and total rate of 26 breaths/min; FIO₂ is 0.60 and PEEP is 10cm H₂O. Peak inspiratory pressure is 35cm H₂O, and static respiratory system compliance is 15 mL/cm H₂O. He is receiving a continuous infusion of dopamine, 20 μg/kg/min. Heart rate is 130 per minute and blood pressure is 86/58 mmHg. Examination of the chest reveals coarse breath sounds and inspiratory crackles throughout both lungs. The abdomen is tensely distended with diminished bowel sounds. Laboratory and hemodynamic studies: Hematocrit-28%, Venous blood lactate-5. 2mEq/L, Arterial blood studies: PO₂-72 mmHg, PCO₂-36 mmHg, pH-7.26, Pulmonary artery occlusion pressure-18 mmHg, Cardiac index-2.1 L/min/m². Urine output has decreased from 60 mL/hr to 15 mL/hr over the last six hours. Intra-abdominal pressure transduced from a catheter in the bladder is 36 mmHg. Computed tomogram of the abdomen, obtained shortly before you see the patient, revealed diffuse bowel wall edema but only a small amount of peritoneal fluid.

Which of the following is most likely to improve this patient’s hemodynamic status?

A. Initiation of muscle paralysis with vecuronium
B. Vasopressor support to noradrenaline +/−vasopressin
C. Transfusion of 2 units of whole blood
D. A change in ventilator mode from SIMV to pressure control ventilation set to deliver the same tidal volume.
E. Decompressive laparotomy

3. Nosocomial pneumonia was recently diagnosed in an intubated patient, and a bronchoalveolar lavage was performed yesterday. The microbiology laboratory has just called to tell you that the gram-negative rod seen on the initial smear is Stenotrophomonas maltophilia and that
the results of sensitivity testing will be available tomorrow. The patient continues to have high fever and worsening arterial blood values while being treated with gentamicin and ticarcillin – clavulanate.

To which of the following antibiotics should this organism be most sensitive?
A. Ceftazidime
B. Imipenem
C. Erythromycin
D. Trimethoprim – sulfamethoxazole
E. Amikacin

4. Which of the following is most likely to occur when a patient on pressure-control ventilation develops a pneumothorax?
A. Increase in peak inspiratory pressure
B. Increase in static respiratory system compliance
C. Decrease in delivered tidal volume
D. Decrease in plateau (end-inspiratory hold) pressure
E. Decrease in end-tidal CO₂

5. When you look at chest radiographs to compare the position of your patient’s endotracheal tube today with its position yesterday, you note that the up of the tube is now slightly closed to his carina. Which of the following is most likely to have caused this change?
A. Large inspirations
B. Prone position
C. Neck extension
D. Neck flexion

6. A 10-year-old girl is being treated in the ER for asthma exacerbation. On examination, her blood pressure was 128/78 mmHg with a 32 mmHg pulsus paradoxus. She used her accessory muscles for breathing, and auscultation revealed little air movement. After treatment with a nebulized beta-agonist, the patient was breathing 2 L/min of oxygen by nasal cannula; arterial blood studies showed PO₂ was 68 mmHg, PCO₂ was 63 mmHg, and pH was 7.27. You have sedated and muscle relaxed her appropriately and intubation was successful. She was then sedated with midazolam and morphine. The nurse manually ventilated the patient, and a chest radiograph was performed. Now, several minutes later, the nurse comments that ventilation is becoming extremely difficult to perform and the patient, who appear pale, is unresponsive and has a blood pressure of 76/40 mmHg by manual cuff measurement. The chest radiograph reveals that the endotracheal tube is well positioned in the mid trachea.

Which of the following should you now do?
A. Decrease the rate of positive pressure breaths and recheck the blood pressure
B. Connect the patient to a volume-cycled ventilator
C. Begin norepinephrine
D. Begin continuous nebulization of beta-agonist
E. Perform a blind needle thoracostomy

7. Which of the following statements regarding permissive hypercapnia is correct?
A. It shifts the oxyhemoglobin dissociation curve to the left
B. It usually depresses cardiac output
C. Expired breaths will have a lower carbon dioxide concentration after its use
D. It is contraindicated in patients who have increased intracranial pressure
E. Sodium bicarbonate, intravenously, is required to buffer the acidosis
F. It is contraindicated in patients with a left to right shunt

8. A 10 year old with kerosene ingestion was transferred to the intensive care unit because of progressive hypoxemia and development of pulmonary infiltrates. The patient was intubated, and mechanical ventilation was begun. For the first 12 hours the patient was hemodynamically stable; hemoglobin remained at 12.0 g/dL. However, an FIO₂ pf 0.80 or greater was required to maintain his arterial blood PO₂ above 60 mmHg. PEEP was instituted, and a pulmonary artery catheter was placed. Over the next two hours, the following measurements were obtained with PEEP set at five different levels and a constant FIO₂ of 0.50.
### CRITICAL THINKING PICU Quiz

<table>
<thead>
<tr>
<th>PEEP (cmH₂O)</th>
<th>Arterial blood PO₂ (mmHg)</th>
<th>Arterial oxygen saturation (%)</th>
<th>Cardiac output (L/min)</th>
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<tr>
<td>0</td>
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<td>2.6</td>
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</table>

Which of the following PEEP settings will result in the highest oxygen delivery?

A. 0 cm H₂O  
B. 5cm H₂O  
C. 10cm H₂O  
D. 15 cm H₂O  
E. 20cm H₂O

9. A 12-year-old girl who has chronic renal insufficiency is admitted to the intensive care unit because of increasing dyspnea after sustaining pulmonary contusions and a crush injury of her left leg in a motor vehicle accident 12 hours ago. Based on the results of physical examination, chest radiograph, and arterial blood studies, the decision is made to intubate her and begin mechanical ventilation. Morphine, midazolam, and succinylcholine are administered intravenously prior to intubation. After intubation, the electrocardiogram shown on the facing page is obtained.

Which of the following best explains the electrocardiographic findings?

A. Hyperkalemia  
B. Hypocalcemia  
C. Hypothermia  
D. Myocardial contusion  
E. Posterior wall ischemia  
F. Malignant hyperthermia

10. A 14-year-old boy who has cystic fibrosis and advanced chronic obstructive pulmonary disease was admitted to the intensive care unit because of fever, dyspnea, and purulent sputum. A new right lower lobe infiltrate was seen on a chest radiograph. On physical examination, his temperature was 39.4°C (103.0°F), respirations were 38 per minute, and blood pressure was 105/55 mmHg. Arterial blood PO₂ was 41 mm Hg, PCO₂ was 68 mm Hg, and pH was 7.22. The patient was intubated, and mechanical ventilation was begun and IV ampicillin/sulbactum was initiated. His temperature returned to normal, and his clinical respiratory status improved. Now, on hospital day 7, the patient is still being mechanically ventilated. His temperature is 37.5°C (99.5°F). Findings on a chest radiograph are unchanged. He produces less sputum, and it is less purulent. A sputum culture specimen sent on hospital day 5 grows normal oral flora and Candida albicans. Gram stain of the sputum shows numerous neutrophils and sheets of pseudohyphae.

Which of the following should you do now?

A. Continue ampicillin/sulbactum  
B. Add fluconazole  
C. Add amphotericin B  
D. Add itraconazole  
E. Add ketoconazole

**Answers**

1. **A**: No changes. These values are acceptable in this situation.  
   **Rationale**: This child is a case of congestive heart failure and pneumonia. The arterial blood gas values in current situation are acceptable as aim of ventilation is never to achieve normal blood gas values. Permissive hypercapnia with pH > 7.2 and permissive hypoxia are acceptable in this clinical scenario.

2. **E**: Decompressive laparotomy  
   **Rationale**: This child is having refractory shock because of abdominal compartment syndrome (ACS), for which he requires decompressive laparotomy as per cutaneous fluid drainage is not an option in this case.
**Pediatric specific definitions of ACS and IAH**

a. ACS in children is defined as a sustained elevation in IAP of greater than 10 mmHg associated with new or worsening organ dysfunction that can be attributed to elevated IAP.  

b. The reference standard for intermittent IAP measurement in children is via the bladder using 1 mL/kg as an instillation volume, with a minimal instillation volume of 3 mL and a maximum installation volume of 25 mL of sterile saline.  
c. IAP in critically ill children is approximately 4–10 mmHg.  
d. IAH in children is defined by a sustained or repeated pathological elevation in IAP>10 mmHg.

**References**


3. **D:** Trimethoprim – sulfamethoxazole  
   Rationale: *S.* maltophilia, as a non-aeruginosa pseudomonad, is usually resistant to aminoglycosides, antipseudomonal penicillins, antipseudomonal third-generation cephalosporins and carbapenems. *S.* maltophilia is consistently susceptible to trimethoprim-sulfamethoxazole (TMP-SMZ). If TMP-SMZ cannot be used, the organism is usually sensitive to minocycline, respiratory quinolones, or colistin/polymyxin B.

4. **C:** Decrease in delivered tidal volume  
   Rationale: In pressure-controlled ventilation, pressure delivered is constant and the volume delivered to the patient will depends upon compliance and resistance. In this case, due to pneumothorax the lung compliance will decrease which will lead to decrease in deliver of tidal volume at same pressure.

5. **D:** Neck flexion

6. **A:** Decrease the rate of positive pressure breaths and recheck the blood pressure  
   Rationale: A patient with severe status astmaticus can deteriorate during immediate post-intubation period due to relative hypovolemia, decrease preload due to effects of positive pressure ventilation, dynamic hyperinflation and tension pneumothorax. Dynamic hyperinflation itself makes an important contribution, however, as it not only increases pulmonary vascular resistance and right ventricular afterload, but the associated auto PEEP elevates pleural and right atrial pressures, impeding venous return. During cardiopulmonary resuscitation of patients with airflow obstruction, auto PEEP generated by overzealous “bagging” impairs ventricular loading and can result in pulseless electrical activity reversible by reducing ventilation

**References**


7. **D:** It is contraindicated in patients who have increased intracranial pressure  
   Rationale: The cerebrovascular response to changes in PaCO2 is mediated locally by changes in perivascular pH. A nearly linear relationship between PaCO2 and CBF exists between the range of PaCO2 values of 20 and 80 torr, with an approximate 4%/mm Hg change in PaCO2. Consequently; vasodilation is seen with increasing arterial CO2 concentration leading to increase in intracranial pressure.

8. **C:** 10 cm H2O  
   Rationale: Oxygen delivery (DO2) = Cardiac output X Arterial Oxygen Content (CaO2)  
   CaO2= 1.34 X hemoglobin concentration x SaO2 + 0.0031 X PaO2

9. **A:** Hyperkalemia  
   Rationale: A child with CRF having crush injury and intubated with succinylcholine is prone to develop hyperkalemia.  
   Effects of hyperkalaemia on the ECG  
   - Peaked T waves (usually the earliest sign of
hyperkalaemia)
• P wave widens and flattens
• PR segment lengthens
• P waves eventually disappear
• Prolonged QRS interval with bizarre QRS morphology
• High-grade AV block with slow junctional and ventricular escape rhythms
• Any kind of conduction block (bundle branch blocks, fascicular blocks)
• Sinus bradycardia or slow AF
• Development of a sine wave appearance (a pre-terminal rhythm)
• Asystole
• Ventricular fibrillation
• PEA with bizarre, wide complex rhythm

In individual patients, the serum potassium level may not correlate closely with the ECG changes. Patients with relatively normal ECGs may still experience sudden hyperkalemic cardiac arrest.

10.A: Continue ampicillin/sulbactum
Rationale: The isolation of Candida species from the respiratory secretions is frequent in mechanically ventilated patients. This occurs as a result of seeding of the lungs secondary to hematogenous dissemination, or it may follow the aspiration of colonized oropharyngeal or gastric contents. Nevertheless, invasive lung infection by Candida species is rare in non-immunocompromised subjects. The isolation of Candida from cultures of sputum, endotracheal aspirates, bronchoscopic samples, percutaneous lung needle aspirates, and even lung tissue may only represent colonization of the tracheobronchial tree. The definite diagnosis of pulmonary candidiasis still rests on histologic demonstration of the yeast in lung tissue with associated inflammation. The presence of Candida in respiratory samples, independently of quantitative cultures, is not a good marker of Candida pneumonia in critically ill, non-neutropenic, non-AIDS patients.

How to cite this article

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Available from: http://www.criticalcarepediatrics.in
Indian Diploma in Pediatric Critical Care Medicine

Brief Information
Indian Diploma in Pediatric Critical Care Medicine (IDPCCM) is a one year course (for MD / DNB) and 2 year course for DCH candidates. The course is currently being run in accredited centers in India. Eligibility is MD / DNB / DCH in Pediatrics (MCI approved). The candidates can check the centers where the course are being run on this website and apply directly to the Directors of the center. The selection of the candidate and remuneration is as per each institutional policy and college is not involved in their internal decisions. Registration for the course, each year, needs to be done usually by 30th of November (to check with director / contact office for updated information); for the exam which will be conducted in subsequent year (Register 1 year in advance). Curriculum for this course is displayed on this website. Exam pattern consists of MCQ based (100 marks question paper- 3 hours), and passing is strictly 60% and above. Those who pass this theory exam, are then allowed to appear for practical exam which consists of case based viva (Long or Short) along with OSCE (Observed structured clinical examination). Thus the exam has 3-4 components (heads), and for passing minimum average 60% is required with minimum 50% in each head. Exam forms are sent to the registered candidates 2 months prior to examination. Registrations forms available on this website.

Indian Fellowship in Pediatric Critical Care Medicine

Brief Information
Indian Fellowship in Pediatric Critical Care Medicine is a two-year course for MD / DNB and three years course for DCH candidates. The course is currently being run in accredited centers in India. Eligibility is MD / DNB / DCH in Pediatrics (MCI approved). The candidates can check the centers (or contact office) where the course are being run on this website and apply directly to the Directors of the center. The selection of the candidate and remuneration is as per each institutional policy and college is not involved in their internal decisions. Registration for the course, each year, needs to be done by 30th of June (Register 2 years in advance) and is permitted to be done till 30th Sept in special circumstances; and also will be allowed to appear along with other candidates registered before 30th June. However, results of late joining candidates will be declared after completing 2 year tenure.

Exam pattern consists of MCQ based (100 marks theory paper- 3 hours) with additional descriptive question paper, and passing is strictly 60% and above. Those who pass this theory exam, are then allowed to appear for practical exam which consists of case based viva (Long or Short), bedside viva along with OSCE (Observed structured clinical examination). Thus the exam has 3-4 components (heads), and for passing, minimum average 60% is required with minimum 50% in each head. Exam forms are sent to the registered candidates 2 months prior to examination.

Indian Diploma in Pediatric Critical Care Nursing

Brief Information
Indian Diploma in Pediatric Critical Care Nursing is a one-year course. The course is currently being run in all the accredited centers across India. Eligibility is graduation in nursing course from authorized body. The exam is in the form of theory and practical- viva. Passing is for 50%.

Currently there are 29 training centers accredited by
the College of Pediatric Critical Care. Accreditation goes through a systematic process to ensure adequate opportunities for trainees in terms of number of patients, case mix, procedures, mechanical ventilations, and accredited teachers. Following is the list of training centers accredited (updated in November 2017). Candidates aspiring to do fellowship can themselves apply to any center below addressing the directors of each unit.

<table>
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<tr>
<th>Training Centres</th>
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<tr>
<td>Name of the Training Center</td>
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<tr>
<td>1 Bai Jerbai Wadia Hospital for Children, Acharya Dhonde Marg, Parel, Mumbai - 400012</td>
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<tr>
<td>2 Max Super Speciality Hospital, Patpar Ganj, L-60 Kalka JI, New Delhi-110019</td>
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<tr>
<td>3 K.E.M. Hospital &amp; Research Centre, Dept. of Pediatrics, TDH Ground Floor, KEM Hospital, Rasta Peth, Pune - 411 011</td>
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<tr>
<td>4 Kanchi Kamakoti Childs Trust Hospital, PICU, 12A, Nageswara Road, Nungambakkam, Madras-600034</td>
</tr>
<tr>
<td>5 Sir Ganga Ram Hospital, Dept of Pediatrics, Institute Child Health, Sir Ganga Ram Hospital, Rajinder Nagar, New Delhi</td>
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<tr>
<td>6 Apollo Childrens Hospital, No-15, Shaifi Mohammed Road, Thousand Heights, Chennai- 06</td>
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<tr>
<td>7 Rainbow Childrens Hospital, Plot#22, Rd#10, Banjara Hills, Hyderabad-34</td>
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<tr>
<td>8 Apollo Hospital, SaritaVihar, Mathura Road, New Delhi - 76</td>
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<td>9 Christian Medical College &amp; Hospital, Vellore-S - 632004</td>
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<td>10 Manipal Hospital, No 98 Rustam Bagh, Old Airport Road, Bangalore - 560017</td>
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<td>11 BLK Superspecialty Hospital, Pus Road, New Delhi</td>
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<td>12 Sri Ramachandra Medical Centre, Porur, Chennai-600116</td>
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<td>13 Lotus Children Hospital, #6-2-29, Lakdipul, Hyderabad, 500004</td>
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<tr>
<td>14 Dayanand Medical College and Hospital, 9/25, P.A.U. Campus, Ludhiana 141004</td>
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<td>15 Nirmal Hospital Pvt Ltd, Ring Road, Surat - 395002</td>
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<td>16 Rainbow Children’s Hospital, Matharhalli, Bangalore</td>
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Fundamental Pediatric Intensive Care Course
FPICCC
This is a two day course, designed to initiate, introduce, and impart basic skills to a practicing pediatrician or to postgraduate students. The comprehensive course consists of didactics and hands on experience that takes one through basics of identification of a sick child to managing shock, neurological emergencies, basic skills of mechanical ventilation, blood gas interpretation etc. The skill stations with smaller groups makes this uniquely interactive. This has been updated in March 2018.

Advanced Pediatric Intensive Care Course
APICCC
This is a two day course, designed to update the knowledge of a practicing pediatric intensivist.
This comprehensive course consists of didactics on recent advances and hands on experience that takes one through advanced ventilation, difficult airway management, renal replacement therapy including CRRT, extra corporeal membrane oxygenation to name a few.

**Advanced Pediatric Intensive Care Course**

For more information: Contact Office

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**Basic Pediatric Critical Care Nursing Course**

BPCCNC

This is a one day course for pediatric critical care nursing course, more useful for those who do have some exposure to PICU nursing, but also for beginners, and involved lectures and skill stations. Identifying a sick baby, monitoring, infection control, trouble shooting etc are some of the important part of this course.

For more information: Contact Office

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For more information: Contact Office
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New Edition 2018