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## IN THIS ISSUE

### Effect of Different Modes of Chest Physiotherapy on Arterial Blood Gases Following Paediatric Cardiac Surgery

by Md. Abu Shaphe, PT, PhD; Rajeev Aggrawal, MPT, (PhD); Mohd Abid Geelani, MCH; Jamal Ali Moiz, MPT  
Page 1

### SCAI Monthly Column: SCAI CHD Council Offers Online Bibliography for Quick Reference

by Eric Grammer  
~Page 11

### Medical News, Products and Information

~Page 12

### January Medical Meeting Focus:

~Page 15

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### UPCOMING MEDICAL MEETINGS

See website for additional meetings

#### TCT2011 (Transcatheter Cardiovascular Therapeutics)

Nov 7-11, 2011; San Francisco, CA USA

[www.tctconference.com](http://www.tctconference.com)

#### European Echocardiography Course

Nov. 16-19, 2010; Munich, Germany

[www.echocardiography-course.com/](http://www.echocardiography-course.com/)

#### Fetal and Pediatric Cardiology Seminar

Dec. 9010, 2011; Paris France

[www.seminarfetalandpediatriccardiologyparis2011.org/accueil.html](http://www.seminarfetalandpediatriccardiologyparis2011.org/accueil.html)

#### LAA 2011 - How to Close the Left Atrial Appendage

Nov. 19, 2011; Frankfurt, Germany

[www.csi-congress.org/laa-workshop.php](http://www.csi-congress.org/laa-workshop.php)

Recruitment Ads on pages:

3, 4, 5, 6, 7, 9, 12, 13, 14, 16, 17, 18, 19

## Effect of Different Modes of Chest Physiotherapy on Arterial Blood Gases Following Paediatric Cardiac Surgery

By Md. Abu Shaphe, PT, PhD; Rajeev Aggrawal, MPT, (PhD); Mohd Abid Geelani, MCH; Jamal Ali Moiz, MPT

### Abstract

#### Background

Lung complications after pediatric heart surgery frequently include atelectasis and pneumonia. Physiotherapy has an important role in the treatment of these complications. This study was designed to compare changes in Oxygenation index ( $\text{PaO}_2/\text{FiO}_2$ ) and  $\text{PaCO}_2$  caused by different modes of chest physiotherapy in ventilated pediatric patients after cardiac surgery.

#### Methods

Pediatric patients who were ventilated after cardiac surgery were randomly assigned to one of three modes of CPT (chest physiotherapy) based on clinical evidence of tracheobronchial secretion retention. Oxygenation index and  $\text{PaCO}_2$  were measured before CPT and fifteen minutes after completion of the CPT sessions up to three days after surgery.

#### Results

All three modes of CPT resulted in improvement of oxygenation of infants. No

*“Lung complications after pediatric heart surgery frequently include atelectasis and pneumonia. Physiotherapy has an important role in the treatment of these complications. This study was designed to compare changes in Oxygenation index ( $\text{PaO}_2/\text{FiO}_2$ ) and  $\text{PaCO}_2$  caused by different modes of chest physiotherapy in ventilated pediatric patients after cardiac surgery.”*

modes of CPT were demonstrated superior to the others in terms of improvements in Oxygenation index or  $\text{PaCO}_2$ .

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The present data suggest all three CPT modes were found to be effective in improving oxygenation of infants following cardiac surgeries in ICU while on ventilation. However, none of the three CPT modes were superior over other.

## Introduction

Children with congenital heart disease often develop changes in respiratory mechanics<sup>1</sup>. In addition, heart surgery associated with cardiopulmonary bypass (CPB) also leads to a number of respiratory complications.<sup>2</sup> Thus, CPT in the post-operative period has as main objectives lung re-expansion, airway clearance, and prevention of complications such as pneumonia.<sup>3</sup>

CPT plays an important role in the prevention and management of lung complications. A large number of studies have reported the effects of CPT on this patient population. Authors have used a variety of strategies, techniques, and duration of treatment. Moreover, different approaches and combinations have been employed without specific scientific rationale. The purpose of this study was to evaluate the impact of three different CPT modes on Oxygenation index and PaCO<sub>2</sub> in ventilated pediatric patients after cardiac surgery.

## Methods

The study was performed in the G. B. Pant Hospital New Delhi, India. It included 45 ventilated pediatric patients, age range 12-72 months (mean 36.75 months), following open heart surgery. Informed consent was obtained from the parents of the subjects.

### Inclusion Criteria

- Children up to 6 years of age.
- Had undergone corrective cardiac surgery.
- Subjects while on mechanical ventilation.
- Clinical evidence of tracheobronchial secretion retention.

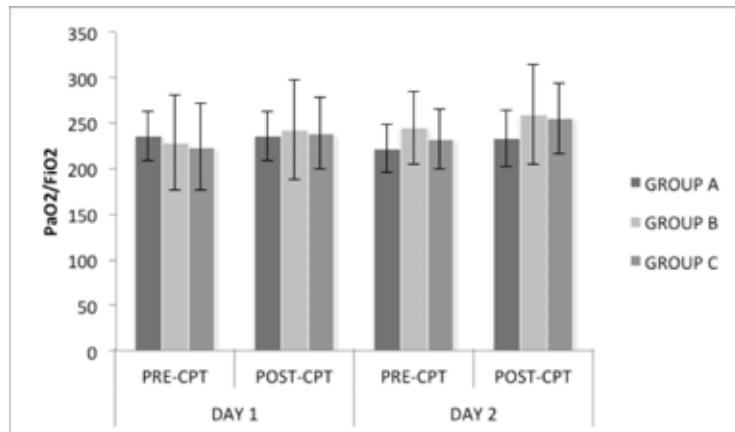


Figure 1. Comparison of PaO<sub>2</sub>/FiO<sub>2</sub> pre- and post-CPT of day 1 among groups.

### Exclusion Criteria

- Cardiovascular unstable subjects.
- Neurologically ill patients.

Patients returning to the cardiac intensive care unit were ventilated using an endotracheal tube attached to a servo ventilator, with humidification at 34° C from a respiratory humidifier. Based on the Inclusion and Exclusion Criteria, eligible patients were randomly assigned to one of three CPT modes designated groups A, B, and C using a chit method.

- Group A: (n=15) Percussion and Suctioning.
- Group B: (n=15) Vibration, Bag squeezing and Suctioning.
- Group C: (n=15) Percussion, Vibration, Position change, Bag squeezing and Suctioning.

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Wieck-Sullivan Professor and Director of Pediatric Cardiology,  
Saint Louis University School of Medicine,  
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St. Louis, MO 63104.  
Telephone: (314)-577-5633  
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email [schowko@slu.edu](mailto:schowko@slu.edu)

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**Design**

The study was a prospective randomized clinical trial designed to compare effectiveness of three different modes of CPT in pediatric patients after cardiac surgery.

**Procedure**

The type of operation and the oxygen requirement ( $\text{FiO}_2$ ) were recorded. Oxygenation Index and  $\text{PaCO}_2$  were measured before CPT and at the end of the first post-operative day, 15 minutes after the last CPT session. This procedure was repeated on the second and third post-operative days. The day and time of extubation was recorded. Evening values of Oxygenation Index and  $\text{PaCO}_2$  were measured fifteen minutes after completion of CPT in order to avoid the immediate effects of CPT.

Chest physiotherapy techniques were employed as follows:

- Percussion consisted of striking the chest with a Bennet face mask at a rate of 10-120 beats per minute.
- Vibration was given when the patient was on exhalation phase.
- Bag squeezing was performed with a 500ml bag with 3 tidal volumes.
- Position changes consisted of moving the patient from left to right side down.

**Data Analysis**

Data analysis was performed using software package SPSS for windows version "15" repeated measure analysis of variance (ANOVA) was used to examine changes in all dependent variables, Significance level set for this study was set at ( $p < 0.05$ ).

**Results**

**Group Analysis**

**Group A:** (Percussion and Suctioning): On day 1st pre- and post-CPT,  $\text{PaO}_2/\text{FiO}_2$  changes were non-significant ( $p=0.975$ ). On day 2 in the morning,  $\text{PaO}_2/\text{FiO}_2$  fall to  $221.68 \pm 26.15$  from  $236.07 \pm 26.55$  which was statically significant ( $p=0.007$ ). On day 2 in the evening, there was significant improvement in  $\text{PaO}_2/\text{FiO}_2$  following percussion and suctioning ( $p=0.008$ ).  $\text{PaCO}_2$  On day 1 pre- and post-CPT changes were non significant ( $p=0.199$ ). On day 2 in the morning,  $\text{PaCO}_2$  fall to  $37.67 \pm 2.47$  from  $38.51 \pm 3.90$  which was non-significant ( $p=0.238$ ). On day 2 in the evening  $\text{PaCO}_2$  improved towards normal ( $p=0.007$ ).

**Group B:** (Vibration, Bag Squeezing and Suctioning): On day 1 pre- and post-CPT,  $\text{PaO}_2/\text{FiO}_2$  change was non-significant ( $p=0.137$ ). There was no difference in  $\text{PaO}_2/\text{FiO}_2$  on post-op day 2 morning when compared with post-op day 1 evening value ( $p=0.586$ ). On day 2 in the evening,  $\text{PaO}_2/\text{FiO}_2$  improved significantly ( $p=0.007$ ).  $\text{PaCO}_2$  On day 1st pre- and post-CPT changes were non-significant ( $p=0.325$ ). On day 2 in the morning,  $\text{PaCO}_2$  improved towards normal which was significant ( $p=0.001$ ). On day 2 in the evening,  $\text{PaCO}_2$  again improved towards normal which was significant ( $p=0.30$ ).

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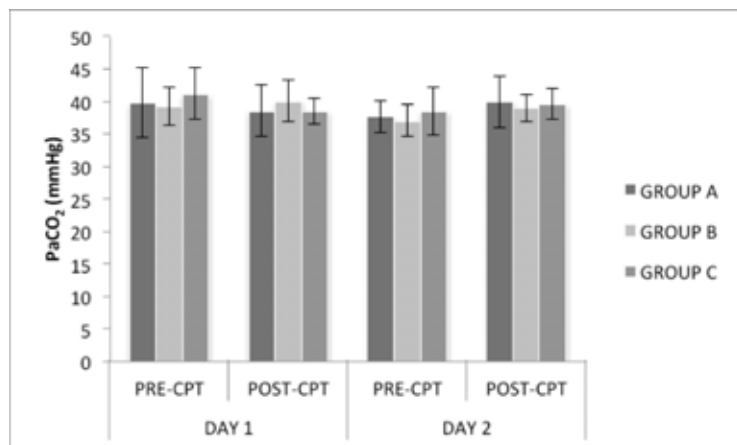


Figure 2. Comparison of PaCO<sub>2</sub> pre- and post-CPT of day 2 among groups.

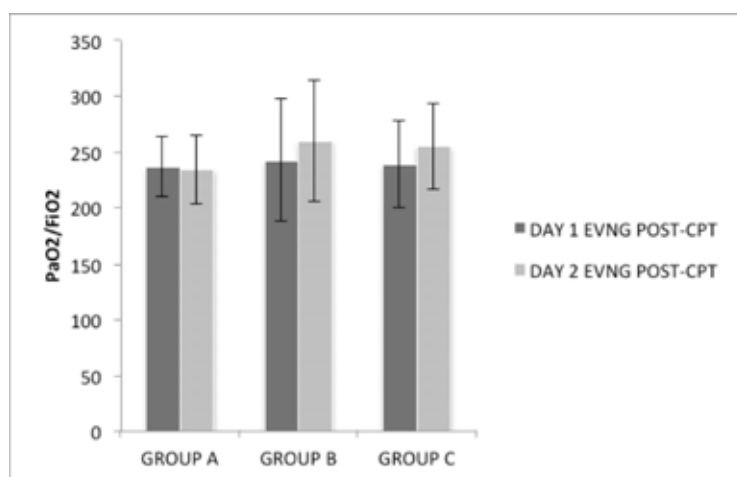


Figure 3. Comparison of PaO<sub>2</sub>/FiO<sub>2</sub> post-CPT of 1st day evening and post-CPT of 2nd day evening among groups.

**Group C:** (Percussion, Vibration, Position change, Bag squeezing and Suctioning). On day 1 pre- and post-CPT, PaO<sub>2</sub>/FiO<sub>2</sub> changes were non-significant (p=0.080). On day 2 in the morning, PaO<sub>2</sub>/FiO<sub>2</sub> changes were non-significant (p=0.217). On day 2 in the evening, PaO<sub>2</sub>/FiO<sub>2</sub> improved to 254.86 ± 38.25 from 232.74 ± 32.51 which was statically significant (p=0.000). PaCO<sub>2</sub>. On day 1 pre- and post-CPT changes were significant (p=0.018). On day 2 in the morning, PaCO<sub>2</sub> changes were non-significant (p=0.995). On day 2 in the evening, PaCO<sub>2</sub> improved towards normal 39.67 ± 2.35 which was statically non-significant (p=0.347).

**"Inter" Group Analysis:** There were no significant differences between the study groups in PaO<sub>2</sub>/FiO<sub>2</sub> or in PaCO<sub>2</sub> at any of the time points evaluated.

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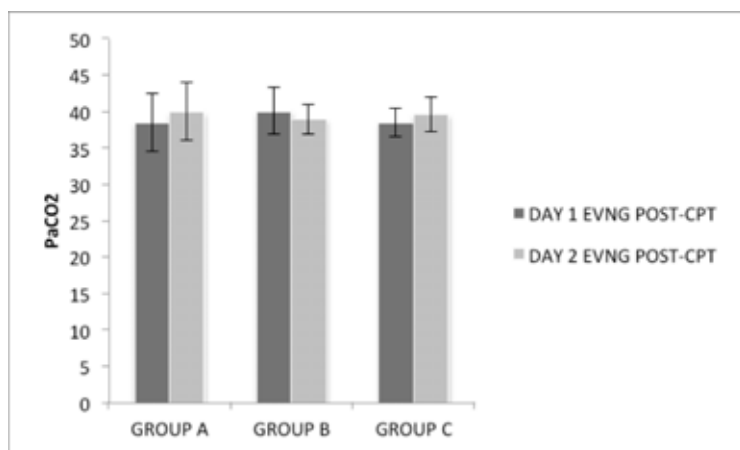


Figure 4. Comparison of  $\text{PaCO}_2$  post-CPT of 1st day evening and post-CPT of 2nd day evening among groups.

### Discussion

This study shows that at no time during treatment was any group superior to the others in terms of  $\text{PaO}_2/\text{FiO}_2$  and  $\text{PaCO}_2$ .  $\text{PaO}_2/\text{FiO}_2$  showed no improvement following CPT on day 1 in all three groups. In group A, only percussion was given before suctioning, where as in group B, vibration and bag squeezing were given before suctioning. These two techniques were found to be equally effective. The combination of both techniques in group C, i.e. percussion, vibration, position change, bag squeezing and suctioning, did not show any additional benefit over the any of the single technique. In this group of patients, no patients had severely deteriorated changes in ABG before the study and could not show dramatic change following various combinations of techniques. Earlier studies showed, that CPT is of no value and has a negative effect in patients without many secretions.<sup>8,9,10</sup>

In group A,  $\text{PaO}_2/\text{FiO}_2$  did not show any change in the evening following CPT. It may be therefore, that pre-CPT, the  $\text{PaO}_2/\text{FiO}_2$  were not deranged. So with percussion and routine suctioning,  $\text{PaO}_2/\text{FiO}_2$  was maintained until evening. But, because there was no percussion given in the night, second day morning  $\text{PaO}_2/\text{FiO}_2$  dropped significantly.

Oxygenation of arterial blood is studied as the ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen ( $\text{PaO}_2/\text{FiO}_2$ ). This is done to control for supplemental oxygen given to patients in critical care settings. The ratio of ( $\text{PaO}_2/\text{FiO}_2$ ) is an indirect measure of oxygen content in the arterial blood and is representative of optimal gas exchange in the acini. A decrease in ratio of  $\text{PaO}_2/\text{FiO}_2$  indicated that less oxygen is available for tissue metabolism which can further lead to acidosis and multiple organ system failure. A decrease in  $\text{PaO}_2/\text{FiO}_2$  can occur in mechanically ventilated patients as a consequence of pulmonary complications like atelectasis, retained secretions and ventilator associated bacterial colonization. Retained secretions increase dead space ventilation and act as a diffusion barrier to gas exchange. The oxygen transport is more adversely affected due to its slower diffusion rate which leads to a gross V/Q mismatch and decrease in  $\text{PaO}_2/\text{FiO}_2$  levels.



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Figure 5. Therapist performing percussion with the Bennet Face Mask.



Figure 6. Arterial Blood Gas Analyzer, ABL System 610.

In the evening of day 2, there was significant improvement in  $\text{PaO}_2/\text{FiO}_2$  following percussion and suctioning which shows the need for CPT in pediatric patients following cardiac surgery. Other literature has also reported the use of chest percussion in improving oxygenation.<sup>11</sup> Finner & Byoad (1978) reported the improvement in arterial oxygenation in the neonate following percussion using a contact heel technique. However, Hussey et al (1996)<sup>7</sup> were unable to show any improvement in oxygenation, Connors et al (1980)<sup>12</sup> found a negative correlation between the amounts of secretions and arterial oxygen level. Husbey et al (1976)<sup>13</sup> showed a decreased in  $\text{PaO}_2$ . In another study by Wollmer et al (1985)<sup>14</sup>, no significant difference in oxygen saturation between pre- and post-treatment was seen. Gallon (1991)<sup>15</sup> reported

sputum production was significantly greater when percussion was included in the treatment regimen.

In group B, vibration and bag squeezing did not show any additional benefit, the results were the same as group A.  $\text{PaO}_2/\text{FiO}_2$  did not show any significant change in the evening following CPT. Again, there was no difference in  $\text{PaO}_2/\text{FiO}_2$  in post-op day 2 morning when compared with the post-op day 1 evening. Holody & Goldberg (1981)<sup>16</sup> showed a significant increase in  $\text{PO}_2$  at 30 min and 1 hour after completion of chest vibration, and said chest vibration is a useful therapeutic modality in the management of hypoxemia in patients with atelectasis or pneumonia. Fox et al (1978)<sup>17</sup> reported mean  $\text{PO}_2$  decreased significantly after suctioning and increased significantly after hyperventilation. Goronezano and Branthwaite (1972B)<sup>18</sup> studied three different groups. Although treatment was similar in all groups, significant changes in  $\text{PaO}_2$  were largely confined to patients in group 2 who were all suffering from serious cardiac pathology.

In group C, the treatment techniques applied were: percussion, vibration, position change, bag squeezing and suctioning,  $\text{PaO}_2/\text{FiO}_2$  shows non-significant changes on the day one following above the technique. On day 2 evening  $\text{PaO}_2/\text{FiO}_2$  improved significantly following CPT. The results of this group were similar to groups A and B, which shows there is no difference following different techniques of chest physiotherapy in pediatric age group. Tudehope and Baglay (1980)<sup>19</sup> show an increase in  $\text{PaO}_2$  with a mean rise of 16.6 mmHg following CPT. Even Mackenzie et al (1978)<sup>20</sup> showed improvement in  $\text{PaO}_2/\text{FiO}_2$  after CPT, though the results were statically insignificant. It was found that the arterial oxygenation improved significantly after initiation of CPT. Interestingly, there was a decline in the levels of  $\text{PaO}_2/\text{FiO}_2$  between the evening values of day 1 and the morning values of day 2. This implies that receiving no CPT during the night adversely affects the level of oxygenation in mechanically ventilated patients. It is conceivable that patients accumulate secretions in the lungs during the no CPT periods leading to drops in the arterial oxygenation as more secretions accumulate." Instead the sentence ending with renowned. Zack M B (1974)<sup>21</sup> showed that  $\text{PaO}_2$  was generally higher in the right lateral decubitus position than in the left, although the difference was not significant. Suctioning induced hypoxemia is frequently reported in the literature. But we were able to abolish it by giving 5-6 breaths of increased oxygenation before and between suction. Finally, this corroborates with Kareem et al (1990).<sup>22</sup>

$\text{PaCO}_2$  in this study groups A, B and C show non-significant changes in the partial pressure of carbon dioxide level following CPT. This is primarily because most of the patients had no  $\text{CO}_2$  retention even prior to CPT initiation. This could be because of the nature of their pulmonary complications which include tachypnea initially, and thus removal of excess  $\text{CO}_2$ . Furthermore, as the  $\text{PaCO}_2$  in arterial blood is an indirect measure of dissolved  $\text{CO}_2$  in arterial blood, the levels are affected by minute ventilation. As the respiratory rate or tidal volume increases, the minute volume also increases, thus removing excess carbon dioxide. Therefore, the lack of any changes in  $\text{PaCO}_2$  in these patients pre- versus post-CPT can be attributed to the modification of respiration rate and tidal volume by the ventilator settings. Finner & Boyad (1978) also reported that there is no significant change in  $\text{PaCO}_2$ .



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Table 1: Comparison of PaO <sub>2</sub> /FiO <sub>2</sub> Pre- and Post-CPT on Day 1 Among Groups					
	GROUP A n=15	GROUP B n=15	GROUP C n=15	F	P
	M± SD	M± SD	M± SD		
Pre-CPT	236.20 ± 34.50	228.66 ± 52.02	223.53 ± 47.39	0.297	NS
Post-CPT	236.07± 26.55	242.23± 54.75	238.11± 38.95	0.895	NS
t	0.032	1.577	1.887		
p	0.975	0.137	0.080		

Table 2 : Comparison of PaO <sub>2</sub> /FiO <sub>2</sub> Pre- and Post-CPT on Day 2 Among Groups					
	GROUP A n=15	GROUP B n=15	GROUP C n=15	F	P
	M± SD	M± SD	M± SD		
Pre-CPT	221.68±26.15	244.89±39.68	232.74±32.51	1.830	NS
Post-CPT	233.66±30.36	259.50±54.36	254.86±38.25	1.599	NS
t	3.098	3.183	4.780		
p	0.008	0.007	0.000		

Table 3: Comparison of PaO <sub>2</sub> /FiO <sub>2</sub> Post-CPT on 1 <sup>st</sup> Day Evening and Post-CPT of 2 <sup>nd</sup> Day Between Group					
	GROUP A n=15	GROUP B n=15	GROUP C n=15	F	P
	M± SD	M± SD	M± SD		
1st Day Post-CPT	236.07±26.55	242.23±54.75	238.11±38.95	1.830	NS
2nd Day Post-CPT	233.66±30.36	259.50±54.36	254.86±38.25	1.599	NS
t	0.659	9.882	5.525		
p	0.007	0.586	0.217		

Table 4: Comparison of PaCO <sub>2</sub> of Pre- and Post- CPT on 1 <sup>st</sup> Day Between Groups					
	GROUP A n=15	GROUP B n=15	GROUP C n=15	F	P
	M± SD	M± SD	M± SD		
Pre-CPT	39.77±5.38	39.14±2.98	41.19±3.91	0.934	NS
Post-CPT	38.51±3.90	40.09±3.22	38.50±1.91	1.291	NS
t	1.349	1.019	2.683		
p	0.199	0.325	0.018		

## Conclusion

In conclusion, the present data suggest all three treatment modes were found to be effective in improving oxygenation of young children following cardiac surgeries in the ICU while on ventilation. Similarly all three regimens were found to be effective in normalizing the PaCO<sub>2</sub> level, although superiority of any regime over the others could not be proved. So, it can be concluded that young children need chest mobilization along with suctioning at regular intervals to avoid hypoxemia and carbon dioxide fluctuation after cardiac surgery.

## Future Research

Further research with longer follow-up periods and larger populations is required for

generalization of these results regarding chest physiotherapy in children.

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***“So, it can be concluded that young children need chest mobilization along with suctioning at regular intervals to avoid hypoxemia and carbon dioxide fluctuation after cardiac surgery.”***

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Table 5: Comparison of PaCO <sub>2</sub> of Pre- and Post-CPT on 2 <sup>nd</sup> Day Among Groups					
	GROUP A n=15	GROUP B n=15	GROUP C n=15	F	P
	M± SD	M± SD	M± SD		
Pre-CPT	37.67±2.47	37.00±2.41	38.50±3.67	1.005	NS
Post-CPT	39.92± 3.91	38.98± 2.04	39.67±2.35	0.420	NS
t 3.193		2.417	0.973		
p	0.007	0.30	0.347		

Table 6: Comparison of PaCO <sub>2</sub> Post-CPT on 1 <sup>st</sup> Day Evening and Post-CPT on 2 <sup>nd</sup> Day Among Groups (S=Significant; NS=Non-Significant)					
	GROUP A n=15	GROUP B n=15	GROUP C n=15	F	P
	M± SD	M± SD	M± SD		
1st Day Post-CPT	38.51±3.90	40.09±3.22	38.50±1.91	1.291	NS
2nd Day Post-CPT	39.92±3.91	38.98±2.04	39.67±2.35	0.420	NS
t 1.644		1.091	1.437		
p	0.238	0.001	0.995		

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CCT

#### Corresponding Author:

*Md. Abu Shaphe, PT, PhD*  
Associate Professor, Faculty of Applied  
Medical Sciences  
Jazan University  
Jazan, Saudi Arabia

Phone: +919868038102  
00966597165564  
shaphe72@yahoo.com

*Rajeev Aggrawal, MPT, (PhD)*  
Neuro Physiotherapy AIIMS  
New Delhi  
India

*Mohd Abid Geelani, MCH, Professor,*  
CTVS  
G.B. Pant Hospital  
New Delhi  
India

*Jamal Ali Moiz, MPT, Assistant Professor*  
CPRS  
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# SCAI Monthly Column: SCAI CHD Council Offers Online Bibliography for Quick Reference

By Eric Grammer

SCAI's CHD Council has created an online bibliography of critical publications for congenital interventionalists that is now available online at [www.scai.org/CHD/Bibliography.aspx](http://www.scai.org/CHD/Bibliography.aspx).



CHD Section Editors Drs. Makram Ebeid and Russel Hirsch are looking to grow this resource even further. If you have suggested additions for this bibliography, please email them to [mebeid@umc.edu](mailto:mebeid@umc.edu) and [russel.hirsch@cchm.org](mailto:russel.hirsch@cchm.org).

**Plan to Celebrate 35 Years of the Best of the Best in Interventional Education at SCAI 2012**

Start planning now to join your colleagues in celebrating 35 Years of the Best of the Best in Interventional Cardiology Education at SCAI 2012 Scientific Sessions in Las Vegas, May 9-12, 2012. Being organized by Symposium Chair Daniel S. Levi, MD, FSCAI and Symposium Co-chair Thomas E. Fagan, MD, FSCAI the Congenital Heart Disease Symposium at SCAI 2012 is starting to take shape.

The CHD Symposium will feature three days of uninterrupted, focused programming on interventional therapies for congenital and structural heart disease in children and adults. Headlining the program, Julio C. Palmaz, MD will be delivering the Mullins Keynote Lecture. The inventor of the first commercially-successful intravascular stent, Dr. Palmaz's keynote will focus on the history and future of stent technology.

With a focus on case-based learning, SCAI's uniquely collegial atmosphere provides ample opportunity to compare notes and network with a faculty of recognized leaders in the field of pediatric and adult congenital/structural interventional cardiology. Here's your chance to get involved in the programming. We need your "I Blew It" and "Brain Scratcher" case submissions. The simple concept behind both the "Brain Scratchers" and "I Blew It" Sessions is that there is no better teaching method than coming together as a community and sharing our unusual and challenging cases.

The "Brain Scratchers" Session challenges attendees to solve hemodynamic, angiographic or interventional mysteries and to provide solutions for less than routine cases in the congenital catheterization laboratory. The "I Blew It" Sessions highlight the creative ways that our colleagues manage complications.

More importantly, the session addresses how to avoid such events in the future.

If you have a case that might be a good learning tool for either session, please contact Thomas Fagan, MD, FSCAI, at [fagan.thomas@tchden.org](mailto:fagan.thomas@tchden.org). Presentations should last no more than a total of 10 minutes including a dialogue with participants and moderators in how to deal with the complication. The presentation should conclude with some teaching points.

To download the preliminary program, learn more or register for SCAI 2012, please visit [www.scai.org/SCAI2012](http://www.scai.org/SCAI2012).

## SCAI Calls for Abstracts

Abstract submissions are now being accepted for SCAI 2012 in a variety of topic areas including pediatric, adult congenital, structural and valvular interventional therapies. In addition to being a great opportunity to present your research to leaders in the field, it is also a great opportunity to have it published, with all presented abstracts being printed in the field's leading journal, Catheterization and Cardiovascular Interventions (CCI).

In addition, abstract presenters also receive free registration to SCAI 2012 and the Top 10 Abstracts are selected for oral presentations on stage during the sessions. Submission is free and easy, but the December 16th deadline will be here before you know it. Submit your abstracts at [www.scai.org/SCAI2012Abstracts](http://www.scai.org/SCAI2012Abstracts).

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***"SCAI's CHD Council has created an online bibliography of critical publications for congenital interventionalists that is now available online at [www.scai.org/CHD/Bibliography.aspx](http://www.scai.org/CHD/Bibliography.aspx)."***

Eric Grammer  
The Society for Cardiovascular  
Angiography and Interventions (SCAI)  
2400 N Street, NW, Suite 500,  
Washington, DC 20037-1153 USA

Tel: 202-741-9854  
Toll Free: 800-992-7224  
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# Medical News Products and Information

## Special Congressional Briefing Examines Role of Public Health in Congenital Heart Disease

Every 15 minutes in hospitals across America, a baby is born with a congenital heart defect (CHD), or a malformation of the heart's structure and function. Thanks to the advances in modern medicine, more than 80% of these babies are surviving into adulthood and living healthy and productive lives. The children and adults living with CHDs still face unique health challenges requiring specialized life-long care.

A recent briefing on Capitol Hill sponsored by the American Academy of Pediatrics and co-sponsored by the American College of Cardiology (ACC) and other leading cardiovascular societies and patient advocacy groups, highlighted the important role of federal and state programs in CHD research, surveillance, screening and prevention. Senators Richard Durbin (D-Ill.) and Thad Cochran (R-Miss.), co-hosted the event, Congenital Heart Defects: A Lifelong Disease.

Panelist Geoffrey Rosenthal, MD, PhD, FACC, Professor of Pediatrics at the University of Maryland School of Medicine, said CHD places an undeniable burden on the public health system, as well as families. The Congenital Heart Futures Act, passed into law as part of the 2010 health reform legislation, would establish a national surveillance program for CHD patients and serve as a step in the right direction to reduce this burden, he asserted.

Rosenthal also pointed to new activities related to research, care, surveillance and policy development, including the Congenital Heart Public Health Consortium (CHPHC), of which the ACC is a member. The Consortium looks to prevent, enhance and prolong the lives of those with CHD through public health activities, including health promotion and education. Additionally, national CHD registries and other CHD collaborative quality improvement and multi-center research activities will continue to advance the care and management of the tiniest heart patients, who are destined to need life-long specialized heart care. Ultimately there is still more work to be done, Rosenthal maintains. "We need to expand birth defect monitoring programs, reduce disparities and plan for adequate health services," he said. "How do we save those who are still dying? Physicians and the federal government have a critical role to play moving forward."

The federal government took a huge step towards improving early detection for CHD patients this week. Health and Human Services (HHS) Secretary Kathleen Sebelius announced that all U.S. hospitals will be required to screen newborns for CHD using pulse oximetry. The Secretary's Advisory Committee for Heritable Disorders in Newborns and Children had recommended adding pulse oximetry, an inexpensive and non-invasive test to the universal screening panel – a move the ACC and other professional societies and patient advocates in the CHD community have endorsed.

For more on the ACC's involvement in CHD, visit the Adult Congenital and Pediatric Cardiology (ACPC) member section on [CardioSource.org](http://CardioSource.org). The ACPC Section has played a major role in strengthening educational programming for congenital cardiology care providers and has several



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## Congenital Cardiac Intensivist

The Heart Center (THC) at Nationwide Children's Hospital, pediatric teaching facility for The Ohio State University in Columbus Ohio, is recruiting an attending Cardiothoracic Intensive Care Unit (CTICU) physician at any academic level. This individual would join a group of seven multi-background academic cardiac intensivists and eight dedicated nurse practitioners devoted to the CTICU. Our current independently-managed CTICU will expand to a 20 bed unit in January 2012 when we move into our new children's hospital. Candidates must have completed fellowship training in pediatric cardiac anesthesia, critical care and/or cardiology that includes advanced cardiac intensive care training. THC embraces a culture of patient safety and quality, transparency, translational/outcome research, education and public health involvement. These create ample participation and leadership opportunities for the candidate's professional growth. THC has an active hybrid palliation of single ventricle program, thoracic organ transplantation program, blood conservation strategies and manages a large number of adult patients with an on-campus adult CHD program as examples of our clinical innovations. Current annual clinical metrics for THC includes: 450 cardiothoracic surgeries, 600 catheterizations, 10,000+ cardiology outpatient visits. We have a pediatric and pediatric/adult combined cardiology fellowship program. We participate in numerous multicenter clinical trials and quality initiatives including the JCCHD QI Collaborative. We are directly linked to our Center for Cardiovascular and Pulmonary Research which has an NIH T-32 training grant.

**Interested candidates are encouraged to submit their curriculum vitae to:**

Janet Simsic, MD  
Director of the Cardiothoracic Intensive Care Unit  
Nationwide Children's Hospital  
T2296, 700 Children's Drive  
Columbus, OH 43205  
or [janet.simsic@nationwidechildrens.org](mailto:janet.simsic@nationwidechildrens.org)



## Update in Congenital Heart Management

*Immediately preceding the World Congress of Cardiology*  
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significant accomplishments in science and quality, including the development of the IMPACT Registry™ (IMproving Pediatric and Adult Congenital Treatment), which tracks diagnostic and interventional cardiac catheterization in pediatric and congenital heart disease patients. In addition, the ICD Registry™ (Implantable Cardioverter Defibrillator) now includes data elements specific to the pediatric population.

### Researchers Develop New Way to Predict Heart Transplant Survival

Johns Hopkins researchers say they have developed a formula to predict which heart transplant patients are at greatest risk of death in the year following their surgeries, information that could help medical teams figure out who would benefit most from the small number of available organs.

"Donor hearts are a limited resource," says John V. Conte, MD, Professor of Surgery at the Johns Hopkins University School of Medicine and the senior author of the study. "Now, we have a simple-to-use tool that is highly predictive of survival after a heart transplant, and can help guide organ allocation decisions."

Conte and his colleagues, writing in the September issue of *Annals of Thoracic Surgery*, pulled together a series of risk factors already associated with poor outcomes, such as age, race, gender, the cause of a patient's heart failure and whether he or she was on dialysis, and then assigned a number of points to each factor. The sum of those points created a score. The higher the score, the higher the risk of death one year after transplant.

Some factors were weighted more heavily than others, such as female gender (three points); African-American race (three points), and the need for dialysis in the time between being put on the transplant waiting list and getting a transplant (five points).

Patients with the lowest scores — between zero and two — had a 92.5% chance of being alive 12 months after surgery.

Patients with so-called IMPACT scores — the acronym the researchers came up with for the Index for Mortality Prediction After Cardiac Transplantation — above 20 points had a less than 50% chance of survival one year after surgery. Every point on the scale increased the chance of death within one year by 14%.

To develop and test the validity of IMPACT, Conte and his team analyzed data provided by the United Network of Organ Sharing comprising information from all heart transplants — 21,378 of them — conducted in the United States between 1987 and 2010.

More research is needed to learn what role is played by factors other than the recipient's risks, Conte says. Results of their study suggest, for example, that an organ coming from a donor over the age of 50 or one that has been outside the body for more than four hours also increases the risk of death in the recipient, he says.

More than 3,000 people are on the waiting list for a heart transplant in the United States, and many will die before they can get a new heart. Only about 2,000 heart transplants are performed in the US annually. Currently, determining who gets an available heart takes into account how long a patient has been on the list and how sick they are. There is

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Penn State Hershey Children's Hospital at  
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Research opportunities are therefore related to, but not exclusive of, the departments of biomechanics, artificial organs, and nanotechnology at the Penn State University. In addition, the Penn State College of Medicine has a vibrant development program that affords junior faculty the opportunity to advance their knowledge in epidemiology and clinical research.

Those interested should forward their curriculum vitae to:

Howard Weber, MD, FSCAI  
Chief, Division of Pediatric Cardiology  
Penn State Hershey Children's Hospital at  
The Milton S. Hershey Medical Center  
Penn State Hershey College of Medicine  
Children's Heart Group  
P.O. Box 850  
Hershey, PA 17033

Phone: 717-531-8674; Fax: 717-531-2052  
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no standardized consideration of other factors that may predict patients' outcomes, as is the case in determining which patients receive available lungs for transplant. Incorporating the IMPACT score would add another dimension to the conversation about who gets a heart transplant, says Conte, Surgical Director of Heart Transplantation at Johns Hopkins.

"As clinicians, we make an educated guess of what the risk is going to be," he says. "This tool provides a quantitative way to assess the risk."

The other researchers involved in the study — all from Johns Hopkins — are Jeremiah G. Allen, MD; George Arnaoutakis, MD; Timothy J. George, MD; Stuart D. Russell, MD; and Ashish S. Shah, MD; Eric S. Weiss, MD, MPH, a former general surgery resident at Hopkins, was also involved.

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### **Commonly Used Defibrillators Raise Risk of Problems**

When it comes to defibrillators, simpler may be safer, even though more complex machines are used on a majority of patients.

That's according to a new study from a team that included University of Colorado School of Medicine researcher Paul Varosy, MD. The group reviewed more than 100,000 records of cardiac patients. They found that there was more chance of surgical problems and death with devices that require electrical leads to be attached to two chambers of the heart compared to those that work on one chamber.

Although there are potential theoretical benefits, the higher-risk complex defibrillators have never been shown to result in improved survival or decreased rates of hospitalization, says Varosy, Assistant Professor of Medicine at the medical school.

"There is no reason for alarm, and it's important to remember that defibrillators of all kinds have clearly-established benefits in terms of reducing mortality among patients at risk for sudden cardiac death," Varosy says. "But this study does suggest that the simpler defibrillators may cause fewer short-term problems, suggesting that the routine use of dual-chamber defibrillators even in the absence of a simultaneous need for a pacemaker should be re-evaluated."

The two-chamber defibrillator is used in about six of 10 surgeries, according to Varosy, Director of Cardiac Electrophysiology at the VA Eastern Colorado Health Care System. The study was published in the *Journal of the American College of Cardiology*. It examined 104,000 records of cardiac cases from 2006-07.

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### **Impact of Clinical and Echocardiographic Response to Cardiac Resynchronization Therapy**

The Echocardiographic Response (reduction of left ventricular end-systolic volume) evaluated at 6 months follow-up, demonstrated to be a better predictor of long-term mortality than improvement in clinical status in a large population of CRT patients. Therefore, assessment of occurrence of left ventricular reverse remodeling at mid-term follow-up may be an adequate surrogate end point in heart failure patients treated with CRT.

The efficacy of Cardiac Resynchronization Therapy (CRT) has been demonstrated with significant reductions in mortality and morbidity of

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heart failure patients. However, many studies have evaluated the efficacy of CRT by means of improvement in heart failure symptoms (clinical response) or reduction in left ventricular volumes (left ventricular reverse remodeling) and improvement in left ventricular function (echocardiographic response) at mid-term follow-up (3 or 6 months after CRT implantation). Based on these surrogate end points, the efficacy of CRT may change significantly and, consequentially, definition of response to CRT is still debated. Ideally, these surrogate end points should determine a significant reduction in mortality. Accordingly, the present evaluation investigated which definition of CRT response at mid-term follow-up (clinical improvement or left ventricular reverse remodeling) best predicts long-term mortality.

A total of 663 advanced heart failure patients were followed-up for the occurrence of all-cause mortality. At 6 months follow-up, the clinical and echocardiographic responses to CRT were evaluated. Clinical response to CRT was defined as a reduction in New York Heart Association functional class of at least 1 point whereas echocardiographic response to CRT was defined by a reduction in left ventricular end-systolic volume of at least 15%. Based on these definitions, 510 (77%) patients showed clinical response and 412 (62%) patients showed echocardiographic response to CRT. During a mean follow-up of 37±22 months, 140 (21%) patients died.

Clinical and echocardiographic CRT responses were both significantly related to all-cause mortality. However, only echocardiographic response to CRT was independently associated with a superior survival. In particular, a patient who did not show echocardiographic response had a risk of death three times higher than a patient showing a good echocardiographic response (hazard ratio 0.38; 95% confidence intervals, 0.27-0.50;  $p < 0.001$ ).

A cumulative 1%, 4% and 8% of the patients with LV reverse remodeling died by 12, 24 and 36 months follow-up, respectively. In contrast, a respective 8%, 19% and 27% of the patients without LV reverse remodeling died during the same time period (log-rank  $p < 0.001$ ).

The present findings have important implications in the design process of clinical trials, since the use of biological markers in the prevention and progression of heart failure (such as changes in left ventricular

volumes and function) allows investigators to make a prompt evaluation of heart failure therapies and helps to understand the biologic processes underlying the disease and the mechanisms of the therapy. In addition, the use of these surrogate endpoints permits smaller sample size, shorter trial duration and reduced costs.

In conclusion, the echocardiographic response (reduction of left ventricular end-systolic volume) evaluated at 6 months follow-up demonstrated to be a better predictor of long-term mortality than improvement in clinical status in a large population of CRT patients. Therefore, assessment of occurrence of left ventricular reverse remodeling at mid-term follow-up may be an adequate surrogate endpoint in heart failure patients treated with CRT.

#### iApp Paed ECG: Paediatric ECG Manual

Available for both iPhone and iPad, the Paed ECG iApp has become an invaluable tool to all health care professionals involved in the recording or reading of paediatric electrocardiograms. A comprehensive manual of Paediatric Electrocardiography designed and developed by Dr. Marion Tipple, Paediatric Cardiologist/Electrophysiologist at the British Columbia Children's Hospital in Vancouver, Canada, it is written in straight-forward bullet style and divided into sections for ease of use. The extensive ECG database contains tracings of high resolution from pre-term infants to young adults. Criteria and examples for the different age group norms are included along with those of pre- and post-operative congenital and acquired heart disease.

The sections are organized as:

- 1) Basics: electrode placements, recording and lead explanation;
- 2) Normal: tables of normal values and variants;
- 3) Abnormal: recording errors, morphology, cardiac malposition, congenital heart disease (pre and post op), syndromes, acquired heart disease, system disorders;
- 4) Rhythm: normal and abnormal (diagrams of arrhythmia mechanisms, diagnostic criteria, differential diagnosis), inherited disorders (LQTS, Brugada, CPVT, ARVD), basic pacemaker interpretation and troubleshooting.
- 5) ECG Quiz: 100 tracings for self assessment.

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### Study Examines Risk of Aortic Complications Among Patients with Common Congenital Heart Valve Defect

While the incidence of the life-threatening condition of aortic dissection is significantly higher than in the general population, it remains low among patients with the congenital heart defect, bicuspid aortic valve; however, the incidence of aortic aneurysms is significantly high, according to a study in the September 14th issue of JAMA.

Bicuspid aortic valve (BAV; defect of the aortic valve that results in the formation of two flaps that open and close, instead of the normal three) is the most common congenital heart defect, with the most serious complication from this condition (due to the high risk of death) being aortic dissection (a tear involving the layers of the wall of the aorta). "...it is estimated that BAV is responsible for more deaths than all other congenital heart defects combined. Consequently, carriers live under the threat of sudden death," according to background information in the article. However, long-term, population-based data are lacking on the incidence of severe aortic complications among patients with BAV.

Hector I. Michelena, MD of the Mayo Clinic, Rochester, MN, and colleagues conducted a study to determine the incidence of aortic complications among patients with BAV and in the general BAV population. The researchers analyzed long-term follow-up data of residents in Olmsted County, Minn., diagnosed with BAV by echocardiography from 1980 to 1999 and searched for aortic complications of patients whose bicuspid

valves had gone undiagnosed. The last year of follow-up was 2008-2009. The study included 416 patients with BAV, with average follow-up of 16 years.

Over the study period, aortic dissection occurred in 2 of the 416 patients and the 25-year cohort risk of aortic dissection after echocardiographic diagnosis was 0.5%. In a comparison of incident rates, patients with BAV had a 8.4 times increased risk of aortic dissection compared with the county's general population, however, the absolute risk remained low. "The low aortic dissection incidence and lack of association with a detectable reduction in survival is reassuring," the authors write.

Of 384 patients without aortic aneurysms at the beginning of the study, 49 developed aneurysms at follow-up. The 25-year risk of aneurysm formation among BAV patients was 26%. Analysis of incidence rates indicated these patients had a 86 times higher risk of aneurysm formation compared with the general population. After aneurysm diagnosis, the 15-year risks of aortic surgery and aortic dissection were 46% and 7%, respectively. The 25-year risk of aortic surgery after BAV diagnosis was 25%.

The researchers also found that the dissection incidence was higher in patients older than 50 years and higher in those with baseline aortic aneurysms, "highlighting the importance of close monitoring and current guideline implementation in these subgroups."

Also, patients with BAV had a 25-year risk of valve replacement of 53%. "Our study confirms that aortic valve replacement remains the most common complication of patients with BAV. This highlights the importance of early recognition of BAV by careful cardiac auscultation [listening for sounds made by internal organs to aid in the diagnosis of certain disorders] in order to prevent heart failure due to late valvular surgery referrals, as well as potentially to prevent dissection by elective aorta surgical repair," the authors write.

"Research efforts should concentrate on elucidating biological pathways of BAV aortopathy [disease of the aorta] amenable to medical treatment, as well as identifying nonsize markers for refining risk prediction of aortic dissection in these patients," the researchers conclude.



## Cardiovascular Implantable Electronic Device-Related Infections Linked with Increased Risk of Death

An association has been found between infection associated with cardiovascular implantable electronic devices (CIEDs) and increases in mortality and hospital care costs, according to a report published Online First by *Archives of Internal Medicine*, one of the JAMA/Archives journals. The article is part of the journal's Health Care Reform series.

Therapy with CIEDs, which include pacemakers, implantable cardioverter-defibrillators and cardiac resynchronization therapy/defibrillator devices, can reduce illness and death rates in appropriately selected patients, according to background information in the article. However, complications including infection may mitigate this benefit. "Although it is well recognized that the rate of CIED infection is increasing faster than the rate of CIED implantation, there are limited published data on the risk-adjusted mortality and cost associated with CIED infection or the relationship of these outcomes to different CIED types," write the authors.

Muhammad R. Sohail, MD, from the Mayo Clinic College of Medicine, Rochester, Minn., and colleagues analyzed the risk-adjusted total and incremental admission mortality, long-term mortality, admission length of stay (LOS) and admission cost associated with infection. They used data from the 100% Medicare Standard Analytic File Limited Data set version for inpatient admissions. The study group consisted of 200,219 Medicare fee-for-service patients who were admitted for CIED generator implantation, replacement or revision between January and December 2007. The researchers used the Centers for Medicare & Medicaid Services' payment-rate calculation methods, and used factors to reflect the admitting hospital's location, teaching status and indigent care load in order to standardize charges.

Researchers found a total of 5,817 admissions with infection. Depending on the CIED type, infection was associated with significant increases in adjusted admission mortality (4.6% to 11.3%, depending on type of device) and long-term mortality (26.5% to 35.1%, depending on type of device). Approximately half of the incremental long-term mortality occurred after patients were discharged. Depending on CIED type, the adjusted LOS was significantly longer with infection. With infection, the standardized adjusted incremental and total admission costs were \$14,360 to \$16,498 and \$28,676 to \$53,349, depending on CIED type. Intensive care accounted for more than 40% of the incremental admission cost. When researchers adjusted long-term mortality rate and cost ratios with infection by CIED type, pacemakers were associated with significantly greater increases in both measures, compared with implantable cardioverter-defibrillators or cardiac resynchronization therapy/defibrillator devices.

"Our work demonstrates that Medicare beneficiary admissions for CIED procedures with infection are associated with significant, device-dependent, incremental increases in admission mortality and long-term mortality, LOS, and cost compared with those without infection," write the authors. "Intensive care and pharmacy services accounted for more than half of the incremental cost with infection and could be targeted to reduce costs associated with management of CIED infection. The etiology of excess mortality in patients with CIED infection after hospital discharge remains unclear and merits further investigation."

## PEDIATRIC HEART FAILURE/ TRANSPLANT CARDIOLOGIST OPPORTUNITY



The Departments of Pediatrics at the University of Louisville School of Medicine and Kosair Children's Hospital are recruiting for a medical director of heart failure and cardiac transplantation for the Congenital Heart Center at Kosair Children's Hospital in Louisville, Ky.

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## Pediatric Cardiac MRI Opportunity

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(Arch Intern Med. Published online September 12, 2011. doi:10.1001/archinternmed.2011.441).

In an accompanying commentary, Ronan Margey, MD, MRCPI, from Massachusetts General Hospital and Harvard Medical School, Boston, describes the increase in both CIED use and of related infections. The author notes that in 2000, approximately 3.4 million people worldwide were living with a permanent CIED, and that new device implantations in the United States increased 49% between 1999 and 2003. Infection rates related to CIEDs also appear to have increased—in one Medicare analysis, a rise of 124% in proven CIED infection between 1990 and 1999 was found.

"There are significant cost implications for CIED infection, with the opportunity cost of having to remove a device and potentially implant a new one," writes Margey. The infections also exert a toll on health, according to the results from Sohail and colleagues' study. "It provides further evidence that patients who develop CIED infection have an ongoing poor prognosis, with more than half of the mortality occurring during follow-up," Margey points out.

"In the current era of appropriate resource utilization, the timely article by Sohail et al highlights the serious cost implications of CIED infection," Margey concludes. "It is a warning siren to physicians to be sure... implantation is appropriate per professional society guidelines and to monitor patients at risk of developing infection closely and intervene promptly."

## CONGENITAL CARDIOLOGY TODAY

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**Headquarters:** 824 Elmcroft Blvd., Rockville, MD 20850 USA

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