

## Role of echocardiography in Pediatric Intensive and intermediate Care Unit

Safaa Hussein Ali, Shaimaa Mohammed Mahmoud, Ayat Ramadan Mohamed

Pediatric Department, Faculty of Medicine, Sohag University, Sohag, Egypt.

### Abstract

**Background:** Echocardiography is a valuable component of the clinical service in the pediatric intensive and intermediate care units. It is an important bedside imaging modality and an accurate diagnostic tool that provides a clear image of the heart. **Objectives:** Our objective in this study was to detect the role of echocardiography in pediatric intensive and intermediate care units at Sohag University Hospital, Egypt. **Method:** It was a prospective hospital-based study conducted in pediatric intensive & intermediate care units from 1 August 2016 to 31 July 2017. These intensive care units receive critically ill children from emergency pediatric department or directly from the outpatient clinic. Data of these patients was collected; including clinical history, clinical examination, clinical indications for echocardiography, echocardiographic findings and management alterations after echocardiography. **Results:** During the study period, 495 patients were admitted to intensive and intermediate care units and 182 echocardiograms were performed for 170 patients. Congenital heart disease was the most common indication and finding of echocardiography. In this study 61% of echocardiograms done produced new findings that lead to additional clinical management steps especially medical interventions (30% of interventions). **Conclusion:** Echocardiography is a very valuable tool in ICUs. More than half of echocardiograms done produced new findings that changed management plans for these critical patients, so its use should be encouraged on a wide base in these units.

**Keywords:** Echocardiography, Pediatric intensive care unit, intermediate care unit

### Introduction:

Management of critically ill pediatric patients requires proper prioritization and judicious time management in the pediatric intensive care unit (PICU) (Tibby, 2009). Echocardiography is an integral component of the clinical services in these units (Pratap et al, 2004). It is important not only for assessing the condition of the patient on a continuous and real-time basis, but also provides vital clues that may help in diagnosis and treatment. (DeNicola et al, 2001). The use of simple bedside non-invasive monitoring devices as echocardiography to add to the clinical judgment is very important in the PICU (Spenceley et al, 2001).

Another major benefit of echocardiography is that it can be used serially to assess response to interventions in a 'real-time' manner and thus guide ongoing therapies (Boyd & Walley, 2009 & Weekes et al, 2001).

### Methods:

It was a prospective hospital-based study. Patients admitted to the intensive & intermediate care units of Sohag University Hospital in the period from 1 August 2016 to 31 July 2017 were assessed. Each unit contained 8 beds & these units provide specialized care to critically ill children

The study included 170 patients who needed echocardiography during their ICU stay. ICUs receive critically ill children from emergency pediatric department or directly from the outpatient clinic. The following data were collected: (1) clinical history focusing on: sociodemographic data especially age, sex, family history, degree of consanguinity if present, complaint and its duration, (2) complete clinical examination, (3) clinical indications for echocardiography, (4) echocardiographic findings, (5) interventions or management alterations after the echocardiography that included: medical intervention, surgical intervention, altered procedure, no intervention or combination of 2 or 3 these decisions. An oral consent was taken from parents of patients included in the study and was introduced to ethics scientific committee at Sohag University Hospital for approval.

### Statistical analysis:

Data were analyzed using STATA intercooled version 14.2. Quantitative data were represented as mean, median, standard deviation, and range. When the data were not normally distributed Kruskal Wallis test for comparison of three or more groups. Qualitative data were presented as number and percentage and compared using either Chi-square test or Fisher exact test. Graphs were produced by using Excel or STATA program. P-value was considered significant if it was less than 0.05. In this study there was a significant positive correlation between the echocardiographic findings and the clinical intervention or the clinical decision as the P-value of the results for most patients [163 patients (95.88%)] was significant.

Variable	Number (%)
<b>Indications of echocardiography</b>	
Known congenital heart disease	47 (27.65%)
Respiratory distress	25 (14.71%)
Known other cardiac problems	23 (13.53%)
Murmur	18 (10.59%)
Recurrent chest infection	16 (9.41%)
Tachycardia & arrhythmia	23 (13.53%)
Unresolved pneumonia	7 (4.12%)
Other congenital anomalies	6 (3.53%)
Hypertension	2 (1.18%)
Distant heart sound	3 (1.76%)
<b>Types of known other cardiac problems</b>	<b>N= 23</b>
Heart failure	11 (47.82%)
Dilated cardiomyopathy	10 (43.48%)
Suspected infective endocarditis	2 (8.69%)

**Table 1:** Indications of echocardiography of studied populations

### Results:

During the study period, **495** patients were admitted to the ICU and **182** echocardiograms were performed for 170 patients. **160** (94.12%) patients had 1 echocardiogram, **8** (4.71%) patients had 2 and 2 patients (1.18%) had 3 echocardiograms performed

during their PICU stay. The age of the studied patients ranged from 1 month to 13 years old. The study included **109** infant (64.12%) & **61** child (35.88%). Of them there were **88** (51.76%) males. Indications for echocardiography are shown in (table 1); The most common indication for

echocardiography was patients known to have a congenital heart disease[47 patients (27.65%)]followed by patients with manifestations of respiratory distress[ 25 patients (14.71%)].

The findings of echocardiography were classified into categories in (Table 2). CHD (Congenital heart disease) was the most common finding[ 89 patients (52.35%)] & 41 (24.12%) patients had normal study.

Echocardiographic findings	Number (%)
Normal study	41 (24.12%)
CHD	89 (52.35%)
Cardiomyopathy	28 (16.47%)
Pericardial effusion	5 (2.94%)
Idiopathic Pulmonary hypertension	3 (1.76%)
Rheumatic heart disease	2 (1.18%)
Vegetations	2 (1.18%)

Table 2: Echocardiographic findings of studied populations

In our study decisions taken after echocardiography were variable as shown in (table 3):

- 1) **66 patients (38.82%) had no intervention.**
- 2) **51 patients (30%) had medical intervention in the form of changes in medical treatment they received** like addition or increasing the dose of diuretics, inotropes, digoxin, angiotensin-converting enzyme inhibitors, sildenafil or  $\beta$ -blockers.
- 3) **16 patients (9.41%) were referred for surgical operation:**
  - 3 patients were referred for surgical valvotomy of severe pulmonary stenosis.
  - 2 were referred for cordectomy of severe coarctation of the aorta.
  - 1 for surgical closure of atrioventricular canal defect.
  - The remaining 10 patients were referred for surgical repair (4 for TGA repair, 4 for repair of TGA&DORV, 1 for repair of TOF&hypoplastic aortic arch; and 1

for repair of TGA &coarctation of Aorta).

- 4) **3 (1.76%) patients had altered procedures** as referral for CT angiography.
- 5) **34 (20%) patients had more than one chance in their treatment plan:**
  - 28 patients (16.47%) had both medical & surgical interventions
  - 2(1.18%) patients had medical interventions &altered procedure
  - 2(1.18%) had surgical interventions &altered procedure
  - 2(1.18%) had medical intervention, surgical interventions & altered procedure.

#### Interventions after echocardiography

There was a significant positive correlation between the echocardiographic findings of the study and the clinical intervention or the clinical decision because the p-value of the results for most patients[ 163 patients (95.88%)]was significant.

Clinical decision	Number (%)
No intervention	66 (38.82%)
Medical intervention	51 (30.00%)
Medical & surgical intervention	28 (16.47%)
Surgical intervention	16 (9.41%)
Altered procedure	3 (1.76%)
Medical intervention & altered procedure	2 (1.18%)
Surgical intervention & altered procedure	2 (1.18%)
Medical , surgical intervention & altered procedure	2 (1.18%)

**Table 3:** Clinical decision based on the echocardiographic findings:

Echo findings	Intervention								P-value
	No N=66	Medical N=51	Medical & surgical N=28	Surgical N=16	Altered procedure N=3	Medical & altered procedure N=2	Surgical & altered procedure N=2	Medical, surgical & altered procedure N=2	
Normal study	41 (100%)	0	0	0	0	0	0	0	<0.0001
CHD	20 (26.47%)	20 (26.47%)	27 (30.33%)	16 (17.98%)	3 (3.37%)	1 (1.12%)	1 (1.12%)	1 (1.12%)	<0.0001
Cardiomyopathy	5 (17.86%)	22 (78.57%)	0	0	0	1(3.57%)	0	0	<0.0001
Pericardial effusion	0	2(40%)	1 (20%)	0	0	0	1 (20%)	1 (20%)	<0.0001
Pulmonary hypertension	0	3 (100%)	0	0	0	0	0	0	0.42
Rheumatic heart disease	0	2 (100%)	0	0	0	0	0	0	0.69
Vegetations	0	2 (100%)	0	0	0	0	0	0	0.69

**Table 4:** Interventions after echocardiography

### Discussion:

Cardiac patients in the intensive and intermediate care units represented about one-quarter of admissions in this study. An echocardiography is an essential tool in their monitoring. Several studies have detected the valuable effect of the use of echocardiography in the management of critically ill patients, changing their treatment in 30%–60% of cases after the test has been performed (*Manasia et al, 2005* and *Croft et al, 2006*).

In this research, we have studied **170 patients** from a total of **495** patients who were admitted to the ICUs (**34.3%**) over a period of 1 year.

Several studies were done to evaluate role of echocardiography in PICU like the study conducted by *Şahin et al, 2017* where echocardiograms were

done for **140** patients out of **186** patients admitted in the Pediatric ICU (**75.2%**) over a period of 6 months and in the study done at Child Health Department, Sultan Qaboos University Hospital, Muscat, Oman by *Rabah et al, 2016* where **93** patients had echocardiography out from 424 patients were admitted in this PICU over a-24-month period..

In the current study, **182** echocardiograms were performed for **170** patients. 160 (**94.12%**) patients had one test& 10 (**5.88%**) patients had 2 or more echocardiograms during their PICU stay. There were 88 (**51.76%**) males. Most of the studied patients were infants (n=**109, 64.1%**).

This agrees with the results of *Rabah et al, 2016* study where **93** patients had

101 echocardiograms. Nine (9.68%) patients had two or more echocardiograms. There were 57 (56.4%) males, most patients (n = 41, 40.6%) were below 1 year of age.

In our study 24% of the cases studied were cardiac patients at time of admission to the PICU which is much lower than that found in Kutty et al, 2014 study where over than 90% of echocardiograms were performed in cardiac patients as the primary diagnosis that was explained by the fact that Kutty et al, 2014 study was conducted in a combined medical-surgical-cardiac PICU and all patients in the PICU had transthoracic echocardiography.

The most common indication for echocardiography in the present study was congenital heart disease in 47 patients (27.65%) followed by respiratory distress in 24 patients (14.12%) while in Rabah et al, 2016 study, more than 25% of exams were done to assess left ventricular function in hemodynamically unstable patients [27 exams (26.7%)] and the second most common indication was suspicion of congenital heart disease [19 exams (18.8%)].

In this study congenital heart disease was the commonest finding (41%) and 24% of the patients had normal study. The opposite in Rabah et al., 2016 study where normal examination was the most common finding (31.7%) followed by congenital heart disease (24.7%) which was explained by the fact that in the current study cardiac patients represent one-quarter of admissions in the ICUs.

In the current study 104 exams (61%) produced new findings that changed the management plan of the patients and 66 exams (39%) yielded clinically insignificant findings. In Rabah et al., 2016 study 81 exams (81%) produced new findings and 19 (18.8%) resulted in clinically insignificant findings and

in Kutty et al,2014 study one-third of echocardiograms resulted in clinical management changes.

The most common medical intervention after echocardiography was increasing the dose of diuretics (9.4%) while in Kutty et al, 2014 study the most common change in management was adjustment of the dose of inotropes (33.3%), the same as in Rabah et al, 2016 study where altered drug therapy, mainly inotropes and fluid management was the most common resulting intervention because most of echocardiograms done in these studies were to evaluate the left ventricular wall function in PICU while most of the cases in the current study were in the intermediate care unit.

In this study there was a significant positive correlation between the echocardiographic findings and the clinical intervention or the clinical decision as the P-value of the results for most patients [163 patients (95.88%)] was significant, the same in Rabah et al, 2016 study a significant P-value of all results was significant.

In this study 81.7% of the studied patients were discharged from the while 18.3% of them died; these results are in concordance with results of Rabah et al, 2016 study where 79.2% of the patients discharged & 20.8% of them died.

### Conclusion:

In this study, we found that the most common 2 indications for echocardiography were patients with congenital heart disease and patients with manifestations of respiratory distress. The most common echocardiographic finding during the study period was congenital heart disease. In present study new findings resulted in 61% of echocardiograms done leading to additional clinical management steps especially medical

interventions (30% of interventions), so there was a significant positive correlation between the findings of the study and changes done in management of patients.

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