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Intrahospital Transport of Children on Extracorporeal Membrane Oxygenation: Indications, Process, Interventions and Effectiveness

Parthak Prodhon, MD, Richard T Fiser, MD, Sophia Cenac, Adnan T Bhutta, MD, Eudice Fontenot, MD, Michelle Moss, MD, Stephen Schexnayder, MD, Paul Seib, MD, Carl Chipman, Lauren Weygandt, Michiaki Imamura, MD, Robert DB Jaquiss, MD, and Umesh Dyamenahalli, MD

Pediatric Critical Care (PP, RTF, ATB, MM, SS), Pediatric Cardiology (PP, SC, ATB, EF, MM, PS, LW, UD), Pediatric Cardiothoracic Surgery (MI, CC, RDBJ), College of Medicine, University of Arkansas Medical Sciences, Arkansas Children Hospital, Little Rock, Arkansas

Abstract

Objective—Critically ill patients supported with extracorporeal membrane oxygenation (ECMO) are transported within the hospital to the radiology suite, cardiac catheterization suite, operating room, and from one ICU to another. No studies to date have systematically evaluated intra-hospital transport (IHT) while on ECMO. This study aims to evaluate indications, process, interventions, and effectiveness of patients undergoing IHT.

Design—Retrospective cohort analysis.

Setting—Cardiac intensive care unit in a tertiary care children's hospital.

Patients—All patients requiring IHT while on ECMO between January 1996 and March 2007 were included and analyzed in detail.

Measurement and Main Results—A total of 57 IHTs for cardiac catheterization (CC) and head CT scans were analyzed. In 14/20 (70%) of CC patients, a management change occurred as a result of the diagnostic CC. In 10/17 (59%) bedside echo was of limited value in defining the critical problem. In the interventional group the majority of transports were for atrial septostomy.

Corresponding Author: Umesh Dyamenahalli, MD, Associate Professor, Division of Pediatric Cardiology, College of Medicine, University of Arkansas Medical Sciences, Arkansas Children Hospital, 1 Children's Way, Slot 512-3, Little Rock, AR, Tel : (501) 364-1479, Fax: (501) 364-3667, prodhanparthak@uams.edu, pprodhon@yahoo.com.

Work Performed at: Arkansas Children's Hospital, Little Rock, AR

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Assistant Professor (PP), Pediatrics, Arkansas Children's Hospital, Little Rock, AR; Professor (RTP), Pediatric Critical Care Medicine, University of Arkansas for Medical Sciences, Little Rock, AR; Student (SC), University of Arkansas for Medical Sciences, Little Rock, AR; Assistant Professor (ATB), Arkansas Children's Hospital, University of Arkansas for Medical Sciences, Little Rock, AR; Associate Professor of Pediatrics (EF), Pediatric Cardiology, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, AR; Professor of Pediatrics (MM), Critical Care and Cardiology, University of Arkansas for Medical Sciences College of Medicine, Little Rock, AR; Professor of Pediatrics and Internal Medicine (SS), Chief (SS), Pediatric Critical Care Medicine, University of Arkansas for Medical Sciences, Arkansas Children's Hospital, Little Rock, AR; Associate Professor of Pediatrics (PS), University of Arkansas for Medical Sciences, Little Rock, AR; Director (PS), Cardiac Cath Lab, Arkansas Children's Hospital, Little Rock, AR; Certified Registered Nursing First Assistant (CC), Arkansas Children's Hospital, Little Rock, AR; Medical Student (LW), University of Arkansas for Medical Sciences, Little Rock, AR; Associate Professor (MI), University of Arkansas for Medical Sciences, Little Rock, AR; Professor and Chief of Pediatric Cardiac Surgery (RDBJ), Arkansas Children's Hospital and University of Arkansas for Medical Sciences, Little Rock, AR; and Associate Professor (UD), Pediatric Cardiology and Cardiac Intensivist (UD), University of Arkansas for Medical Sciences, Little Rock, AR.

In the head CT group significant pathology was identified, which led to management change. No major complications occurred during these IHTs.

Conclusions—IHT while on ECMO is labor intensive and requiring extensive logistic support, it can be carried out safely in experienced hands and results in important therapeutic and diagnostic yields. To our knowledge this is the first study designed to evaluate safety and efficacy of IHT for patients receiving ECMO support.

Keywords

Extracorporeal membrane oxygenation; intra-hospital transport; cardiac catheterization; CT scan; children

Introduction

Extracorporeal membrane oxygenation (ECMO) support, a modified cardiopulmonary bypass technique, has long been an integral part of the management of patients with acute refractory life-threatening cardiac or respiratory failure. It is initiated when there is an inadequate clinical response to maximal conventional cardio-pulmonary support in order to optimize tissue perfusion and thus preserve organ function [1].

While on ECMO support there are situations when some patients require diagnostic or therapeutic procedures, and therefore, require transport from the ICU to either the cardiac catheterization laboratory or the radiology suite [2-4]. While intra-hospital transport (IHT) on ECMO may be a crucial part of patient management, it imposes significant risks for the patient [13-23]. These risks are related to moving critically ill patients on cardiopulmonary support: mechanical ventilation and ECMO support with cannulae placed in major blood vessels and multiple infusions pumps that require multiple long tubing's.

The decision to transport a patient receiving ECMO support is based on an assessment of the potential benefits of the transport weighed against the potential risks. Due to the fear of potential for disastrous complications during IHT while on ECMO, there may be a reluctance to transport these patients for the required diagnostic and/or therapeutic interventions. Such a delay may hinder optimal patient management and result in suboptimal outcome.

Despite its practice, there is lack of comprehensive published information concerning indications, process, safety, and efficacy of IHT on patients supported with ECMO. We hypothesized that IHT on ECMO support facilitates timely and effective management and can be carried out safely. In order to investigate this hypothesis we retrospectively analyzed our institutional experience of IHT on ECMO support over a ten-year period.

Material and Methods

After obtaining approval from the University of Arkansas for Medical Sciences Institutional Review Board, we retrospectively identified from our institutional ECMO database all patients who underwent IHT for computerized tomography (CT) scan and/or cardiac catheterization between January 1996 and March 2007. Patients who required IHT while on ECMO support to and from the cardiothoracic operating room were excluded.

Data were obtained by reviewing the hospital medical record, including ECMO daily care sheets, pharmacy records, cardiac catheterization reports, and daily progress notes written by physicians, nurses, and ECMO coordinators.

During the study period, all patients receiving ECMO support were managed by a dedicated ECMO team and underwent IHT using standardized management procedure (*see Appendix 1*). IHT of ECMO patients was carried out with specific focus on the preparatory phase, the transfer phase, and the post-transport stabilization. During the *preparatory phase*, after the decision for IHT was made, the ECMO coordinator would direct the timing and anticipated procedures with the cardiac catheterization suite or the radiology personnel. The bedside nurse, ECMO technician and the ECMO coordinator completed a checklist to ensure safety during IHT which included a review of sedation, muscle relaxation, monitors, backup battery, gas supply, blood products, and emergency resuscitation cart. The time for preparation prior to IHT was approximately 30 minutes. The *transfer phase* consisted of moving the patient on the same bed to the cardiac catheterization and/ or the radiology suite table. The ECMO coordinator was responsible during IHT to maintain the optimal position of the ECMO cannulae to minimize inadvertent displacement. The IHT was managed by at least four staff members (ECMO specialist, ECMO coordinator, bedside ICU nurse, nurse practitioners) under the supervision of an attending physician. The patient was hand-bagged during the IHT which involved moving two or three floors below the ECMO unit. The total transport time for the study included actual transport, transfer from the bed to the CT scan/ catheterization table, the time for investigation, and return to the ECMO unit.

The data collected included patient demographics, type and indication for ECMO support, duration of ECMO support prior to IHT, details about the IHT (duration; change in management during IHT such as the need for extra sedation, muscle relaxation, fluid and blood product infusion, and change in inotropic and ventilatory support) was noted. The decision for the IHT was defined in the study as being emergent if it had to be carried out within about 1 hour of clinical indication. Complications related to ECMO circuit, cannulae and endotracheal tube displacement occurring during and within 1 hour of return to the unit were documented.

For patients who underwent cardiac catheterization during IHT, we analyzed the indications for cardiac catheterization and interventions, and correlated echocardiography and cardiac catheterization findings.

Statistical Analysis

Descriptive data are depicted using medians, percentages, and ranges. Fisher exact test and the unpaired t test were used to calculate p values where applicable. For the study a p value of ≤ 0.05 was considered significant.

Results

During the study period, a total of 471 patients received ECMO support with 38 patients requiring 57 IHTs. Thirty-one patients required 37 IHTs for cardiac catheterization, out of which 20 were diagnostic and 17 required interventional procedures. Fifteen patients required 20 IHTs to the radiology suite for CT scan of the head.

IHT for Cardiac Catheterization

Table 1 shows the characteristics of 37 IHTs to the cardiac catheterization laboratory for diagnostic and interventional purposes. Overall, there were 12 neonates (11 diagnostic; 1 interventional), 9 infants (5 diagnostic; 4 interventional), and 12 were more than 1 year-of-age (2 diagnostic; 11 interventional). In the interventional group transports were undertaken for blade and balloon atrial septostomy (16); endomyocardial biopsies (8), radiofrequency ablation (1), and aortic valvotomy (1).

The median weight for the diagnostic group was 3.8 kilograms and 12 kilograms for the interventional group. In the diagnostic group, 10 patients were placed on ECMO support for low cardiac output and 8 for severe cyanosis. All patients requiring interventions were placed on ECMO for low cardiac output.

The median time from initiation of ECMO to transport for interventional cardiac catheterization was 4 hours compared to 23 hours for patients requiring diagnostic catheterization. The median time for the transport and procedure was 119 minutes for the diagnostic group compared to 158 minutes for the interventional group. In 14/20 (70%) patients there was a management change as a result of the diagnostic cardiac catheterization (Table 1). The details of the specific lesions found in the study cohort are provided in Table 2. Among the 14 patients, 10 patients required surgical intervention and were subsequently weaned off ECMO support (Table 2).

In the diagnostic CC group, there were 17 patients (18 catheterizations) whose bedside echocardiography findings were compared with cardiac catheterization findings (Table 3). In 7/17 (41%) the problem was correctly identified by echocardiography, and subsequently confirmed by cardiac catheterization. In the other 10 patients (59%), the diagnostic capabilities of bedside echocardiography were limited or problems were not identified. This was particularly a problem in patients who had branch pulmonary arterial and systemic-to-pulmonary-artery shunt abnormalities.

IHT for CT Scan

Table 4 shows the characteristics of 20 IHTs (15 patients) to the radiology suite for CT scan of the head. The indication for these transports was a significant change in neurologic status while on ECMO support, suggestive of the development of a new intracranial event. Of these IHTs for CT scan, 13/20 (65%) were carried out on an emergent basis. Significant intracranial pathology was identified in 14/15 patients transported on ECMO for head CT scan. The CT abnormalities identified included intracranial hemorrhages (8), massive stroke (3), and severe cerebral edema (7), with uncal herniation (6) and frequently resulted in subsequent withdrawal of the life support (12).

The median age and weight for this group of patients was 6 years and 15 kilograms, respectively. The median time from initiation of ECMO to IHT was 40 hours and the median time for the IHT was 40 minutes. The median time of pre-IHT ECMO support in those where the CT scan lead to a change in management [81 hours (range 1-745 hrs)] was different from those where the CT scan did not lead to a change in management [13 hrs (range 3-77 hrs)].

Table 5 depicts the details of the changes in ventilatory parameters, acid-base balance, requirement for sedation, use of muscle relaxants, and blood products, along with the changes in inotropic support and the complications during the IHT. Most patients received additional sedation and muscle relaxants during the IHT. There were no major mechanical complications such as cannulae dislodgement or circuit rupture. In 3 patients, however, there was insufficient venous return during IHT which responded to volume bolus. In 4 patients there was minor cannulae site bleeding requiring no active interventions. ECMO flow changes were made in 14/57 IHTs and inotropes were titrated in 12/57 IHTs. Additional fluid (5% albumin and blood products) requirement and some changes in acid-base status balance were noted in a majority of patients. One patient developed cardiac tamponade during the cardiac catheterization and was appropriately resuscitated.

Discussion

Our study results show that IHT can be carried out safely while facilitating timely diagnosis and effective management of clinically recognized abnormalities. While IHT is a common practice in experienced ECMO centers, this study provides the first systematic evaluation of its safety and efficacy. Additionally, our results highlight the potential limitations of bedside echocardiography in certain situations and the potential benefit of early cardiac catheterization in these patients.

At our institution, IHT to the CC laboratory for either diagnostic or interventional indications resulted in changing the patient's management in a majority (83.7%) of transported patients. These results are similar to those reported earlier by Booth et al. (83%) and desJardins et al. (73%) [2,3]. Lesions demonstrated on cardiac catheterization necessitated surgical or interventional procedures with subsequent successful separation from ECMO support in most cases. Specifically, patients with systemic to pulmonary artery shunts or those with pulmonary arterial abnormalities were more likely to have lesions amenable to further interventions which would result in a change in their management. Our data support the previous experience [2,3] and assert the need for judicious and early consideration of cardiac catheterization in patients with congenital heart disease requiring ECMO support.

All IHTs to the CC laboratory for interventional indications were for low cardiac output states, and a majority of these (94.1%) were for blade and balloon septostomy (BBAS) for relief of left atrial hypertension and pulmonary edema. One patient required a repeat BBAS due to residual restriction at the atrial level. As shown previously at our institution [5], BBAS is an important part of the optimal management of patients with left ventricular failure who are supported with ECMO and facilitates adequate reduction of left atrial hypertension and associated pulmonary edema.

Our study is the first to objectively correlate clinical findings on CC with those from echocardiography performed prior to CC. Our observations suggest that for the interventional group (atrial septostomy and aortic valvotomy) transthoracic echocardiography was adequate in identifying the underlying problem and directing appropriate intervention. In the diagnostic group, however, transthoracic echocardiography was limited in identifying certain abnormalities. In a significant number of patients (59%) with branch pulmonary arterial and shunt abnormalities the transthoracic echocardiography completed prior to CC was limited in identifying the pathology. This highlights the limitations of echocardiography especially in patients with these clinical settings due to poor transthoracic echo windows. Booth and colleagues [2] described that transthoracic echocardiography in patients supported on ECMO was suboptimal for guiding both diagnosis and therapeutic interventions. However, unlike our study they have not described details of the correlation between transthoracic echocardiography and subsequent cardiac catheterization nor the types of lesions commonly missed on transthoracic echocardiography. These findings highlight the need for early diagnostic catheterization in selected cases while on ECMO support. This would provide information for effective management and will minimize the delay in diagnoses thus improving the overall outcome.

In our study, all IHTs to the radiology suite were for CT scan of the brain to evaluate changes in the patient's neurological examination. A significant number of CT findings resulted in a change in the patient's management. Our results are similar to the European experience reported by Lidegran et al [4], although none of our IHT was for thoracic or abdominal CT scan. Our findings reaffirm that a significant change in patients' neurologic

status while on ECMO has a high likelihood of heralding major intracranial pathology, which can be promptly diagnosed by CT scan.

Critically ill patients undergoing IHT are at increased risk of morbidity and mortality [13-23]. For IHT of patients supported with ECMO, the risks are even more considerable. IHT of ECMO patients is a labor intensive process and requires considerable logistic support and an experienced team. This would be possible with appropriate multidisciplinary team approach with judicious communication and cooperation particularly with radiology or cardiac catheterization suite staff.

Prior to every IHT, the team must weigh the potential benefits of the transport against the potential risks. This study demonstrates that IHT on ECMO can be carried out safely and without major complications, however, every patient has the potential for life threatening complications during IHT. Our experience is similar to that reported by Booth et al. (2) and highlights the importance of the being cognizant of the risks for complications during cardiac interventions. The risks of IHT of ECMO-supported patients can be minimized and outcomes improved with careful planning, use of trained personnel, and the selection and availability of appropriate equipment.

This study is limited by its retrospective nature and relatively small sample size. Our results may not, therefore, be applicable universally. The study findings, however, do support clinical practice, in which IHT of ECMO patients has anecdotally been felt to be helpful for optimal management.

Conclusions

Intrahospital transport of patients on ECMO, while labor intensive and requiring extensive logistic support, can be carried out safely in experienced hands. Our experience highlights the indications, process, interventions and effectiveness of IHT of children while on ECMO. Further, investigations carried out during IHT to cardiac catheterization laboratory and CT scan often results in important therapeutic and diagnostic information, thereby influencing the management of these patients. Diagnostic ability of transthoracic echocardiography is of limited value in shunt-dependent congenital heart lesions and those with branch pulmonary artery abnormalities. The early and judicious use of diagnostic cardiac catheterization is warranted to achieve optimal results.

Learning Objectives

After participating in this educational activity, the participant should be better able to:

1. Recognize the complications warranting intrahospital transport of children on extracorporeal membrane oxygenation.
2. Recognize the spectrum of interventions that can be performed in children during intrahospital transport on extracorporeal membrane oxygenation.
3. Recognize the time required for carrying out an intrahospital transport of a critically ill child on extracorporeal membrane oxygenation.

Unless otherwise noted below, each faculty or staff's spouse/life partner (if any) has nothing to disclose.

Dr. Schexnayder has disclosed that he was/is a compensated editor for the American Heart Association. The remaining authors have disclosed that they have no financial relationships with or interests in any commercial companies pertaining to this educational activity.

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APPENDIX 1: Intra-Hospital Transport of Patients on ECMO Support

Purpose

To provide a safe and coordinated transportation of the patient supported on ECMO within the hospital.

[A]. Preparatory Phase of Transport

- 1 The ECMO coordinator will be the TEAM LEADER during the transport.
- 2 After clinical decision is made for to perform diagnostic/ surgical procedure off the unit the parents/ family members will be informed and the consent will be obtained.
- 3 The appropriate time of the transport will be established after discussion among the attending physician, ECMO specialists, the nursing team, respiratory therapist, and the responsible personnel in the area where the patients are to be transported (cardiac catheterization laboratory, radiology suite, operating room).
- 4 Approximately a minimum time of 15-30 minutes to gather appropriate equipment (monitors, extra tubing's, syringes, oxygen source, ventilator, colloids/ crystalloids, emergency drug sheet, intubation box and emergency drug box code box).
- 5 In case of head CT scan the near infra-red spectroscopy probe is removed.
- 6 Patients will be transported, usually on their own bed.
- 7 Another 15-30 minutes to reach the destination should be factored in while timing the transport. Extra personnel (if required) are asked to help with the transport.
- 8 The attending physician should be consulted for need for extra sedation and/ or paralytic agent.
- 9 The patient's records (chart, written orders, and labels) will be carried during transport with the patient.
- 10 The patient's ventilator will accompany the patient when transporting to the cardiac catheterization laboratory.
- 11 The ECMO specialist and the ECMO coordinator will minimize the ECMO pump footprint by removing extra power cords and pumps. The ECMO coordinator will attach a FULL transport oxygen cylinder and set the flow rate to match the patient's current sweep flow rate.

- 12 If patient is being transported to the cardiac catheterization laboratory, the ECMO specialist will check the availability of the activated clotting time (ACT) machine and cartridge there.
- 13 Adequate thermal protection should be provided for the patient to maintain normal temperature range.

[B]. Transfer Phase

- 14 The ECMO pump, once unplugged, is automatically on battery power and the ECMO specialist will closely monitor venous return and line pressures as well as A-V color difference of the blood.
- 15 The respiratory therapist will bag and maintain the patients PEEP.
- 16 The ECMO coordinator is responsible for maintaining the optimal position of the ECMO cannulae to minimize inadvertent displacement.
- 17 At the destination all power to the ECMO pump and water bath is re-established to maintain battery power and to maintain normothermia.
- 18 The oxygenator should be attached to the main oxygen supply to ensure adequate supply for the return transport.
- 19 Extra caution will be taken during transfer from the bed on which the patient is transported to the examining/ procedural table to minimize accidental adverse events.

[C]. Post transport Stabilization Phase

- 20 After completion of the diagnostic procedure the transport process is done in reverse, all staff members will monitor the patient's clinical condition during transport.
- 21 All the parts of the ECMO circuit are re-checked for new issues.
- 22 New set of arterial blood gas, electrolyte, complete blood count are checked on return to the unit.
- 23 Documentation such as time off unit, time return to unit, procedure done, any interventions performed, any complication and the patient's condition on return to the unit is performed.

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Table 1
Characteristics of patients requiring intrahospital transport for cardiac catheterization

Variables	Diagnostic	Interventions	p value
Cardiac catheterization	20 ^a	17 ^a	-
Gender: (male/female)		6: 9	0.4905
Weight (kilograms)			
Median	10.8	12	
Mean	3.8	21.6	0.0321
Range	7.9 (2.6-40.8)	(4.8-81.3)	
Age			
<1 mo	11	1	0.0011
1 mo-1 yr	5	4	1.0000
1->15 yr	2	11	0.0004
Indication for ECMO			
Low cardiac output syndrome	10	15	0.0016
Cyanosis	8	0	0.0056
Intervention types			
Cardiac biopsy	-	8	
Blade and balloon atrial septostomy	-	16	
Radiofrequency ablation	-	1	
Aortic valvotomy	-	1	
Hours on ECMO (pre-intrahospital transport)			
Median	23	4	
Mean	90.4	24.6	0.0873
Range	0-433	0-312	
Intrahospital transport duration (mins)			
Median	119	158	
Mean	115	171	0.0001
Range	60-153	105-300	
Required ECMO for cardiopulmonary resuscitation	2	9	0.0040
Emergent transport	7	15	0.0020

Variables	Diagnostic	Interventions	<i>p</i> value
Management change	14	17	0.0220

ECMO, extracorporeal membrane oxygenation.

^a 2 patients required > 1 intrahospital transport; ECMO for cardiopulmonary resuscitation- cardiopulmonary resuscitation with ECMO rescue.

Table 2
Diagnostic details of IHT patients, interventions performed and outcome

No.	Diagnosis	Operation	ECMO Type and Indication	Findings	Intervention	Outcome
1	TOF	Repair	VA: LCO	Left PA narrowing	Patch enlargement	Decannulated in OR
2	TAPVR	Repair	VA: LCO	Left pulmonary vein atresia; right pulmonary vein hypoplasia	None	Life support withdrawal
3	HLHS, DORV TGA and COA	Norwood	VV: Cyan	Distal BT shunt narrowing; Left PA narrowing	Left PA plasty and central shunt;	Weaned off ECMO
4	TA	Redo-Fontan	VA: LCO	Pulmonary embolus	Local tPA therapy into branch PAs	Died, MOF
5	HLHS	Norwood	VA: Cyan	Thrombosed shunt and branch PAs	-	Life support withdrawal
6	Dextrocardia, DIV, and pulmonary atresia	Central shunt	VV: Cyan	Distal shunt and branch PA stenosis	Shunt revision & Branch PA augmentation	Decannulation in OR
7	PAI/VSD	Central shunt	VV: Cyan	Small left PA	Lt. PA patch augmentation	Decannulation in OR
8	TOF/PA	Unifocalization and RMBTS	VA: Cyan	Severe distal PA abnormalities	none	Withdrawal of life support
9	DORV & "TGA"	Switch and VSD closure	VA: LCO	Branch PA stenosis	Stents in PAs	Decannulated from ECMO/ Died of MOF
10	TAPVR	Repair	VA: LCO	IVC obstruction	IVC and RA augmentation	Weaned off ECMO, failed 2nd ECMO support Died of MOF
11	Heterotaxy, AVSD, sub-PS and hypoplastic PA	DKS and central shunt	VA: Cyan	Stenosis of proximal end of the shunt	Shunt revision	Weaned off ECMO
12	Unbal. AVSD, TGA, PA	MBT Shunt	VA: LCO	Severe left PA stenosis	Lt. PA Plasty	Decannulated
13	PS, supra PS, VSD	Repair	VA: LCO	Severe RVOTO	Resection of hypertrophied RV muscle bundle	Weaned off : died NEC
14	HLHS	Norwood	VA: Cyan	Proximal shunt and Lt. PA stenosis	Shunt ligation RV to PA conduit & Lt. PA plasty	Decannulated

AVSD, atrioventricular septal defect; COA, coarctation of aorta; Cyan, cyanosis; DORV, double outlet right ventricle; DIV, double inlet ventricle; DKS, Damus-Kaye-Stanzel operation; HLHS, hypoplastic left heart syndrome; IVC, inferior vena cava; LCO, low cardiac output; MOF, multi-organ failure; OR, operating room; PA, pulmonary artery; PAT., pulmonary atresia; PS, pulmonary stenosis; RV, right ventricular; RVOTO, RV outflow tract obstruction; RMBTS, right modified Blalock Taussig shunt; TA, tricuspid atresia; TAPVR, total anomalous venous return; tGA, transposition of great arteries; TOF, Tetralogy of Fallot; VA, veno-arterial; VSD, ventricular septal defect.

Table 3
Correlation between the bedside echocardiographic findings and cardiac catheterization which required IHT

Diagnosis	ECMO indication	ECHO	Cardiac Catheterization
ToF PAT -- central shunt	Cyanosis+LCOS	LPA stenosis suspected	Confirmed
TAPVR -- repair	LCOS	Inadequate echocardiogram windows for PV	Left pulmonary vein stenosis; right pulmonary venous hypoplasia
CCF and AF h/o Repair dTGA and VSD	LCOS	Inadequate echocardiogram windows for PA	Normal PA anatomy
ToF, discontinuous PAs	LCOS	PA not visualized	LPA stenosis.
TAPVR repair	LCOS	IVC obstruction suspected	Confirmed
DORV and "TGA"	LCOS	Decreased ventricular function and branch PS suspected	Confirmed
PA and complex single ventricle	Cyanosis	Patent central shunt	Distal shunt and proximal branch PA stenosis
ToF PAT	Cyanosis	PA not visualized	Hypoplastic branch and distal PA
AVSD	LCOS	LVOTO suspected	Wide open LVOT
DORV HLHS s/p Norwood Sano	Cyanosis	Suspected Distal conduit obstruction	Confirmed
HLHS status post Norwood	Cyanosis + LCOS	Inadequate echocardiogram windows	Thrombosed branch PAs
Critical Aortic stenosis	LCOS	Adequate	Confirmed/ balloon dilatation
VSD PS supra PS Noonans syndrome	LCOS	Dynamic subvalvar RVOTO	Confirmed
HLHS status post Norwood BT shunt	Cyanosis	Distal shunt and proximal branch PA stenosis not identified	Distal shunt and proximal LPA stenosis
Heterotaxy, TAPVR, unbalanced AVSD s/p RMBTS	LCOS and tamponade	Limited echocardiogram windows	Confirmed patent shunt and pulmonary vein stenosis
Fontan and PLE Fontan revision	LCOS	Limited echocardiogram	Massive PA thrombus
ToF discont PA	LCOS	PA not visualized	No PA stenosis identified
Complex DORV and tGA	LCOS	Decreased function patent PA's	Confirmed
Switch and VSD closure			

AVSD, atrio-ventricular septal defect; CCF, congestive heart failure; DORV, double outlet right ventricle; HLHS, hypoplastic left heart syndrome; IVC, inferior vena cava; LCOS, low cardiac output syndrome; LVOTO, left ventricular outflow tract obstruction; PA, pulmonary artery; PS, pulmonary stenosis; RMBTS, right modified Blalock-Taussig shunt; RVOTO, right ventricular outflow tract obstruction; TAPVR, total anomalous venous return; tGA, transposition of great arteries; ToF, Tetralogy of Fallot; PAT, pulmonary atresia; VSD, ventricular septal defect.

Table 4
Characteristics of patients requiring intrahospital transport for computed tomography scan

Variables	Computed tomography scans (n =15)
Number of IHTs	20
Gender (male:female)	5:10
Median weight: kg (range)	15 (5-81.3)
Type of ECMO:veno-arterial	15
Age	
1-5 yrs	8
5-15 yrs	4
Median age: mos (range)	72 (3- 166)
Type of patients	
Cardiac	11 (16 IHTs)
Non-cardiac	4
Indications for IHT	
Neurological evaluation	17
Pre-transplantation evaluation	3
Median pre-IHT ECMO support hrs: (range)	40 (1-745)
Emergent IHT	13
Median transport time: mins (range)	40 (30-90)
Management change	14

ECMO, extracorporeal membrane oxygenation; IHT, intrahospital transport.

Table 5
Interventions and complications during intrahospital transport for cardiac catheterization

Variables	Diagnostic Catheter (n= 20)	Interventions Catheter (n=17)	Computed Tomography Scans (n=20)
Additional sedation	18	13	18
Additional muscle relaxant	11	13	11
Mechanical problems: cannula	0	0	1
Mechanical problems: circuit	2	1	2
Bleeding	2	0	2
Δ Flow (increase:decrease)	1:4	4:4	5:0
Δ Inotrope (increase:decrease)	3:0	3:3	3:0
Additional Fluids			
Fluids/albumin	5	7	5
Packed red blood cells	7	7	7
Fresh frozen plasma	3	4	3
Platelets	2	6	2
Surgical intervention during intrahospital transport	1 *	0	0
FIO2 change	2	4	17
Δ pH change range	-0.07 to +0.22	-0.19 to +0.22	-0.16 to +0.1
Δ Paco2 change range (mm Hg)	-13 to + 88	-21 to + 12	-8 to + 18
Δ Pao2 change (mm Hg)	-150 to + 150	-196 to + 349	-154 to +84
Δ Base deficit/excess change	-5.5 to + 6.2	-3.3 to + 3.2	-4 to +4.3

Femoral cannulation: Fio2, inspired oxygen concentration; Δ, change.