

SHORT REPORT

Resource use and health outcomes of paediatric extracorporeal membrane oxygenation

R Van Litsenburg, N De Mos, D Edgell, C Gruenwald, D J Bohn, C S Parshuram

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The use of extracorporeal membrane oxygenation (ECMO) can be rationalised by the assumption that non-zero survival after refractory cardiorespiratory failure represents improved outcome. Survivors may have cognitive and or functional morbidities, require complex ongoing care, and as a consequence consume considerable healthcare resources.¹

We performed a retrospective evaluation of the survival, morbidity, and hospital based costs of children receiving ECMO between January 1997 and May 2002. The indication for ECMO, survival, neurological outcome as assessed by the pediatric cerebral and overall performance category scores,² and resource use were abstracted from medical records. Costs were based on in-house estimates. Local billing fees were applied where in-house estimates were not available. Five year hospital based costs in CAD\$2003 were calculated beginning at ECMO initiation. A 5% discount rate was applied in arrears.

We excluded resources consumed before the institution of ECMO, costs to families, and blood products (centrally funded). For logistic reasons, the cost of drugs was not

included. Years with missing data were imputed based on resource use from survivors. Costs were converted into € (2003).

Eighty of 83 children who received ECMO during the study period were evaluated; 47 (59%) survived 24 hours after decannulation, 31 (39%) survived to hospital discharge, and 28 (35%) were alive one year after hospital discharge. The five year costs were €5 117 551 in total and €165 082 per child surviving to hospital discharge (table 1); 85% of costs occurred in the first year, and 53% were due to hospital stay (mean 37.5, maximum 275 days).

Morbidity was assessed in 30 (97%) survivors at hospital discharge. Three (10%) had no functional impairment, and nine (30%) were developmentally normal. Nineteen (68%) children were assessed at 12 months; function was normal in four (21%) and mildly or moderately impaired in 15 (79%) (table 2).

These findings highlight the importance of identifying the children who are most likely to benefit from ECMO. In our institution, as in others, the limited evidence to support the use of ECMO for specific indications has necessitated ECMO use on a case by case basis. Reported patterns of ECMO use are changing,³ and the indications for ECMO are broadening and now include sepsis and cardiac arrest.⁴ We found, retrospectively and in a single centre cohort, that fewer than two of five children who received ECMO survived to hospital discharge. Improved outcome prediction before initiation of ECMO has great potential to facilitate improvements in the outcome of ECMO, improve end of life decision making, and will permit more efficient use of healthcare resources. This knowledge is urgently needed.

Table 1 Costs and survival of 80 children treated with extracorporeal membrane oxygenation (ECMO)

	Total	ECMO survival	Hospital survival	12 month survival	Median 5-year costs (€)	Total costs (€)	Cost per life saved (€)
All	80	47 (59)	31 (39)	29 (36)	40 935	5 117 551	176 467
Congenital heart disease	55	33 (60)	19 (35)	16 (29)	43 943	3 819 204	238 700
Myocarditis/cardiomyopathy	7	5 (71)	5 (71)	5 (71)	68 877	559 582	111 916
Neonatal respiratory*	9	4 (44)	3 (33)	3 (33)	28 632	276 977	92 326
Paediatric or infant respiratory†	4	3 (75)	3 (75)	3 (75)	65 894	371 695	121 665
Neonates	32	20 (63)	13 (41)	12 (38)	41 620	2 410 026	200 835
Infants	27	15 (56)	7 (26)	4 (15)	34 386	1 188 019	297 004
Paediatric	21	12 (57)	11 (52)	10 (48)	48 580	1 519 507	151 951
Cardiac transplant rescue	8	7 (88)	7 (88)	6 (75)	149 212‡	1 193 089	198 848

Costs and survival of 80 children treated with ECMO in the period 1997–2002. The patient age at initiation of ECMO was classified as neonatal (0–28 days), infant (28 days–18 months), or paediatric (>18 months), and the indication for ECMO was classified as respiratory, congenital heart disease, or acquired heart disease (myocarditis or cardiomyopathy). Children who received a cardiac transplant while receiving ECMO are represented in the cardiac transplant rescue category. Values are number (%).

*One congenital diaphragmatic hernia, three meconium aspiration, three persistent pulmonary hypertension, two alveolar capillary dysplasia.

†Wegener's syndrome, pneumonitis, lung transplant, Bordetella pertussis.

‡p = 0.002 compared with children not receiving cardiac transplantation (Wilcoxon rank sum test).

Table 2 Neurological outcomes for hospital survivors

	Score	Before ECMO*	Hospital discharge	1 year after hospital discharge
Assessed		16 (100)	30 (100)	19 (100)
POPCS				
Normal	1	12 (75)	9 (30)	10 (53)
Mild	2	3 (19)	13 (43)	6 (31)
Moderate	3	1 (6)	8 (27)	3 (16)
Severe	4	0 (0)	0 (0)	0 (0)
Vegetative	5	0 (0)	0 (0)	0 (0)
PCPCS				
Normal	1	8 (50)	3 (10)	4 (21)
Mild	2	4 (25)	16 (53)	12 (63)
Moderate	3	2 (13)	10 (33)	3 (16)
Severe	4	2 (13)	1 (3)	0 (0)
Vegetative	5	0 (0)	0 (0)	0 (0)

Neurodevelopmental outcomes for survivors of extracorporeal membrane oxygenation (ECMO) from 1997 to 2002, using the pediatric overall performance category scale (POPCS) and the pediatric cerebral performance category scale (PCPCS) of Fiser.² Thirteen children were newborns and could not be assessed. Values are number (%).

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