indications for ECMO support

potentially reversible, life-threatening respiratory and / or cardiac failure which is unresponsive to conventional therapy
short-term cardiac support in NSW.

1994 → 1998

![ABIOMED BVS SYSTEM 5000](image1)

Cost of disposables: $36,000 $4,000

2009-13: Cardiohelp pump

![Cardiohelp pump](image2)
January 2009:
First aeromedical ECMO retrieval in NSW

17 year-old female, community-acquired pneumonia, ventilated for 14 days, severe air leaks

Mater Hospital, Brisbane to RPAH, Sydney
4 weeks of vv ECMO at RPAH, 3 thoracotomies for bleeding chest drains, massive transfusion

transferred to SVH, 2 weeks on ECMO, double lung transplant: massive transfusion, postop VA ECMO for RV failure, then VV ECMO..

**total days on ECMO:** 52  
**ICU stay:** 5 months
May 2008:

“working party” formed to develop indications for ECMO referral

Royal Prince Alfred: Robert Herkes, Richard Totaro, Paul Forrest, Ross Wallace
St Vincent (Sydney): David Lowe
Prince of Wales: Andrew Belessus
Royal North Shore: Ray Raper
Liverpool: Michael Parr
St George: Theresa Jacques, Andy Pybus
Westmead: Peter Clark
Newcastle: Martin Rowley
Nepean: Ian Seppelt
Alfred (Melbourne): Vin Pelligrino

Non-cardiogenic respiratory failure

Optimal ventilation (including PEEP >10cmH2O)
Consider PCV or CMV

V_t < 8mL/kg (ideal body weight), prone ventilation, recruitment manoeuvres

PaO2 / FiO2 < 80mmHg or pH < 7.25 for > 2 hours

Cardiogenic shock of any aetiology

Optimal ventilation
Consider PCV or CMV
V_t < 8mL/kg (ideal body weight), prone ventilation, recruitment manoeuvres

Candidate for destination therapy
OR: Fulminant myocarditis requiring inotropes or IABP at any time

NSW Indications for ECMO referral

NSW Indications for ECMO referral

* All non-ICU failure = acute non-cardiac process; 1 week post cardiac surgery, mechanical ventilation, shock
* Absolute contraindications to all forms of ECMO: Non-cardiogenic respiratory failure = associated shock; Cardiogenic shock = non-cardiogenic respiratory failure
NSW ECMO Retrieval Service

Winter 09...

18 H1N1 patient retrievals:

12 outside Sydney
6 in Sydney
Winter 2009: 15 ANZ hospitals

68 H1N1 ECMO cases:

38 retrieved on ECMO (56%)
54 survived (79%)
Survival: H1N1 cases influenza: 17/19 (89%)
Survival: Other: 17/20 (85%)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus</td>
<td>1/3</td>
</tr>
<tr>
<td>Streptococcus</td>
<td>4/5</td>
</tr>
<tr>
<td>'Community acquired'</td>
<td>8/8*</td>
</tr>
<tr>
<td>Asthma</td>
<td>1/1</td>
</tr>
<tr>
<td>Aspiration</td>
<td>1/1</td>
</tr>
<tr>
<td>Trauma</td>
<td>1/1</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
</tr>
</tbody>
</table>

*1 patient bridged to transplant

| RPAH ECMO program 2009-2013:                                                                 |
|-----------------------------------------|--------|------|------|--------|
| **Indication**                          | **Mode** | **Age (Mean)** | **n=105** | **Survival** |
| Respiratory                             | VV      | 45   | 60   | 78%    |
| Post cardiac surgery                    | VA      | 58   | 14   | 43%    |
| Other cardiac                           | VA      | 51   | 17   | 59%    |
| Procedural support:                     | VA      |      |      |        |
| TAVI                                      | 78     | 10   | 100% |
| PCI                                       | 68     | 4    |      |
ECMO for AMI and cardiogenic shock

600 patients with AMI and cardiogenic shock, for PCI or CABG

- mortality (30 days) with IABP: 40%
- mortality (30 days) without IABP: 41%
- no differences in secondary outcomes
Peripheral venoarterial extracorporeal membrane oxygenation improves survival in myocardial infarction with cardiogenic shock

Gilbert H. L. Tang, MD, MSc, Ramin Malekan, MD, Masashi Kai, MD, Steven L. Lansman, MD, PhD, and David Spielvogel, MD, Valhalla, NY

- 21 patients: AMI, sBP < 80mmHg despite inotropes
- mean age 61
- IABP in all cases
- CPR: 10 patients

J Thorac Cardiovasc Surg, 2013

TABLE 2. ECMO implantation and outcomes data (n = 21)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implant data</strong></td>
<td></td>
</tr>
<tr>
<td>Location of ECMO implant:</td>
<td></td>
</tr>
<tr>
<td>Catheterization laboratory</td>
<td>7 (33%)</td>
</tr>
<tr>
<td>Operating room</td>
<td>14 (67%)</td>
</tr>
<tr>
<td>Site of arterial outflow</td>
<td></td>
</tr>
<tr>
<td>Percutaneous femoral (all placed in catheterization laboratory)</td>
<td>7 (33%)</td>
</tr>
<tr>
<td>Axillary (all placed in operating room)</td>
<td>14 (67%)</td>
</tr>
<tr>
<td>Duration of support (d)</td>
<td>9.0 ± 7.5</td>
</tr>
<tr>
<td><strong>Outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>30-day all-cause mortality</td>
<td>5 (24%)</td>
</tr>
<tr>
<td>30-day mortality by location of ECMO implant:</td>
<td></td>
</tr>
<tr>
<td>Catheterization laboratory</td>
<td>4/7 (57%)</td>
</tr>
<tr>
<td>Operating room</td>
<td>1/14 (7%)</td>
</tr>
<tr>
<td>ECMO as bridge</td>
<td></td>
</tr>
<tr>
<td>Recovery</td>
<td>9 (43%)</td>
</tr>
<tr>
<td>CABG</td>
<td>5 (24%)</td>
</tr>
<tr>
<td>LVAD/transplantation</td>
<td>2 (10%)</td>
</tr>
</tbody>
</table>
ECMO for refractory cardiac arrest (eCPR)

case: 47yo male: R) thoracotomy / decortication

- empyema R) lower lobe
- T2DM, HTN, hypercholesterolemia, smoker
- ambulant on ward, preoperative TTE: normal
- postop: VF x 2, 13 min ACLS total
- transfused 2U
- diffuse ST depression, anterior SWMA: emergency PCI.
cath. lab

• diffuse 80% stenosis proximal vessels LAD
  ➔ balloon angioplasty

• profuse bleeding from chest drains
  massive transfusion / Factor VII

• VF on transfer to ICU bed

• peripheral VA ECMO during CPR (~20min)

• defib x 1, sinus rhythm

progress

• redo thoractomy for haemostasis - massive transfusion

• decannulated day 1

• chest closed day 2

• extubated day 5

• repeat cath day 11: normal coronaries!

• discharged day 23, neurologically intact
eCPR for IHCA and OHCA

- 24 patient, median age 48
- therapeutic hypothermia in 17 patients (71%)
- time to eCPR: 58min (45-70)
- survived intact at 4 weeks: 6 patients (24%)
- organ donors: 4 patients (17%)

Fagnoul, Resuscitation 2013
the future of eCPR

eCPR proposal

• institutional protocol, clearly defined team roles
• patients < 65 years, witnessed arrest
• CPR with Lucas device
• no ROSC within 5 minutes, establish femoral arterial and venous access with 6F catheters
• no ROSC after 5 minutes, call for ECMO
...a pragmatic approach for eCPR

- aim to establish peripheral VA ECMO within 60 minutes
- cool patient for 24 h
- transfer for PCI / surgery
- withdraw after 24-48h if severe neurological injury

ECMO for cardiogenic shock: “bridge to decision”

- withdraw / organ donation
- recovery

- CABG
- PCI
- VAD
- transplant
ECMO for cardiogenic shock / cardiac arrest

- improve survival in selected cases (?)
- decrease neurological injury
- increase organ donor pool
- cost-effective (?)
- a new treatment paradigm (?)