Extracorporeal Membrane Oxygenation (ECMO) - Local experience

Dr. Yan Wing Wa
ICU Director, Pamela Youde Nethersole Eastern Hospital, HKSAR
Chairman, Hong Kong Society of Critical Care Medicine
Chairman, Specialty Board of Critical Care Medicine, HKCP

12 December 2010
CCM Inter-hospital Grand Round

Date : 22nd September 2009
Time : 6:00pm to 8:00pm
Venue : Lecture Theatre,
G/F, Block M,
Queen Elizabeth Hospital

Lecture : 6:00pm to 7:00pm
Topic : A sleepy Man
Speaker : Dr HO Chun Ming
Resident (ICU), NDH

Lecture : 7:00pm to 8:00pm
Topic : Breathe without lungs
Speaker : Dr KWAN Ming Chit, Arthur
Resident (ICU), PYNEH

Chairmen : Dr TSANG Chi Chung, Chris
Associate Consultant (ICU), NDH
Dr CHAN King Chung, Kenny
Associate Consultant (ICU), PYNEH

CME Point
“An Introductory to ECMO in different applications”

Speaker:
Dr. Vincent A. Pelligrino,
Senior Intensivist of the Alfred Hospital,
Melbourne, Australia

Date & Venue:
Thursday, 19th of November, 2009
5th Floor Lecture Theatre,
Professorial Block, Queen Mary Hospital,
2p.m. – 3p.m.

Organised by:
Queen Mary Hospital,
Department of Cardiothoracic Surgery

Any enquires, please contact:
Brandon Chen 9852 – 9783
Ernest Chan 9852 - 9772

MAQUET
Shun On Healthcare
Case Presentation – Malaria Multi-Organ Failure Treated With Extracorporeal Membrane Oxygenation (ECMO)

Dr. John W. Simon
B.M., B Ch (Oxford), D.T.M. & H., FHKAM (Medicine), FHKCP (Infectious Diseases), FRCP (Edin), FRCP (London)
Specialist in Internal Medicine
Honorary Professor Dept. Microbiology University of Hong Kong
Chairman Scientific Committee Vector-Borne Disease Centre Health protection, Department of Health

Dr. Kenneth Tsang
MD (Glasgow, Hons) FRCP (Edin, Glas, Lond) MB ChB (Glasgow), MRCP (UK), FHKCP, FHKAM (Med), Specialist in Respiratory Medicine

Dr. Ignatius Cheng
MBBS (HK), PhD (Sydney), FRACP, FRCP (Lond), FRCP (Edin), FHKCP, FHKAM (Med)
Specialist in Nephrology
HKACCN Seminar (2010-1)

Extracorporeal Membrane Oxygenation (ECMO) for patients with severe respiratory failure

Speakers
Dr. Yan Wing Wa (Doctors’ perspectives)
Director
Department of Intensive Care
Pamela Youde Nethersole Eastern Hospital

Ms. So Hang Mui (Nurses’ perspectives)
Nurse Specialist
Department of Intensive Care
Pamela Youde Nethersole Eastern Hospital

Date and Time: 30 June 2010(Wed), 6:30-8:30 pm
Venue: Multi-function Room, D Block, Queen Elizabeth Hospital
First Co-Joint ECMO Training in Hong Kong – Pre-Course Training

4 identical half-day sessions in 4 different hospitals

Goal: To equip staff working in centers with essential knowledge on ECMO service in HK

**Lectures** 14:30 – 16:30
- Physiology of cardiac and respiratory support using ECMO
- Equipment / ECMO circuit
- Patient selection/ Percutaneous cannulation
- Management of patient on ECMO, potential complications and weaning

**Simulation workshops** 17:00 – 18:30

**Venue and time:**
- **PWH** 10th Aug 2010
  - Ms. Gigi Fung
  - Conference Rm 132, 1/F. Block A. Staff Quarters. PWH

- **QEH** 2nd Sept 2010
  - Ms. Rowlna Leung
  - Block D. G/F. Multi-function Rm. QEH

- **PYNEH** 10th Sept 2010
  - Ms. HM So
  - Seminar Rm 2. G/F. HKCEC Training Center for Healthcare Management and Clinical Technology. PYNEH

- **QMH** 5th Oct 2010
  - Mr. YK Lau
  - Administrative Block. G/F. Seminar Rm. 1. QMH
將血液體外加氧送回 讓心肺暫休息

人工肺續命 存活增兩成

受嚴重肺炎、肺纖維化或貪氧感侵襲的病人，可出現急性肺功能衰竭，導致氧氣無法進入血液，最終因多重器官衰竭死亡。本港近年引入俗稱“人工肺”的體外膜氧合器（ECMO），將病人血液於體外加氧再送回體內，暫代心肺功能，病人存活率可提高近兩成。

【人工肺】治療 存活率達71%

俗稱“人工肺”的體外膜氧合器，以往常用於開放式心臟手術時幫助病人呼吸，近年發現也適用於患有急性肺衰或肺功能衰竭患者身上，如電擊傷、流感、流感等。國際上有多個研究結果顯示，人工肺治療病人存活率可由五成提升至七成。本港公立醫院去年亦曾利用人工肺治療嚴重肺衰患者。有私家醫院更成功利用人工肺治療一名感染禽流感的外籍人士，為全球首宗案例。

人工肺的運作原理是把病人體內的靜脈血液引至體外密閉的膜器或微孔膜氧合器內，代替病人肺部將氧氣溶入血內，再輸回血內中氧氣和二氧化碳，經溫度調節後輸入動脈的血液按回大動脈，患者體內的血氣交換經過人工肺部。而患者新動脈內由氧氣和二氧化碳從體外交換，達到呼吸作用；從而減輕心肺負荷，和讓肺部休息，維持供氧生，避免肺功能進一步喪失及器官衰竭。

2名58歲印度裔女性，由今年一月由家庭求診急症室，經手術後，病情急轉趨危，最終進人工肺治療。當中一名有6個月懷孕，經人工肺治療後，胎兒在 doğum時，已成活。

澳洲及紐西蘭一項研究顯示，去年七十八名感染禽流感患者，於人工肺治療後，存活率達71%。其中有12名患者因人工肺治療後出現合併症，需要更進行治療。
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
<th>Chairpersons</th>
<th>Title</th>
<th>Presenters</th>
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<tbody>
<tr>
<td>13:30-14:30</td>
<td>P2</td>
<td><strong>Plenary 2</strong></td>
<td><strong>Chairpersons: Prof Zi-tung Huang</strong></td>
<td><strong>What Wenchuan Earthquake tell us?</strong></td>
<td>Prof Xin-bo Liao</td>
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<td><strong>Pao Yue Kong Auditorium</strong></td>
<td><strong>Dr Fu Ng</strong></td>
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<td>14:30-16:00</td>
<td>B1</td>
<td><strong>Emergency Nursing</strong></td>
<td><strong>Chairperson: Ms Josephine YM Chung</strong></td>
<td><strong>A portrait of future emergency nurses</strong></td>
<td>Dr Julie Considine</td>
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<td>14:30-16:00</td>
<td>B2</td>
<td><strong>Toxicology and Clinical Pearls</strong></td>
<td><strong>Chairperson: Dr Tak-shun Poon</strong></td>
<td><strong>Resuscitation on poisoning – clinical toxicologist perspective</strong></td>
<td>Dr Yiu-cheung Chan</td>
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<td>16:30-18:00</td>
<td>C1</td>
<td><strong>Critical Care Medicine</strong></td>
<td><strong>Chairperson: Dr Chun-wah Lam</strong></td>
<td><strong>Hypothermic resuscitation</strong></td>
<td>Dr Hing-yu So</td>
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<td></td>
<td><strong>Topic on extracorporeal membrane oxygenation</strong></td>
<td>Dr Wing-wa Yan</td>
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<td><strong>Antimicrobial use in the critically ill patient</strong></td>
<td>Dr Vincent CC Cheng</td>
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</table>
CCM Inter-hospital Grand Round

HKSCCM
Inter-hospital
Grand round

Doctor,
Don’t give up yet!

Speaker: Dr. Anfernee Yim
(Medical Officer, PWH)
Chairman: Dr. Philip Lam
(Associate Consultant, PWH)
Date: 21st September 2010
Time: 6:00-8:00
Venue: Lecture Theatre, G/F, Block M,
Queen Elizabeth Hospital
ECLS - The New Era

Aim: To address all aspects of care required by patients under ECMO support to treat severe forms of cardiac and respiratory failure

Date: 3rd & 4th November 2010 (Lecture)
5th November 2010 (Cannulation Workshop)

Venue:
Certificate Course - 3rd, 4th Nov
Rm 120, New Clinical Building
Queen Mary Hospital
CNE Course - 3rd, 4th Nov
Rm 211, New Clinical Building
Queen Mary Hospital
Cannulation Workshop - 5th Nov
Department of Surgery, 10/F Laboratory
Block, Li Ka Shing Faculty of Medicine, HKU, Sassoon Road.

Time: According to following timetable

Enquiry:
Mr. Kit Leung (98529776)
Ms. Sarah Ip (98529781)
Shun On Healthcare

Time Table

Certificate Course
Day 1: Wed 3rd Nov
08:00-08:20 Registration
08:20-10:30 Lecture Session 1
11:00-13:00 Lecture Session 2
Coffee Break
11:00-13:00 Lunch
14:00-15:15 Lecture Session 3
Coffee Break
15:45-17:15 Hands on Session
E2: Group 1+2
E5: Group 3+4 (Switch after each session)
- End of Day 1

Day 2: Thu 4th Nov
10:30-11:00 Registration
11:00-13:00 Lecture Session 4
Lunch
13:45-15:15 Lecture Session 5
Coffee Break
15:45-17:15 Simulations
E2: Group 1+2
E5: Group 3+4 (Switch after each session)
- End of Day 2
Remarks:
- All Registration and Lecture Sessions would be held in Rm 211
- Multiple Choice Exam and closing remarks

CNE Course
Day 1: Wed 3rd Nov
08:00-08:20 Registration
08:20-10:30 Lecture Session 1
Coffee Break
11:00-13:00 Lecture Session 2
Coffee Break
11:00-13:00 Lunch
14:00-15:15 Lecture Session 3
- End of Day 1

Day 2: Thu 4th Nov
10:30-11:00 Registration
11:00-13:00 Lecture Session 4
Lunch
13:45-15:15 Lecture Session 5
- End of Day 2
Remarks:
- All Registration and Lecture Sessions would be held in Rm 211

Cannulation Workshop, Fri 5th Nov
09:00-12:00 Groups 1 and 2 concurrent
12:30-15:30 Groups 3 and 4 concurrent

Grouping Arrangement
(for Hands-On, Simulation Session and Cannulation Workshop)
Group 1: QMH
Group 2: QEIH
Group 3: PWH
Group 4: PYNEH
<table>
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<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>08:30 – 09:15</td>
<td>Registration</td>
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<tr>
<td>09:15 – 09:25</td>
<td>Opening Remarks</td>
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<td>Dr. Kin-sang Chan (Chairman, Hong Kong Lung Foundation)</td>
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<td>09:25 – 10:25</td>
<td>Symposium I: Critical Care - Clinical Update</td>
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<td>Chairperson: Dr. Wai-ming Chan</td>
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<td><strong>Use of ECMO in H1N1 influenza</strong></td>
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<td>Dr. Wing-wa Yan (Hong Kong)</td>
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<td><strong>Sedation towards weaning from mechanical ventilation</strong></td>
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<td>Professor Mervin Maze (USA)</td>
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</table>
CCM Inter-hospital Grand Round

Date: 23rd November 2010
Time: 6:00pm to 8:00pm
Venue: Lecture Theatre, G/F, Block M, Queen Elizabeth Hospital

Lecture: 6:00pm to 7:00pm
Topic: My heart will go on
Speaker: Dr TAM Oi Yan, Jackie
        Resident (ICU), PYNEH
Chairman: Dr LAM Sin Man, Grace
          Associate Consultant (ICU), PYNEH

Lecture: 7:00pm to 8:00pm
Topic: An invisible killer
Speaker: Dr CHUNG Yat Kiu, Edward
        Resident (ICU), TKOH
Chairman: Dr SINN Ting Ting, Maria
          Associate Consultant (ICU), TKOH
体外膜氧合治疗 肺衰竭患者救星

今年二月为至的十个月期间，並有七名
甲型流感患者接受額外的ECMO治疗，
最终一名患者死亡，其余六人完全康复，
並无发现直接由ECMO引致可威脅生
命或肢體的併發症。

此為訊息亦稱為ECMO，拯救嚴重
肺衰竭患者，把病人的靜脈血引至體
外，經體外交換後再送回人體內。

傳染病專科醫生勞永樂表示，EC-
MO是患者最後的希望。當人體肺功能
壞掉時，ECMO像人工肺一樣，但治療
人力物力需要嚴謹及龐大，否則患者會
受到血的細菌感染及生蠔，均可致命。

傳染病專科醫生勞永樂表示，EC-
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生蠔？
Hong Kong Society of Critical Care Medicine
Annual Scientific Meeting 2010
What’s Up?
Current Trends in Local ICUs
12 December 2010 Sunday 08:30-17:30
HKEC Training Centre for Healthcare Management & Clinical Technology,
Pamela Youde Nethersole Eastern Hospital, 3 Lok Man Road, Chai Wan, HK

Officiating Guest:
Dr Shao Haei LIU
Chief Manager (Infection, Emergency & Contingency)
Hospital Authority
Hong Kong

Speakers:
Prof William CLARK
Assistant Professor of Clinical Medicine,
Indiana University of Medicine, Indianapolis, USA
Dr Tom BUCKLEY, COS, ICU, PMH / YCH
Dr Wai Ming CHAN, Consultant, AICU, QMH
Dr Kang Yiu LAI, COS, ICU, QEH
Dr Wing Wa YAN, Director, ICU, PYNEH
Dr Florence YAP, Consultant, ICU, PHW
Dr Thomas LI, Consultant Respiratory Physician, Union Hospital

Symposiums:
- Continuous Renal Replacement Therapy
- Extracorporeal Membrane Oxygenation Therapy
- Massive Transfusion Protocol in Trauma
- Catheter-related Bloodstream Infections
- Venous Thromboembolism Prophylaxis
- Infection Control in ICU
- Exercise Therapy in ICU
ECMO Principle

- Desaturated blood is drained via a venous cannula.
- CO₂ is removed, O₂ added through an “extracorporeal” device.
- The blood is then returned to body circulation via another vein (VV ECMO) or artery (VA ECMO).
- Flow 80-100 ml/kg/min (vs. 2-3 ml/kg/min in CRRT).
# Types of ECMO

<table>
<thead>
<tr>
<th></th>
<th>Bad lung</th>
<th>Good lung</th>
<th>Bad lung</th>
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<tbody>
<tr>
<td></td>
<td>good Heart</td>
<td>Bad heart</td>
<td>Bad heart</td>
</tr>
<tr>
<td>V-V ECMO</td>
<td>[✓]</td>
<td>[✗]</td>
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<tr>
<td>V-A peripheral</td>
<td>[✗]</td>
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<tr>
<td>V-A Central</td>
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Jostra Quadrox PLS system
ECMO and RRT
Indications

- Principles
  - Reversible life threatening disease
    - Un-response to conventional therapy
  - At the discretion of the critical care / intensive care team
  - Absence of contraindication
Diseases suitable for V-V ECMO

- **Common**
  - Severe pneumonia
  - ARDS (primary or secondary)
  - Acute graft failure following transplant
  - Pulmonary contusion

- **Others**
  - Alveolar proteinosis
  - Smoke inhalation
  - Status asthmaticus
  - Airway obstruction
  - Aspiration syndromes

Alfred Hospital, Melbourne, Australia

Diseases suitable for V-A ECMO

Common

- Primary Graft failure: post heart / heart-lung transplant

- Non-ischaemic cardiogenic shock (includes)
  - Acute fulminant myocarditis
  - Acutely de-compensated dilated cardiomyopathy

- Ischaemic cardiogenic shock

- Post cardiac surgery: unable to wean safely from cardiopulmonary bypass using conventional supports

- Cardiomyopathy: as a “bridge” to longer term ventricular assist device

- Drug overdose with profound cardiac suppression

- Sepsis with profound cardiac depression

Alfred Hospital, Melbourne, Australia

Contraindications

- Vary between different institutions

- In general
  - Progressive & Non-recoverable diseases
  - Terminal diseases
  - Contraindication to anticoagulation
Single ECMO centre at Glenfield Hospital, UK

Survival without severe disability (confined to bed, or unable to dress/wash oneself) by 6 months

- ECMO: 57 in 90 patients (63%)
- Conventional ventilation: 41 in 87 patients (47%)
- Relative risk reduction in favour of ECMO: 0.69 (0.05–0.97; P = 0.03)
- NNT to save one life without severe disability is 6
During winter 2009 (1 June 2009 to 31 August 2009), Australia & New Zealand ICUs

68 (34%) required ECMO out of 133 patients with IPPV

For patients given ECMO

- 48/68 (71%) survived ICU
  - 32/68 (47%) survived hospital
  - 16/68 (24%) still in hospital
- 6/68 (9%) still in ICU
- 14/68 (21%) died
ECMO development in Hong Kong

- In the past years
  - Cardiology & Cardiothoracic units & QMH Paediatrics dept.

- In past one year
  - Local ICUs started to use more, especially during the Influenza H1N1 pandemic 2009
  - UCH, PYNEH, PWH, QEH and QMH
  - Establishment of referral ECMO centres in HK.
Pulmonary Alveolar Proteinosis in Extremis: The Case for Aggressive Whole Lung Lavage with Extracorporeal Membrane Oxygenation Support

Alan D.L. Sihoe, FRCSEd(CTh)\textsuperscript{a,*}, Vivian M.W. Ng, FANZCA\textsuperscript{b}, Raymond W.T. Liu, FHKAM\textsuperscript{c}, Lik-Cheung Cheng, FRCS\textsuperscript{a},

\textsuperscript{a} Division of Cardiothoracic Surgery, The University of Hong Kong, Grantham Hospital, Hong Kong SAR, China
\textsuperscript{b} Department of Anaesthesiology, The University of Hong Kong, Grantham Hospital, Hong Kong SAR, China
\textsuperscript{c} Department of Respiratory Medicine, Ruttonjee Hospital, Hong Kong SAR, China

Pulmonary alveolar proteinosis (PAP) is a rare disorder in which lipoproteinaceous material is deposited in the alveoli, compromising gaseous exchange. We report the case of a 29-year-old female patient presenting with the most extreme case of PAP yet reported. She successfully managed by aggressive bilateral whole lung lavage (W LL) in a single sitting using extracorporeal membrane oxygenation (ECMO) support. Despite critical hypercarbia and ventilator-dependence for 12 days before lavage, the patient experienced rapid recovery of pulmonary function after WLL and ECMO could be discontinued on-table. Aggressive WLL with ECMO support can be safe and effective even in the most severe cases of PAP.

(Heart, Lung and Circulation 2008;17:62–79)
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Keywords. Pulmonary alveolar proteinosis (PAP); Extracorporeal membrane oxygenation (ECMO); Whole lung lavage (WLL)
Pulmonary alveolar Proteinosis

- F/29, critical hypercarbia and ventilator dependence for 12 days
- Aggressive bilateral whole lung lavage in a single setting (total duration 508 mins) with VA-ECMO support (580 mins)
- Almost immediately weaned off ECMO after the procedure
- 12 hours later, wean off IPPV
The first novel influenza A (H1N1) fatality despite antiviral treatment and extracorporeal membrane oxygenation in Hong Kong

T Liong 梁 婷
KL Lee 李家龍
YS Poon 潘逸陞
SY Lam 林兆源
CP Chan 陳展鵬
CS Yue 余朝棨
CM Chu 朱順明
KY Yuen 袁國勇
KI Law 羅建業

We report the first fatality caused by novel influenza A (H1N1) infection despite having the diagnosis confirmed and being given antiviral treatment after hospitalisation. This patient was also the first with influenza A (H1N1) to be supported with extracorporeal membrane oxygenation in Hong Kong. Although extracorporeal membrane oxygenation is an effective means of supporting patients with refractory hypoxaemia on high mechanical ventilatory support, it is labour-intensive and technically demanding. We also discuss the challenges faced when managing this case.

Introduction

The novel influenza A (H1N1) pandemic began in Mexico in late March 2009. As of 13 August 2009, there have been more than 180 000 confirmed cases and nearly 1800 deaths worldwide.1 In Hong Kong, more than 10 000 cases had been confirmed by 27 August 2009. Forty-four of these were reported to be in serious condition. Among them, four had died and 17 had recovered and been discharged.2 It is expected that the number of confirmed and severe cases will continue to rise, which will increase the burden on the health care system in Hong Kong. We report the first fatality caused by novel influenza A (H1N1) infection, despite the use of antiviral treatment and extracorporeal membrane oxygenation (ECMO) as salvage therapy, in Hong Kong.
H1N1 Pandemic pneumonia

- F/37, Filipino woman with pandemic H1N1 in late June 2009
- Rapidly developed into severe respiratory failure ~ 10 days after symptom onset
- From AED to ICU
- Aggressive antivirals and IPPV were given
- VV-ECMO day 7 to day 21
- Died despite maximal support on day 21
Hong Kong’s experience on the use of extracorporeal membrane oxygenation for the treatment of influenza A (H1N1)

Kenny KC Chan 陈宏松
KL Lee 李家龍
Philip KN Lam 林冠毅
KL Law 罗建業
Gavin M Joynt 喬伊諾
WW Yan 殷榮華

Objective To report Hong Kong’s experience with the use of extracorporeal membrane oxygenation for the treatment of acute respiratory distress syndrome caused by influenza A (H1N1).

Design Multi-centred, retrospective observational study.

Setting Intensive care units in Hong Kong.

Patients Recipients of extracorporeal membrane oxygenation for confirmed influenza A (H1N1) infection from 1 May 2009 to 28 February 2010

Main outcome measure Hospital mortality.

Results During the study period, 120 patients were mechanically ventilated in intensive care units, among whom seven received veno-venous extracorporeal membrane oxygenation. The median (interquartile range) age of the latter patients was 42 (39-50) years, four had various chronic illnesses and one had a body mass index of greater than 30 kg/m². The median (interquartile range) time from symptom onset to hospital admission was 5 (4-7) days. Corresponding values for the duration of extracorporeal
Pandemic Influenza H1N1 in Hong Kong

Epidemic Curve of Influenza A (H1N1) Requiring ICU Admission & Mechanical Ventilation

* = Case that Required ECMO
May 1, 2009 to Feb 28, 2010. 3 ICUs

<table>
<thead>
<tr>
<th>Number (%) or Median [IQR] or Mean (±SD)</th>
<th>This Study</th>
<th>Australia &amp; New Zealand</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Cases</td>
<td>7 (100%)</td>
<td>61 (100%)</td>
<td>6 (100%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>42.0 [39.0-50.0]</td>
<td>36 [27-45]</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>44.0 (±17.7)</td>
<td>---</td>
<td>22 (±15.5)</td>
</tr>
<tr>
<td>Male</td>
<td>2 (27%)</td>
<td>29 (48%)</td>
<td>1 (17%)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.5 (±3.7)</td>
<td>---</td>
<td>32.6(±7.4)</td>
</tr>
<tr>
<td>Co-morbidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>2 (29%)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1 (14%)</td>
<td>9 (15%)</td>
<td>---</td>
</tr>
<tr>
<td>Chronic Lung Disease</td>
<td>1 (14%)</td>
<td>18 (30%)</td>
<td>---</td>
</tr>
<tr>
<td>Pregnancy or Post-partum</td>
<td>0 (0%)</td>
<td>10 (16%)</td>
<td>---</td>
</tr>
<tr>
<td>Liver Disease</td>
<td>2 (29%)</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Duration (days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptom to ICU Admission</td>
<td>5.5 [4.1 – 6.7]</td>
<td>5 [3 – 7]</td>
<td>---</td>
</tr>
<tr>
<td>Hospital to ICU Admission</td>
<td>0.1 [0.1 – 0.4]</td>
<td>---</td>
<td>0.5 [0 – 2.5]</td>
</tr>
<tr>
<td>Symptom to ECMO</td>
<td>11.3 [6.4 – 13.3]</td>
<td>8 [7 – 11]</td>
<td>---</td>
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<tr>
<td>Hospital Admission to ECMO</td>
<td>5.3 [1.1 – 6.8]</td>
<td>---</td>
<td>5 [2.5 – 8.3]</td>
</tr>
<tr>
<td>ICU Admission to ECMO</td>
<td>5 [0.8 – 6.7]</td>
<td>---</td>
<td>4.5 [3.3 – 8]</td>
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<tr>
<td>APACHE II score</td>
<td>17 (±3.2)</td>
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<td>25 (±3)</td>
</tr>
<tr>
<td>Acute Lung Injury Score (Murray’s Score)</td>
<td>3.75 [3.75 – 3.88]</td>
<td>3.8 [3.5 – 4]</td>
<td>---</td>
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<tr>
<td>Before ECMO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>pH</td>
<td>7.30</td>
<td>7.2</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>[7.19 – 7.36]</td>
<td>[7.1 – 7.3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.26 (±0.13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PaO2/FiO2 (mmHg)</td>
<td>56 [53 – 71]</td>
<td>56 [48 – 63]</td>
<td>58 (±17)</td>
</tr>
<tr>
<td></td>
<td>61 (±11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FiO2</td>
<td>1.0 [1.0 – 1.0]</td>
<td>1.0 [1.0 – 1.0]</td>
<td>1 [1 – 1]</td>
</tr>
<tr>
<td></td>
<td>14.9 (±2.7)</td>
<td></td>
<td></td>
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<tr>
<td>Peak Inspiratory Pressure (cmH2O)</td>
<td>33 [30.5 – 35.5]</td>
<td>36 [33 – 38]</td>
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</tr>
<tr>
<td></td>
<td>34.1 (±4.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compliance (mL/cmH2O)</td>
<td>22.1 [20.4 – 23.4]</td>
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<td></td>
</tr>
<tr>
<td>PaCO2 (mmHg)</td>
<td>55 [45 – 79]</td>
<td>69 [54 – 83]</td>
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<tr>
<td>Adjuncts for Ventilation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Prone Ventilation</td>
<td>1 (14%)</td>
<td>12 (20%)</td>
<td>2 (33%)</td>
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<tr>
<td>High Frequency Oscillatory Ventilation</td>
<td>0 (0%)</td>
<td>3 (5%)</td>
<td>4 (67%)</td>
</tr>
<tr>
<td>Nitric Oxide</td>
<td>0 (0%)</td>
<td>20 (32%)</td>
<td></td>
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<tr>
<td>Prostacyclin</td>
<td>0 (0%)</td>
<td>14 (22%)</td>
<td>---</td>
</tr>
<tr>
<td>Inotrope/Vasopressor</td>
<td>5 (71%)</td>
<td>46 (68%)</td>
<td>2 (33%)</td>
</tr>
<tr>
<td>Renal Replacement Therapy</td>
<td>1 (14%)</td>
<td>16 (24%)</td>
<td>---</td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>0 (0%)</td>
<td>---</td>
<td>2 (33%)</td>
</tr>
<tr>
<td>Treatment of Influenza A (H1N1)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oseltamivir</td>
<td>7 (100%)</td>
<td>64 (94%)</td>
<td>---</td>
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<tr>
<td>Intravenous Zanamivir</td>
<td>3 (43%)</td>
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<td>---</td>
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<tr>
<td>Convalescent Plasma</td>
<td>4 (57%)</td>
<td>---</td>
<td>---</td>
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<tr>
<td>Hyperimmune Immunoglobulin Study</td>
<td>1 (14%)</td>
<td>---</td>
<td>---</td>
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<tr>
<td>Steroid</td>
<td>2 (29%)</td>
<td>---</td>
<td>---</td>
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<tr>
<td>Tracheostomy</td>
<td>1 (14%)</td>
<td>39 (57%)</td>
<td>---</td>
</tr>
<tr>
<td>Duration of Mechanical Ventilation (days)</td>
<td>18.5 [11.4 – 25.3]</td>
<td>25 [13 – 34]</td>
<td>26.5 [18 – 40.3]</td>
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<tr>
<td>Hospital Length of Stay (days)</td>
<td>30.5 [24.8 – 54.9]</td>
<td>39 [23 – 47]</td>
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</tr>
<tr>
<td>Hospital Death</td>
<td>1 (14%)</td>
<td>14 (21%)</td>
<td>2 (33%)</td>
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</tbody>
</table>
ECMO in PYNEH ICU

May 2009

First case of VV-ECMO
CCM Inter-hospital Grand Round

Date : 22nd September 2009
Time : 6:00pm to 8:00pm
Venue : Lecture Theatre,
G/F, Block M,
Queen Elizabeth Hospital

Lecture : 6:00pm to 7:00pm
Topic : A sleepy Man
Speaker : Dr HO Chun Ming
Resident (ICU), NDH

Lecture : 7:00pm to 8:00pm
Topic : Breathe without lungs
Speaker : Dr KWAN Ming Chit, Arthur
Resident (ICU), PYNEH

Chairmen : Dr TSANG Chi Chung, Chris
Associate Consultant (ICU), NDH
Dr CHAN King Chung, Kenny
Associate Consultant (ICU), PYNEH

CME Point
F/27

good past health

Took 100ml of 24% paraquat (Forxone®) after quarrel with boyfriend
Paraquat poisoning

- Supportive treatment +
- Fuller Earth, Gastric lavage, Activated charcoal
- Steroid and Cyclophosphamide
- Charcoal Haemoperfusion
- High Volume Haemofiltration
- VV-ECMO

Still succumbed on day 10
ECMO in PYNEH ICU

- May 2009
  - First case of VV-ECMO for paraquat poisoning

- September 2009 - September 2010
  - VV-ECMO for viral pneumonitis
### Individual Cases

**Hong Kong Med J 2010;16:447-54**

<table>
<thead>
<tr>
<th>Gender / Age (years)</th>
<th>BMI (kg/m²)</th>
<th>Co-morbidity</th>
<th>Outcome</th>
<th>Muscle Relaxant Infusion</th>
<th>Hospital Admission to ECMO</th>
<th>ECMO/MV/ICU/Hospital stay (days)</th>
<th>Treatment for Influenza (H1N1)</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/37</td>
<td>26.3</td>
<td>Nill</td>
<td>Died</td>
<td>Yes</td>
<td>6.2 days</td>
<td>13.0/18.5 to 19.2/19.2</td>
<td>Oseltamivir, Neb Zanamivir, N-acetylcysteine, Zinc</td>
<td>Candida colonisation in sputum, Candida colonisation in urine, Haemolysis, Pneumothorax, Not applicable</td>
</tr>
<tr>
<td>F/42</td>
<td>27.5</td>
<td>Chronic Active Hepatitis</td>
<td>Home</td>
<td>No</td>
<td>5.3 days</td>
<td>5.8/20.7 to 27.7/30.5</td>
<td>Oseltamivir, Nebulised Zanamivir, Hydrocortisone, Convalescent Plasma, N-acetylcysteine, Zinc, Selenium</td>
<td>Candida colonisation in sputum, Candida colonisation in urine, Delirium, Nil</td>
</tr>
<tr>
<td>F/47</td>
<td>27.2</td>
<td>Asthma Hypertension</td>
<td>Home</td>
<td>Yes</td>
<td>17 days</td>
<td>28.5/48.2 to 48.5/68.0</td>
<td>Oseltamivir Intravenous Zanamivir, Cefepime, Gentamicin, Meropenem, Sildenafil</td>
<td>Candidaemia, MRSA bacteraemia, Haemolysis, Delirium, Nil</td>
</tr>
<tr>
<td>M/54</td>
<td>26.4</td>
<td>Diabetes Hypertension</td>
<td>Home</td>
<td>Yes</td>
<td>1.0 days</td>
<td>6.4/10.3 to 18.8/51.7</td>
<td>Oseltamivir, Nebulised Zanamivir, Intravenous Zanamivir, Methylprednisolone</td>
<td>Stenotrophomonas pneumonia, Critical illness polyneuropathy, Pulmonary embolism</td>
</tr>
<tr>
<td>M/41</td>
<td>25.2</td>
<td>Hepatitis B Carrier</td>
<td>Home</td>
<td>No</td>
<td>1.1 days</td>
<td>5.7/12.5 to 17.0/21.0</td>
<td>Oseltamivir Convalescent Plasma, Meropenem</td>
<td>Klebsiella pneumonia, E. coli urinary tract infection, Pseudomembranous Colitis, Nil</td>
</tr>
<tr>
<td>F/53</td>
<td>35.4</td>
<td>Nill</td>
<td>Home</td>
<td>No</td>
<td>7.4 days</td>
<td>4.8/29.8 to 31.5/58.0</td>
<td>Oseltamivir Intravenous Zanamivir, Convalescent Plasma</td>
<td>C. difficile peritonitis, E. coli urinary tract infection, Candida colonisation in sputum, Candida colonisation in urine, Nil</td>
</tr>
<tr>
<td>F/34</td>
<td>24.4</td>
<td>Nill</td>
<td>Home</td>
<td>No</td>
<td>0.7 days</td>
<td>5.8/8.8 to 15.0/28.6</td>
<td>Oseltamivir, Hyperimmune immunoglobulin Study</td>
<td>MRSA Pneumonia, Delirium, Minor catheter site bleeding, Transient vocal cord paralysis</td>
</tr>
</tbody>
</table>

- **Up to 12 December 2010, PYN ICU has done 8 more cases of respiratory failure due to viral pneumonitis**
Causes of viral pneumonitis

- Influenza A (H1N1) pandemic: 10
- Human metapneumovirus: 1
- Mycoplasma pneumoniae: 1
Statistics of patients treated with ECMO in PYNEH ICU

- Male/Female: 5 to 5+2

- Age distribution
  - 19-25: 1 + 1
  - 26-35: 2
  - 36-45: 2 + 1
  - 46-55: 4
  - 56-60: 1
Comorbidities

- Nil: 3 + 1
- Hypertension: 4
- Diabetes mellitus: 3 + 1
- Morbid obesity (BMI $\geq 35$): 3
- Hyperlipidaemia: 1
- Hepatitis B carrier: 1
- Schizophrenia: 1
- Obstructive sleep apnoea: 1
- Non-toxic nodular goitre: 1
Referrals

- PYNEH: 8 (7 pH1N1, 1 Human MPV)
- TMH ICU: 2 (1 pH1N1, 1 Mycoplasma P)
- KWH ICU: 1
- Canossa Hospital ICU: 1
On-site ECMO setup at referring hospital + escort

- F/22 university student, good past health
- Admitted to TMH because of severe pneumonia (mycoplasma pneumonia)
  - Failed conventional mechanical ventilation
    - FiO2 1.0, high PC/PEEP, prone ventilation
- PYNEH ICU was called for ECMO support
  - 4 doctors and 1 ICU nurse specialist
  - ECMO set, cannulae and ECMO machine (exclude warmer)
  - To TMH ICU, setup ECMO there
  - Escorted the patient back to PYNEH
  - Within 3 hours
- ECMO for 6 days, Weaned off ventilator on day 10
- CRRT for initial 4 days, followed by intermittent SLED
- Transfer back to general ward on day 14, Home on day 28
Duration of ECMO

- 4 days: 2
- 5 days: 2 + 1
- 6 days: 4 + 1
- 7 days: 1
- 24 days: 1

- Put on IPPV >14 days with prolonged exposure to high FiO2 (>0.7) and high ventilatory pressures
Day 0 at A&ED
Outcome

- Home: 12
1. Objectives
   In response to the H1N1 pandemic in 2009 and after a review of the published literatures, it was deemed necessary to introduce extracorporeal membrane oxygenation (ECMO) to the Intensive Care Unit (ICU) as a rescue therapy for the most severely ill. This document describes the management of adults with acute respiratory failure who requires veno-venous (VV)-ECMO.

2. Scope and Definition
   This document is intended for ICU medical and nursing staff. Since ECMO service is still in its early stage of development in Hong Kong, changes will likely be made to this document with accumulation of experience in concordance with the Capability Maturity Model.

3. Responsibilities
   Custodian: ICU Director
   Author: Dr Lam Sin-Man Grace
Indications for VV-ECMO

- Potentially reversible and life-threatening respiratory failure unresponsive to optimum conventional ventilation and therapy.

- Severe respiratory failure was defined in the CESAR trial as:
  - Murray score* $\geq 3.0$; or
  - Uncompensated hypercapnia with pH $\leq 7.20$
Critical Care Column

Extracorporeal Membrane Oxygenation (ECMO): Revival ± Revolution?

Drs. WW Yan, Arthur CW Lau, Grace SM Lam and Kenny KC Chan, on behalf of the PYNEH ICU ECMO Team*, Department of Intensive Care, Pamela Youde Nethersole Eastern Hospital, Hong Kong

Introduction
Extracorporeal membrane oxygenation (ECMO) is a form of extracorporeal life support (ECLS) where an artificial circuit carries venous blood to a gas exchange device (the oxygenator) for oxygen enrichment and carbon dioxide removal. If the blood is returned to the venous system, it is called a veno-venous ECMO (VV-ECMO), while if blood is returned to the arterial system, it is called veno-arterial ECMO (VA-ECMO). VV-ECMO is considered for acute respiratory failure with good cardiac function, while VA-ECMO is used in cardiac failure with or without

Early trials
ECMO has been in use since the 1970’s. However, initial experience was so unsatisfactory that it put out much ensuing enthusiasm. In a prospective, randomized, multi-centered study from nine medical centres in the United States published in 1979,2 VA-ECMO as a therapy for severe acute respiratory failure was used in 90 adult patients. Patients were treated either with conventional mechanical ventilation (48 patients) or mechanical ventilation supplemented with partial VA-ECMO (42 patients). Only four patients in

Hong Kong Thoracic Society - Newsletter Sep/Oct 2010

Full article is available at www.hkresp.com & www.hksccm.org
May 2009
- First case of VV-ECMO for paraquat poisoning

September 2009
- VV-ECMO for viral pneumonitis for 12 patients
- ECMO setup at referral site + interhospital transfer

October 2010
- First case of VA-ECMO
CCM Inter-hospital Grand Round

Date : 23rd November 2010
Time : 6:00pm to 8:00pm
Venue : Lecture Theatre, G/F, Block M,
        Queen Elizabeth Hospital

Lecture : 6:00pm to 7:00pm
Topic : My heart will go on
Speaker : Dr TAM Oi Yan, Jackie
         Resident (ICU), PYNEH
Chairman : Dr LAM Sin Man, Grace
           Associate Consultant (ICU), PYNEH

Lecture : 7:00pm to 8:00pm
Topic : An invisible killer
Speaker : Dr CHUNG Yat Kiu, Edward
         Resident (ICU), TKOH
Chairmen : Dr SINN Ting Ting, Maria
           Associate Consultant (ICU), TKOH
Severe myocarditis

- F/15, good past health

- Pulseless VT & Vf requiring repeated defibrillation & CPR (total duration: 162 mins)

- VA-ECMO started (procedure time: 110mins)
Upon admission to ward
During CPR and ECMO cannulae insertion
Backflow cannula to right superficial femoral artery was inserted by surgeon at bedside
Backflow cannula to superficial femoral artery

Before

After
Day 6  

Return of sinus rhythm
Weaning of VA ECMO

- Trial of ECMO weaning on Day 7
- ECMO flow reduced, noradrenaline and dobutamine infusion increased to facilitate weaning
- Ventilator support and anticoagulation increased
- Successfully weaned off ECMO and decannulated on Day 8 (ECMO duration: 7 days)

- However,
CT brain on Day 10

Certified brain death on Day 11
ECMO in Taiwan

- Reimbursable item
- Popular treatment in hospitals
- Large case load
  - National Taiwan University Hospital
  - Taipei Veterans General Hospital
Experience in Taipei Veteran General Hospital

- Structured
- Considered for CPR >10 mins
- Determined within 10 mins
- Onsite setup in another 10 mins (i.e. eCPR setup within 30 mins)
  - A primed ECMO circuit is available at all times
  - Early recognition of complications and aggressive management
  - The doctor setting up the circuit would be responsible for all circuit complications throughout the whole hospitalization
Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis

Yih-Sharng Chen*, Jou-Wei Lin*, Hsi-Yu Yu, Wen-Je Ko, Jih-Shuin Jerng, Wei-Tien Chang, Wen-Jone Chen, Shu-Chien Huang, Nai-Hsin Chi, Chih-Hsien Wang, Li-Chin Chen, Pi-Ru Tsai, Sheoi-Shen Wang, Juey-Jen Hwang, Fang-Yue Lin

Lancet 2008;372:554-61
Extracorporeal cardiopulmonary resuscitation in patients with inhospital cardiac arrest: A comparison with conventional cardiopulmonary resuscitation

Tae Gun Shin, MD; Jin-Ho Choi, MD, PhD; Ik Joon Jo, MD, PhD; Min Seob Sim, MD; Hyoung Gon Song, MD, PhD; Yeon Kwon Jeong, MD, PhD; Yong-Bi Jeong, MD, PhD; Joo-Yong Hahn, MD, PhD; Seung Hyuk Choi, MD, PhD; Hyeon-Cheol Gwon, MD, PhD; Eun-Seok Jeon, MD, PhD; Kiick Sung, MD, PhD; Wook Sung Kim, MD, PhD; Young Tak Lee, MD, PhD

Cumulative survival (%) vs Days

- E-CPR
- C-CPR

$p<0.001$ by stratified log-rank test

Crit Care Med 2011;39:Epub
ECMO in mainland China

- The lung protection strategy under the support of extracorporeal membrane oxygenation in patients suffering from influenza A H1N1
  - 5 patients underwent salvage VV-ECMO
  - 3 survived (60%)


- The use of extracorporeal membrane oxygenation in sustaining pulmonary function in patients with influenza A H1N1
  - 5 patients underwent salvage VV-ECMO
  - Mean ECMO duration: 178h (7.4 days)
  - 4 survived (80%)

  Duan DW et al; Zhongguo Wei Zhong Bing Ji Jiu Yi Xue. 2010 Mar;22(3):161-3
CCM Inter-hospital Grand Round

HKSCCM
Inter-hospital
Grand round

Doctor,
Don't give up yet!

Speaker: Dr. Anfernee Yim
(Medical Officer, PWH)
Chairman: Dr. Philip Lam
(Associate Consultant, PWH)
Date: 21st September 2010
Time: 6:00-8:00
Venue: Lecture Theatre, G/F, Block M,
Queen Elizabeth Hospital
Case 3

52/M

Transferred back from mainland by SOS

Post out of hospital VF cardiac arrest, down time 40 minutes

VA ECMO for 7-8 hours

Cardiac catheterization with PCI to LAD

Complicated with complete heart block

Good neurological recovery, extubated

Complicated with AKI on CRRT, derangement of LFT,
<table>
<thead>
<tr>
<th>項目描述</th>
<th>作者</th>
<th>雜誌</th>
<th>年份</th>
</tr>
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<tbody>
<tr>
<td>體外膜肺氧合快速建立血管通路方法的探討</td>
<td>吳桂深</td>
<td>實用醫學雜志</td>
<td>2010/03</td>
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<td>心臟移植術後體外膜肺氧合支持治療的監護</td>
<td>吳榮中</td>
<td>華護理雜志</td>
<td>2010/01</td>
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<tr>
<td>體外膜肺氧合支持治療39例心肺功能衰竭患者的臨床經驗</td>
<td>龍村</td>
<td>中國循環雜志</td>
<td>2007/05</td>
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<td>無泵體外膜肺氧合治療急性呼吸窘迫綜合征的實驗研究</td>
<td>梁海龍</td>
<td>中國急救醫學</td>
<td>2007/09</td>
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<td>體外膜肺氧合技術支持治療期間患者血乳酸濃度及其預後</td>
<td>李景文</td>
<td>中國組織工程研究與臨床康復</td>
<td>2007/18</td>
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<td>機械循環支持治療病毒性心肌炎研究進展</td>
<td>李小明</td>
<td>實用兒科臨床雜誌</td>
<td>2007/01</td>
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<td>高容量血液濾過聯合體外膜肺對多器官功能障礙綜合征患者的治療作用</td>
<td>陶立堅</td>
<td>中國危重病急救醫學</td>
<td>2004/12</td>
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<td>體外膜肺氧合技術救治心肺衰竭患者監護要點</td>
<td>蘇潔</td>
<td>第四軍醫大學學報</td>
<td>2004/20</td>
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<td>非常規呼吸支持技術治療呼吸衰竭</td>
<td>解立新</td>
<td>中華醫學雜志</td>
<td>2004/10</td>
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<td>體外膜肺技術臨床應用進展</td>
<td>甘小莊</td>
<td>中國實用兒科雜志</td>
<td>2004/01</td>
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</table>
ECMO in Macau

- Under planning as in May 2010
- Good prospect with strong government support
Likely future indications for ECMO in Hong Kong ICUs

- **VV-ECMO**
  - More wide spread use, may extend to bacterial pneumonia besides viral pneumonitis

- **VA-ECMO**
  - Poisoning with profound cardiac suppression
  - Viral myocarditis
  - Peri-cardiac operation in cardiothoracic centres
  - e-CPR
Drugs having “membrane stabilising activity” with potential for severe cardiotoxicity
FJ Baud et-al, Critical Care 2007,11:207

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Class 1 anti-arrhythmics</td>
<td>Flecainide, disopyramide, propafenone,</td>
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<td>quinidine, lignocaine, procainamide</td>
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<tr>
<td>Beta-blockers</td>
<td>Propranolol, acebutolol, nadolol, pindolol,</td>
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<td>labetalol, oxprenolol, metoprolol</td>
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<tr>
<td>Polycyclic antidepressants</td>
<td>Imipramine, desipramine, amitryptiline,</td>
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<td>clomipramine, doxepine</td>
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<tr>
<td>Selective serotonin reuptake inhibitors</td>
<td>Venlafaxine, citalopram</td>
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<td>Dopamine and noradrenaline uptake inhibitors</td>
<td>Bupropion</td>
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<td>Anti-epileptics</td>
<td>Carbamazepine, phenytoin</td>
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<td>Phenothiazines</td>
<td>Thioridazine</td>
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<td>Opioids</td>
<td>Dextropropoxyphene</td>
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<td>Antimalarial agents</td>
<td>Chloroquine, quinine</td>
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<td>Anaesthetic-recreational agents</td>
<td>Cocaine</td>
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Team work
Learn together through practice.
Conclusion

- ECMO is Life saving and should be provided to indicated patients

- Hong Kong is able to provide ECMO service
  - Adventist H, HKSH, PWH, PYNEH, QEH, QMH, UCH

- Hong Kong should catch up in this area
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- Dr Loretta Yam, CCE, HKEC
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- Dr Chan King Chung, Kenny, AC
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- Dr Lam Sin Man, Grace, AC
- Dr Shum Hoi Ping, AC
- Dr Wu Hiu Lam, RS
- Dr Leung Yuk Wah, Natalie, RS
- Dr Kwan Ming Chit, Arthur, RT
- Dr Tam Oi Yan, Jackie, RT
- Dr Chang Li Li, Lily, RT
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Lui, Kam-cheung, NO,
Chan, Shiu-kee Danny, NO,
Kwan, Yuen-fan Eva, NO,
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Tam, Yuen-fan RN,
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Thank you for your attention.

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