

Hong Kong Society of Critical Care Medicine Annual Scientific Meeting 2010

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

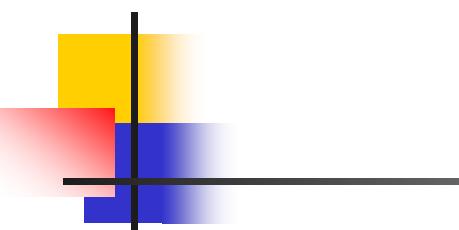


Date : 22nd September 2009
Time : 6:00pm to 8:00pm
Venue : Lecture Theatre,
G/F, Block M,
Queen Elizabeth Hospital

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



“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

Topic

**Case Presentation – Malaria Multi-Organ Failure
Treated With Extracorporeal
Membrane Oxygenation (ECMO)**

16 March 2010

Speakers

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*



Hong Kong Association of Critical Care Nurses Ltd
香港危重病學護理協會

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	10 th Aug 2010	Ms. Gigi Fung	Conference Rm 132, 1/F, Block A. Staff Quarters. PWH
QEH	2 nd Sept 2010	Ms. Rowlina Leung	Block D. G/F, Multi-function Rm. QEH
PYNEH	10 th Sept 2010	Ms. HM So	Seminar Rm 2. G/F, HKEC Training Center for Healthcare Management and Clinical Technology. PYNEH
QMH	5 th 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、肺纖維化或禽流感侵襲的病人，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炎或肺功能衰竭患者身上，如感染豬流感、瘧疾等，國際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七成。本港公立醫院去年亦曾利用人工肺治療嚴重豬流感患者，有私家醫院更成功利用人工肺治療一名感染瘧疾的外籍人士，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流至體外密封的矽膜或微孔膜氧合器內，代替病人肺部將氧氣溶入血內，再帶離血中的二氧化碳，經溫度調節後將含氧血液送回大動脈內，患者體內的血和氧不需經過自身肺部，而是在體外進行氣體交換，達到呼吸作用；從而減輕心臟壓和讓肺部休息，維持患者生命，避免肺功能進一步喪失及重器官衰竭。

Wingate)指，該患者因出現嚴重肺炎，肺功能愈來愈差，瀕臨死亡邊緣；他說如半成缸血球有瘧疾寄生蟲已是很嚴重。

助染瘧疾印裔在港康復

其後醫院利用「人工肺」，病人經兩日搶救後逐漸轉好，至今年一月，在住院約兩個月後更康復出院。鍾世文指，此宗是全球利用人工肺治療瘧疾的首宗個案。

澳洲及紐西蘭一項研究顯示，去年六十八名感染豬流感後引致急性呼吸窘迫綜合症的患者，曾入住深切治療部（ICU）接受人工肺治療，四十八人治療後病情好轉。呼吸系統科專科醫生曾華德指，綜合國際有關人工肺在治療嚴重肺炎的研究結果，整體使用後的存活率達七成，相較沒有使用人工肺的患者，存活率則僅五成。但使用人工肺亦有一定風險，如有六成二患者曾出

肺功能衰竭令其他器官壞死

人工肺吊命 存活率七

【本報訊】呼吸系統疾病可導致急性肺功能衰竭。身體器官可能因缺氧和衰竭，甚至致命。本港多間公立和私家醫院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。

化、黃疸和沙士等呼吸系統疾病，嚴重影響肺功能，令血液含氧量下降，導致身體其他器官衰竭，甚至死亡。

每日收費約三萬元

香港醫院管理局正考慮增加此項服務

現，為功能衰竭的肺部提供氧氣及幫助肺部休息，維持生命。對於07年一名10歲

2nd September 2010





Scientific Symposium on Emergency Medicine

ABC for Resuscitology: Advances, Beliefs and Consensus

17-18 September 2010

17 September 2010

13:30-14:30	P2	Plenary 2 Pao Yue Kong Auditorium	Chairpersons: Prof Zi-tung Huang Dr Fu Ng
		What Wenchuan Earthquake tell us?	Prof Xin-bo Liao
14:30-16:00	B1	Emergency Nursing Pao Yue Kong Auditorium	Chairperson: Ms Josephine YM Chung
	B1.1	A portrait of future emergency nurses	Dr Julie Considine
	B1.2	The role and operation of the emergency intensive care unit in China	Ms Pei-ling Xie
	B1.3	Sharing on overseas training experiences in St. Kitts & UK: Resuscitation--from pre-hospital to ER & training	Mr Shing-lam Kwok Ms Kwai-lin Yeung
14:30-16:00	B2	Toxicology and Clinical Pearls Lim Por Yen Lecture Theatre	Chairperson: Dr Tak-shun Poon
	B2.1	Resuscitation on poisoning – clinical toxicologist perspective	Dr Yiu-cheung Chan
	B2.2	Fatal poisonings in Hong Kong	Dr Man-li Tse
	B2.3	Clinical tips of ensuring safe & effective procedural sedation & analgesia in children	Dr Gwen GW Fok
16:30-18:00	C1	Critical Care Medicine Pao Yue Kong Auditorium	Chairperson: Dr Chun-wah Lam
	C1.1	Hypothermic resuscitation	Dr Hing-yu So
	C1.2	Topic on extracorporeal membrane oxygenation	Dr Wing-wa Yan
	C1.3	Antimicrobial use in the critically ill patient	Dr Vincent CC Cheng

CCM Inter-hospital Grand Round



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

Dates: 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
Coffee Break
11:00-13:00 Lecture Session 2
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)
17:30-18:30 Multiple Choice Exam and closing remarks

- End of Day 2

Remarks:

- All Registration and Lecture Sessions would be held in Rm 120.
- Hands-On and Simulation Sessions would be held in E2/E5 ICU.

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
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

08:00-12:00 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 3: PWH

Group 2: QEH
Group 4: PYNEH

Jointly Organised by:
The Alfred Hospital
The University of Hong Kong



Autumn Respiratory Seminar 2010

Date: 14 November 2010 (Sunday)

Venue: Hong Kong Convention and Exhibition Centre, Wan Chai

08:30 – 09:15 **Registration**

09:15 – 09:25 **Opening Remarks**

Dr. Kin-sang Chan (Chairman, Hong Kong Lung Foundation)

09:25 – 10:25 **Symposium I: Critical Care - Clinical Update**

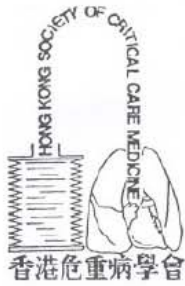
Chairperson: Dr. Wai-ming Chan

Use of ECMO in H1N1 influenza

Dr. Wing-wa Yan (Hong Kong)

Sedation towards weaning from mechanical ventilation

Professor Mervin Maze (USA)



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



體外膜氧合治療 肺衰竭患者救星

患嚴重甲型流感（H1N1）可致命，自甲型流感於去年爆發後，香港部份深切治療病房開始為有需要病人提供體外膜氧合治療（俗稱ECMO），拯救嚴重肺衰竭患者，把病人的靜脈血引至體外，經氣體交換後再送回人體內。

《香港醫學雜誌》指，ECMO是一

種醫療急救設備，當大部份醫療方法皆無效時，就會拯救嚴重肺衰竭患者，做體外的呼吸與循環。ECMO會將病人的靜脈血引流至體外，經氣體交換後再送回病人的動脈或靜脈。

這樣可暫時替代患者的心肺功能，並為醫療人員爭取更多救治時間。直至

今年二月為止的十個月期間，並有七名甲型流感患者接受額外的ECMO治療，最終一名患者死亡，其餘六人完全康復，並無發現直接由ECMO引致可威脅生命或肢體的併體症。

傳染病專科醫生勞永樂表示，ECMO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蝨，均可致命。

傳染病專科醫生勞永樂表示，ECMO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蝨，均可致命。

生蝨？

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

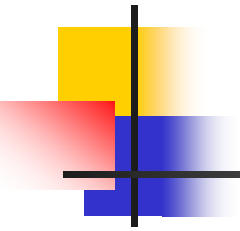
Dr Florence YAP, Consultant, ICU, PWH

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

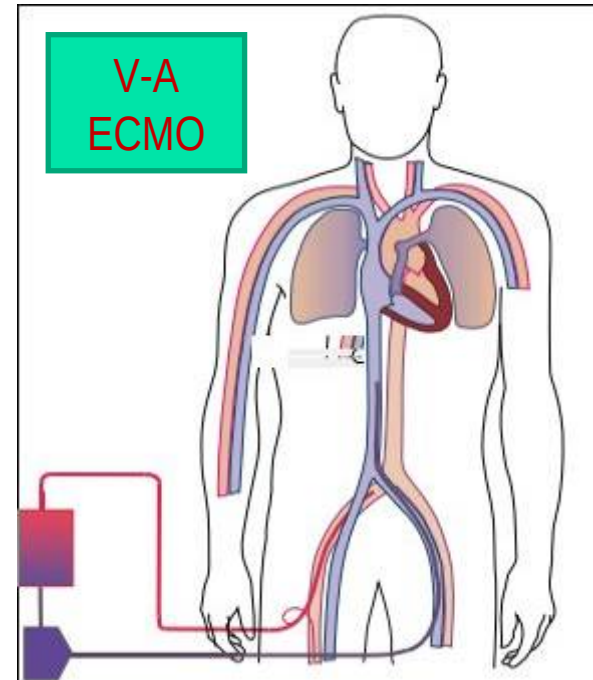
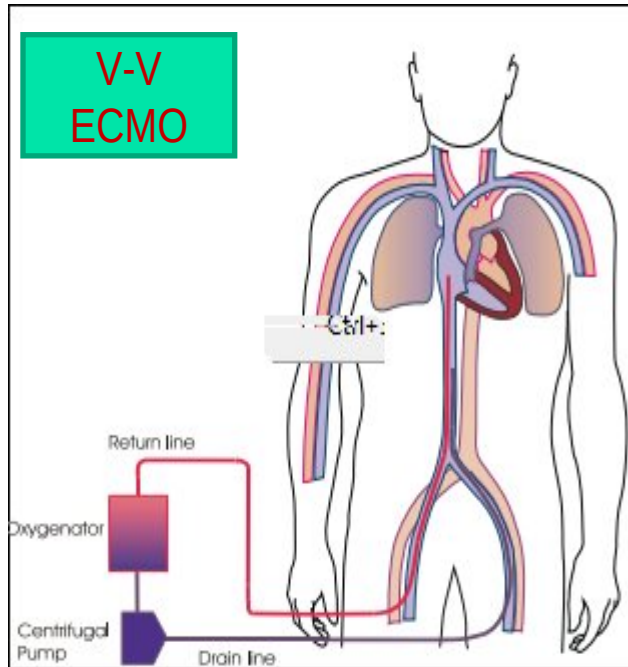




ECMO Principle

- Desaturated blood is drained via a venous cannula
- CO_2 is removed, O_2 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



	Bad lung good Heart	Good lung Bad heart	Bad lung Bad heart
V-V	√	X	X
V-A peripheral	X	√	√
V-A Central	√ (not required)	√	√

OUTLINE



Jostra Quadrox PLS system



**NO alcohol
Containing Solution
on ECMO circuit**
→ materials to weaken & crack



Rota- Flow

RPM

2695

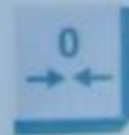
LPM

3.03

FRE -***-



LPM
Mode





3500 LOW FLOW
AIR-OXYGEN
MIXER

800
600
400
200
ml/min
O₂ / AIR



8
6
4
2
LPM
O₂ / AIR



F_IO₂



38.0

°C

Made in Germany

380

°C

Made in Germany

HEAT ENLSS. 75W



380

°C



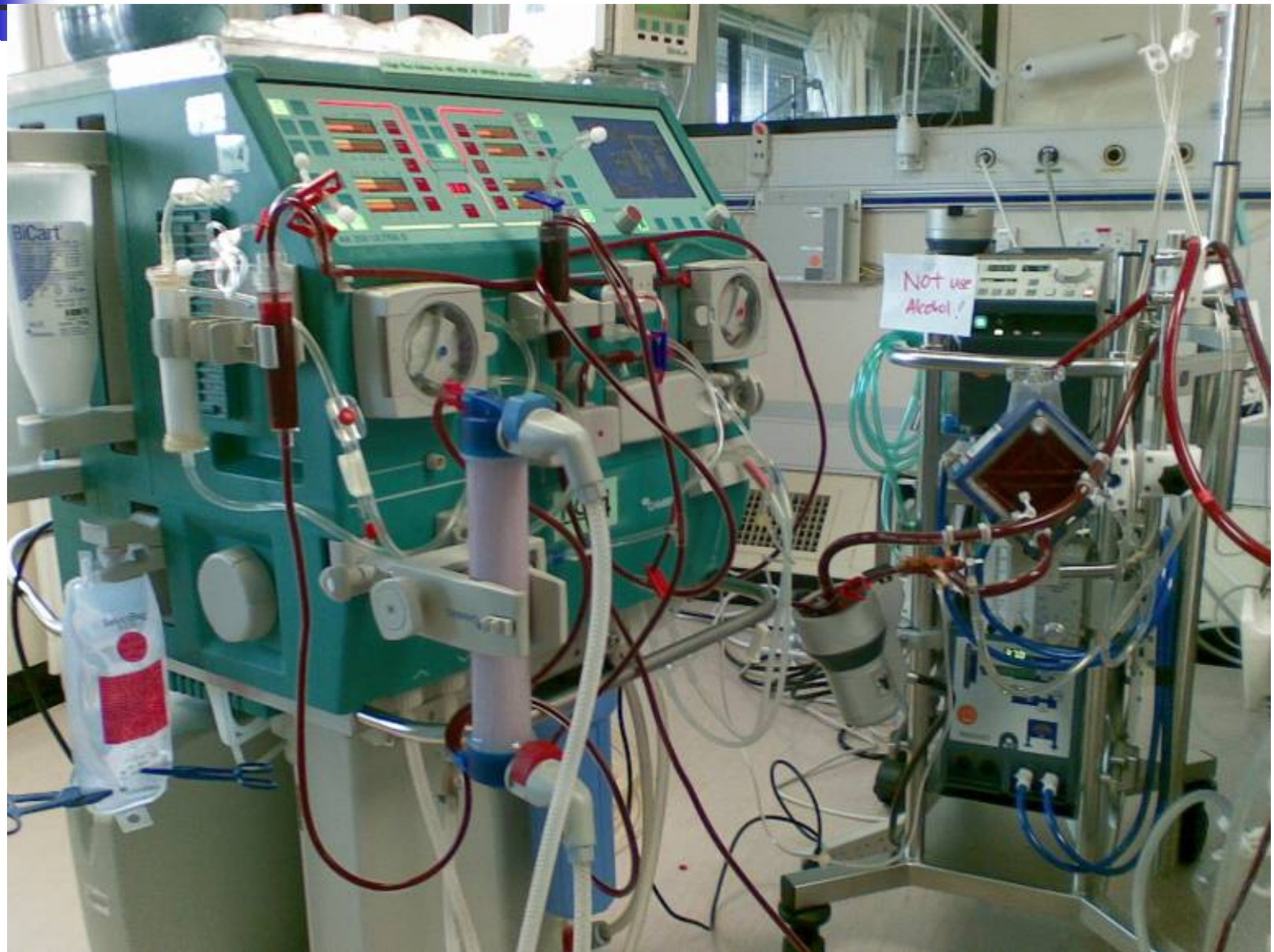
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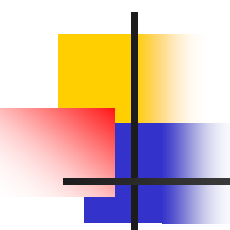


MAQUET



ECMO and RRT

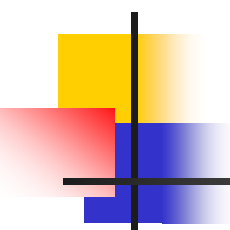




Indications

- 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

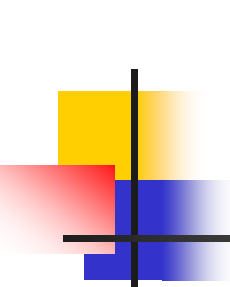
- Severe pneumonia
- ARDS (primary or secondary)
- Acute graft failure following transplant
- Pulmonary contusion

■ Others

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

Alfred Hospital, Melbourne, Australia

<http://alfredecmo.com.au/Indications.htm>



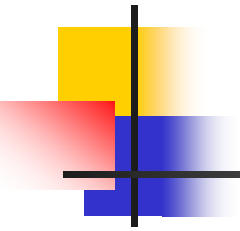
Diseases suitable for V-A ECMO

■ 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

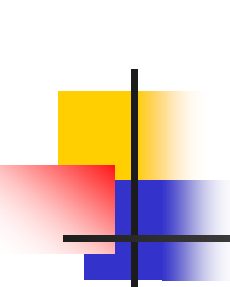
Alfred Hospital, Melbourne, Australia

<http://alfredecmo.com.au/Indications.htm>



Contraindications

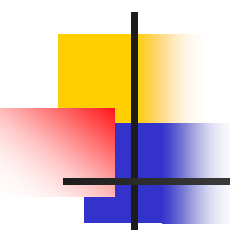
- Vary between different institutions
- In general
 - Progressive & Non-recoverable diseases
 - Terminal diseases
 - Contraindication to anticoagulation



CESAR study

Conventional ventilation or ECMO for Severe Adult Respiratory failure
Lancet 2009, 374:1351-63

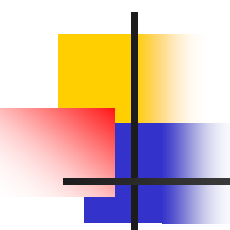
- Single ECMO centre at Glenfield Hospital, UK
- Survival without severe disability (confined to bed, or unable to dress/wash oneself) by 6 months
 - ECMO: 57 in 90 patients (63%)
 - Conventional ventilation: 41 in 87 patients (47%)
 - Relative risk reduction in favour of ECMO
 $0.69 (0.05-0.97; P = 0.03)$
 - NNT to save one life without severe disability is 6



ECMO for 2009 Influenza A(H1N1) Acute Respiratory Distress Syndrome

The Australia and New Zealand Extracorporeal Membrane Oxygenation (ANZ ECMO) Influenza Investigators
JAMA. 2009;302(17):1888-1895. Published online October 12, 2009(doi:10.1001/jama.2009.1535)

- 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)^{a,*}, Vivian M.W. Ng, FANZCA^b,
Raymond W.T. Liu, FHKAM^c, Lik-Cheung Cheng, FRCS^a,

^a Division of Cardiothoracic Surgery, The University of Hong Kong, Grantham Hospital, Hong Kong SAR, China

^b Department of Anaesthesiology, The University of Hong Kong, Grantham Hospital, Hong Kong SAR, China

^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 (WLL) 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.

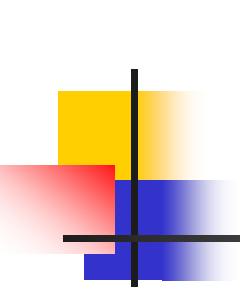
(Heart, Lung and Circulation 2008;17:62–79)

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Keywords. Pulmonary alveolar proteinosis (PAP); Extracorporeal membrane oxygenation (ECMO); Whole lung lavage (WLL)

In 2006

Heart, Lung and Circulation 2008;17:62-79



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

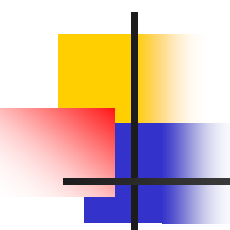
The first novel influenza A (H1N1) fatality despite antiviral treatment and extracorporeal membrane oxygenation in Hong Kong

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 余朝燊
CM Chu 朱頌明
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 陳勁松
KL Lee 李家龍
Philip KN Lam 林冠毅
KI Law 羅建業
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

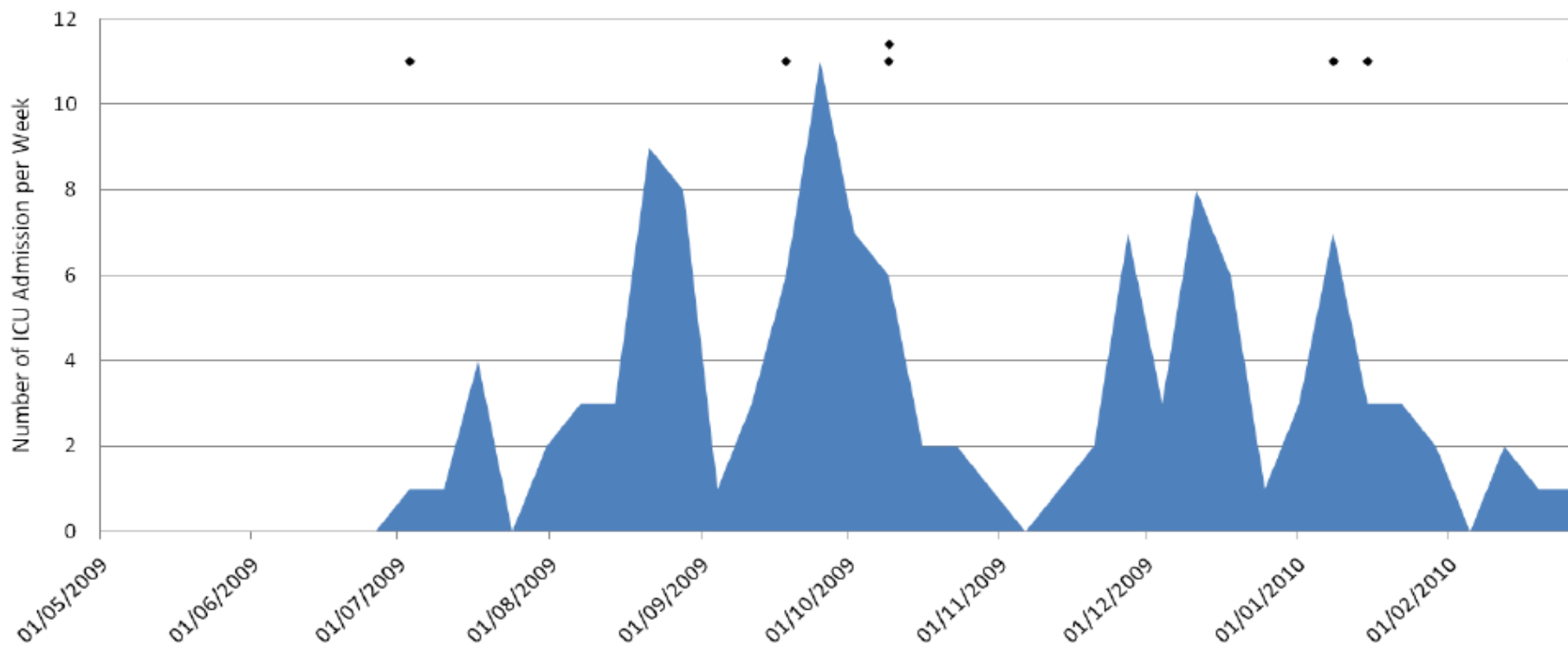
Main outcome measure Hospital mortality.

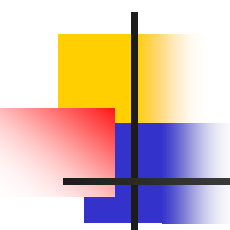
Results During the study period, 120 patients were mechanically ventilated in intensive care units, among whom seven received veno-venous extracorporeal membrane oxygenation. The median (interquartile range) age of the latter patients was 42 (39-50) years, four had various chronic illnesses and one had 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



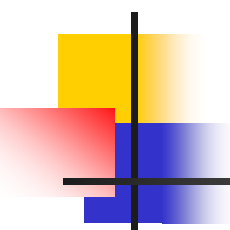


Summary of Cases

- May 1, 2009 to Feb 28, 2010. 3 ICUs

Number (%) or Median [IQR] or Mean ($\pm$ SD)	This Study	Australia & New Zealand ⁶	Canada ¹¹
Number of Cases	7 (100%)	61 (100%)	6 (100%)
Age (years)	42.0 [39.0-50.0] 44.0 ($\pm$ 7.7)	36 [27-45] ---	--- 22 ($\pm$ 15.5)
Male	2 (27%)	29 (48%)	1 (17%)
BMI (kg/m²)	27.5 ($\pm$ 3.7) 26.4 [25.8 – 27.4]	--- 29 [23 – 36]	32.6($\pm$ 7.4) ---
Co-morbidity			
Hypertension	2 (29%)	---	---
Diabetes	1 (14%)	9 (15%)	---
Chronic Lung Disease	1 (14%)	18 (30%)	---
Pregnancy or Post-partum	0 (0%)	10 (16%)	---
Liver Disease	2 (29%)	---	---
Duration (days)			
Symptom to Hospital Admission	5 [4 – 6.5]	5 [3 – 6]	6 [2 – 6]
Symptom to ICU Admission	5.5 [4.1 – 6.7]	5 [3 – 7]	---
Hospital to ICU Admission	0.1 [0.1 – 0.4]	---	0.5 [0 – 2.5]
Symptom to ECMO	11.3 [6.4 – 13.3]	8 [7 – 11]	---
Hospital Admission to ECMO	5.3 [1.1 – 6.8]	---	5 [2.5 – 8.3]
ICU Admission to ECMO	5 [0.8 – 6.7]	---	4.5 [3.3 – 8]
APACHE II score	17 ($\pm$ 3.2)	---	25 ($\pm$ 3)
Quadrant of Radiograph Infiltrates	4 [4 – 4]	4 [4 – 4]	---
Acute Lung Injury Score (Murray's Score)	3.75 [3.75 – 3.88]	3.8 [3.5 – 4]	---

Before ECMO			
pH	7.30 [7.19 – 7.36] 7.26 (±0.13)	7.2 [7.1 – 7.3]	--- 7.31 (±0.05)
PaO ₂ /FiO ₂ (mmHg)	56 [53 – 71] 61 (±11)	56 [48 – 63]	58 (±17)
FiO ₂	1.0 [1.0 – 1.0]	1.0 [1.0 – 1.0]	1 [1 – 1]
PEEP (cmH ₂ O)	16 [15 – 19] 14.9 (±2.7)	18 [15 – 20] ---	--- 20 (±0)
Peak Inspiratory Pressure (cmH ₂ O)	33 [30.5 – 35.5] 34.1 (±4.9)	36 [33 – 38] ---	--- 44 (±42)
Compliance (mL/cmH ₂ O)	22.1 [20.4 – 23.4]	---	---
PaCO ₂ (mmHg)	55 [45 – 79]	69 [54 – 83]	---
Adjuncts for Ventilation			
Prone Ventilation	1 (14%)	12 (20%)	2 (33%)
High Frequency Oscillatory Ventilation	0 (0%)	3 (5%)	3 (50%)
Nitric Oxide	0 (0%)	20 (32%)	4 (67%)
Prostacyclin	0 (0%)	14 (22%)	---
Inotrope/Vasopressor	5 (71%)	46 (68%)	2 (33%)
Renal Replacement Therapy	1 (14%)	16 (24%)	---
Cardiac Arrest	0 (0%)	---	2 (33%)
Treatment of Influenza A (H1N1)			
Oseltamivir	7 (100%)	64 (94%)	---
Intravenous Zanamivir	3 (43%)	---	---
Convalescent Plasma	4 (57%)	---	---
Hyperimmune Immunoglobulin Study	1 (14%)	---	---
Steroid	2 (29%)	---	---
Tracheostomy	1 (14%)	39 (57%)	---
Duration of Mechanical Ventilation (days)	18.5 [11.4 – 25.3]	25 [13 – 34]	26.5 [18 – 40.3]
Duration of ECMO (days)	5.9 [5.7 – 9.7]	10 [7 – 15]	15 [14 – 15]
ICU Length of Stay (days)	19.2 [17.9 – 29.6]	27 [16 – 37]	28 [18.5 – 37.5]
Hospital Length of Stay (days)	30.5 [24.8 – 54.9]	39 [23 – 47]	---
Hospital Death	1 (14%)	14 (21%)	2 (33%)



ECMO in PYNEH ICU

- May 2009
 - First case of VV-ECMO



CCM Inter-hospital Grand Round



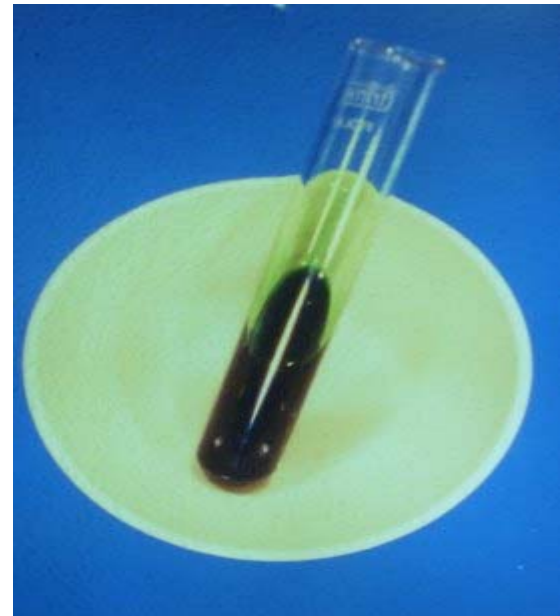
Date : 22nd September 2009
Time : 6:00pm to 8:00pm
Venue : Lecture Theatre,
G/F, Block M,
Queen Elizabeth Hospital

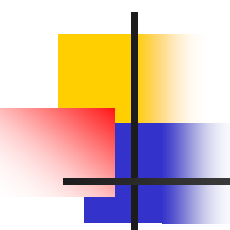
Lecture : 6:00pm to 7:00pm
Topic : A sleepy Man
Speaker : Dr HO Chun Ming
Resident (ICU), NDH

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

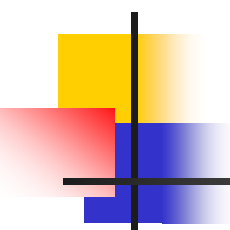
- F/27
- good past health
- Took 100ml of 24% paraquat (Forxone®) after quarrel with boyfriend





Paraquat poisoning

- Supportive treatment +
 - Fuller Earth, Gastric lavage, Activated charcoal
 - Steriod and Cyclophosphamide
 - Charcoal Haemoperfusion
 - High Volume Haemofiltration
 - VV-ECMO
-
- Still succumbed on day 10



ECMO in PYNEH ICU

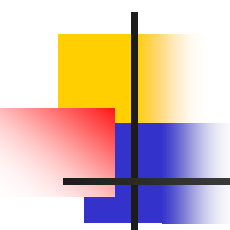
- May 2009
 - First case of VV-ECMO for paraquat poisoning
- September 2009 - September 2010
 - VV-ECMO for viral pneumonitis

Individual Cases

Hong Kong Med J 2010;16:447-54

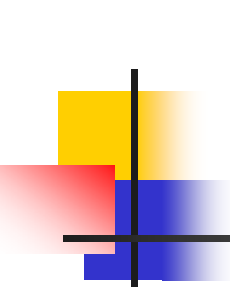
Gender / Age (years)	BMI (kg/m ²)	Co-morbidity	Out-come	Muscle Relaxant Infusion	Hospital Admission to ECMO	ECMO/MV/ICU/Hospital stay (days)	Treatment for Influenza (H1N1)	Complications		
								Infection	During ICU stay	After ICU Discharge
F/37	26.3	Nil	Died	Yes	6.2 days	13.0/18.5/19.2/19.2	Oseltamivir Neb Zanamivir N-acetylcysteine Zinc	Candida colonization in sputum Candida colonization in urine	Haemolysis Pneumothorax	Not applicable
F/42	27.5	Chronic Active Hepatitis	Home	No	5.3 days	5.9/20.7/27.7/30.5	Oseltamivir Nebulized Zanamivir Hydrocortisone Convalescent Plasma N-acetylcysteine Zinc Selenium	Candida colonization in sputum Candida colonization in urine	Delirium	Nil
F/47	27.2	Asthma Hypertension	Home	Yes	17 days	28.6/48.2/48.5/68.0	Oseltamivir Intravenous Zanamivir	Candidaemia MRSA bacteraemia	Haemolysis Delirium	Nil
M/54	26.4	Diabetes Hypertension	Home	Yes	1.0 days	6.4/10.3/18.8/51.7	Oseltamivir Nebulized Zanamivir Intravenous Zanamivir Methylprednisolone	Stenotrophomonas pneumonia	Critical illness polyneuropathy	Pulmonary embolism
M/41	25.2	Hepatitis B Carrier	Home	No	1.1 days	5.7/12.5/17.0/21.0	Oseltamivir Convalescent Plasma	Klebsiella pneumonia E coli urinary tract infection Pseudomembranous Colitis	Nil	Nil
F/53	35.4	Nil	Home	No	7.4 days	4.8/29.8/31.5/58.0	Oseltamivir Intravenous Zanamivir Convalescent Plasma	E coli urinary tract infection Candida colonization in sputum Candida colonization in urine	Minor cannulation site bleeding	Nil
F/34	24.4	Nil	Home	No	0.7 days	5.8/8.8/15.0/28.6	Oseltamivir Hyperimmune Immunoglobulin Study	MRSA Pneumonia	Delirium Minor cannulation site bleeding	Transient vocal cord palsy

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



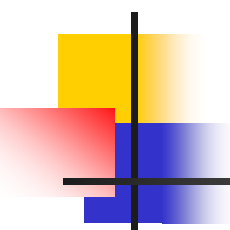
Causes of viral pneumonitis

- Influenza A (H1N1) pandemic: 10
- Human metapneumovirus: 1
- Mycoplasma pneumoniae: 1



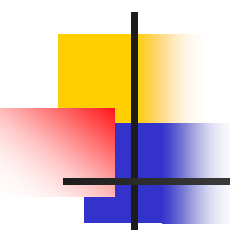
Statistics of patients treated with ECMO in PYNEH ICU

- 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



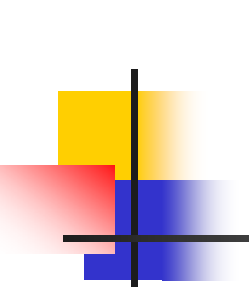
Comorbidities

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



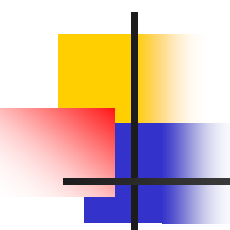
Referrals

- PYNEH: 8 (7 pH1N1, 1 Human MPV)
- TMH ICU: 2 (1 pH1N1, 1 Mycoplasma P)
- KWH ICU: 1
- Canossa Hospital ICU: 1



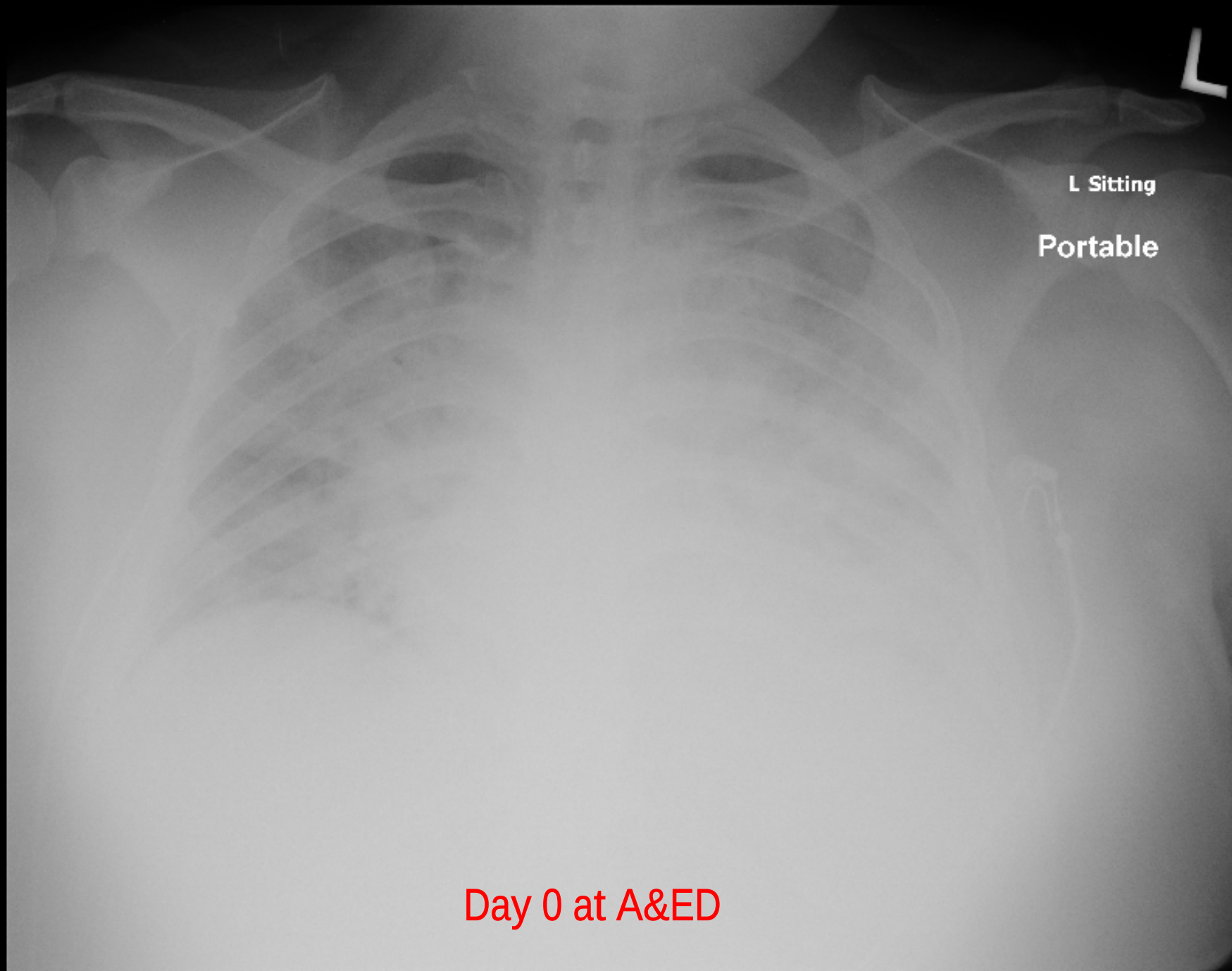
On-site ECMO setup at referring hospital + escort

- 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 FiO_2 (>0.7) and high ventilatory pressures



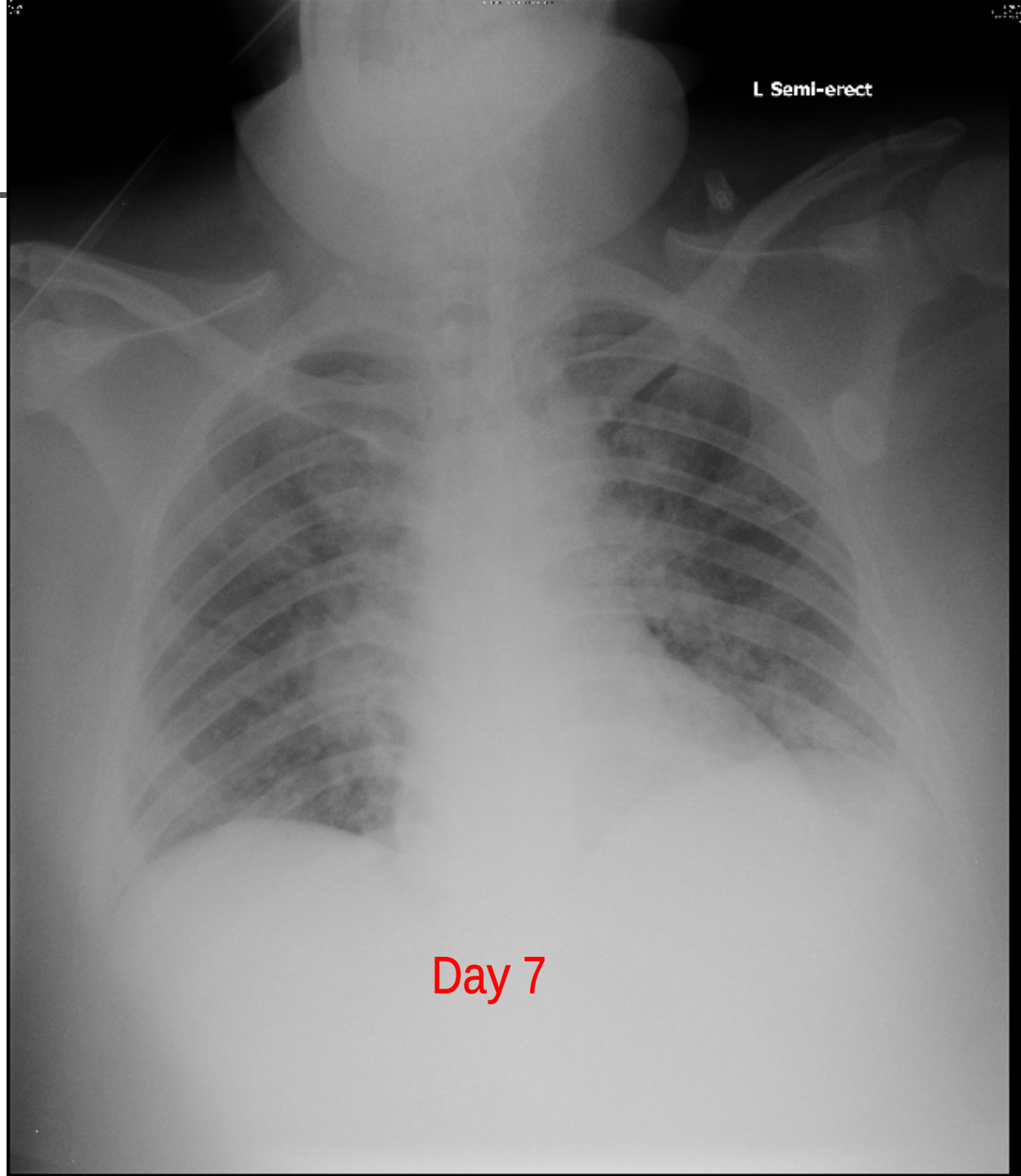
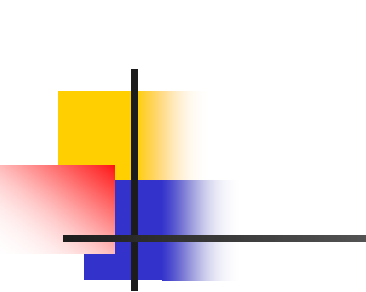
L Sitting

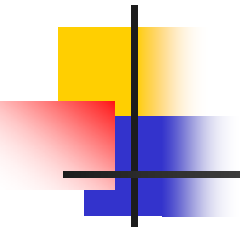
Portable

Day 0 at A&ED

L Semi-erect
Portable

Day 1





Outcome

- Home: 12

	PAMELA YOUDE NETHERSOLE EASTERN HOSPITAL Department of Intensive Care	Doc. no.	PYN-ICU-AA-GL- -R0 (E)
		Effective date	19 March 2010
		Review date	
	Veno-venous Extracorporeal Membrane Oxygenation for Acute Respiratory Failure in Adults	Custodian	ICU Director

1. Objectives

In response to the H1N1 pandemic in 2009 and after a review of the published literatures,¹⁻³ 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.

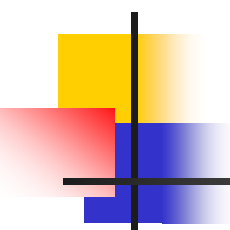
2. Scope and Definition

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* ≥ 3.0 ; or
 - Uncompensated hypercapnia with $\text{pH} \leq 7.20$



Extracorporeal Membrane Oxygenation (ECMO): Revival $\pm$ 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

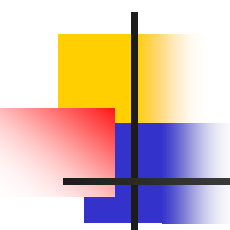
Extracorporeal membrane oxygenation (ECMO) is a form of extracorporeal life support (ECLS) where an artificial circuit carries venous blood to a gas exchange device (the oxygenator) for oxygen enrichment and carbon dioxide removal. If the blood is returned to the venous system, it is called a veno-venous 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



ECMO in PYNEH ICU

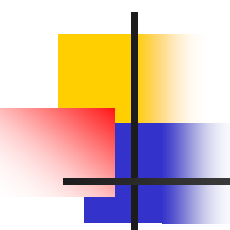
- May 2009
 - First case of VV-ECMO for paraquat poisoning
- September 2009
 - VV-ECMO for viral pneumonitis for 12 patients
 - ECMO setup at referral site + interhospital transfer
- October 2010
 - First case of VA-ECMO

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)

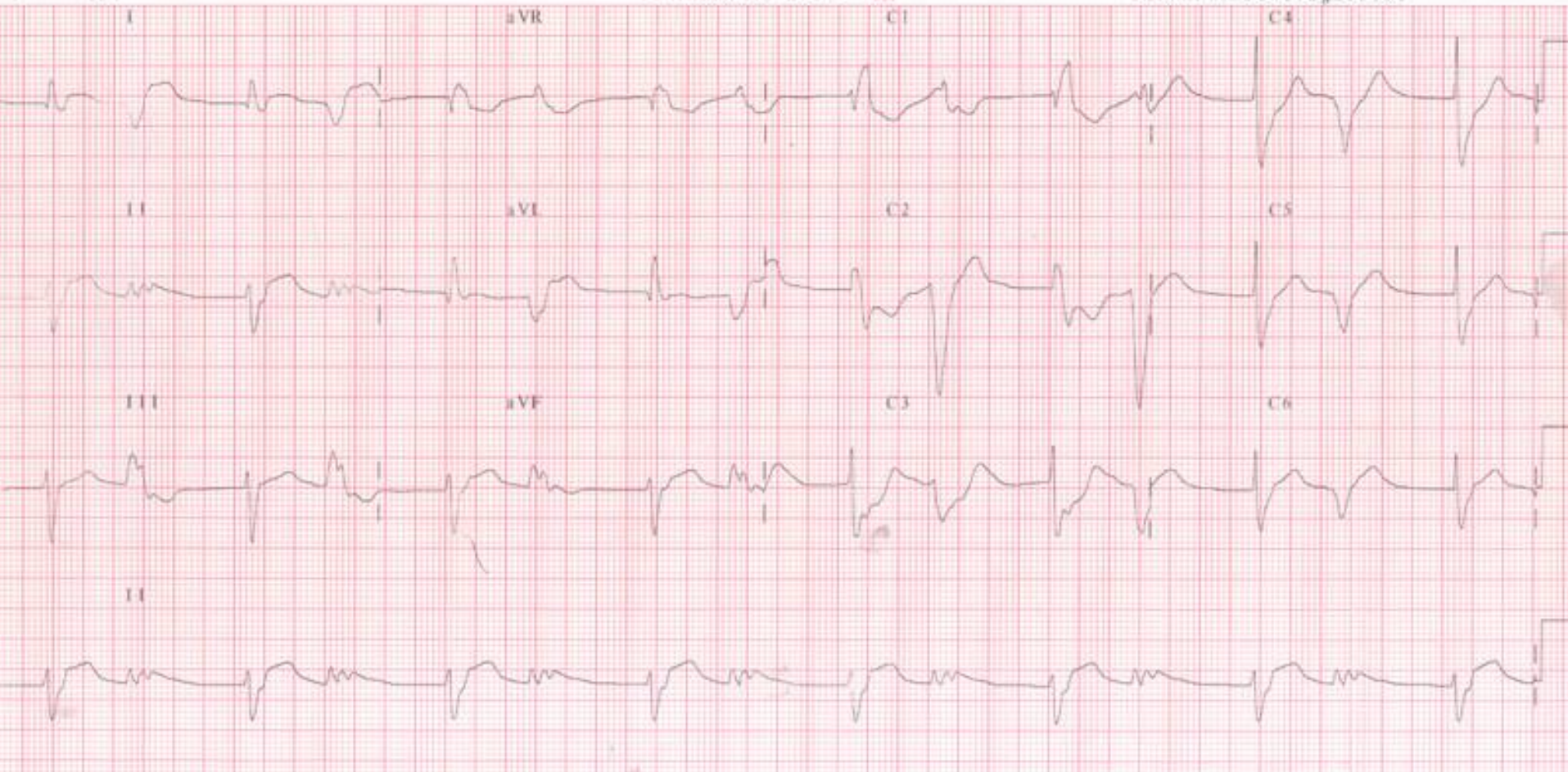
Rate 45 . AGE NOT ENTERED, ASSUMED TO BE 50 YEARS FOR PURPOSE OF ECG INTERPRETATION
 PR 0 . AV DISSOCIATION, MEAN RATE 45 PR variation > 30%
 QRSD 153 . RIGHT ATRIAL ABNORMALITY, CONSIDER LAA P > 0.30mV 2 lds & < -0.30mV aVR/aVL
 QT 687 . RBBB AND LAFB RBBB, QRS axis (-40, 240)
 QTc 594

Dr CHAN Mo KR
 P41224

--Axis--
 P 40
 QRS -78
 T 150

- ABNORMAL ECG -

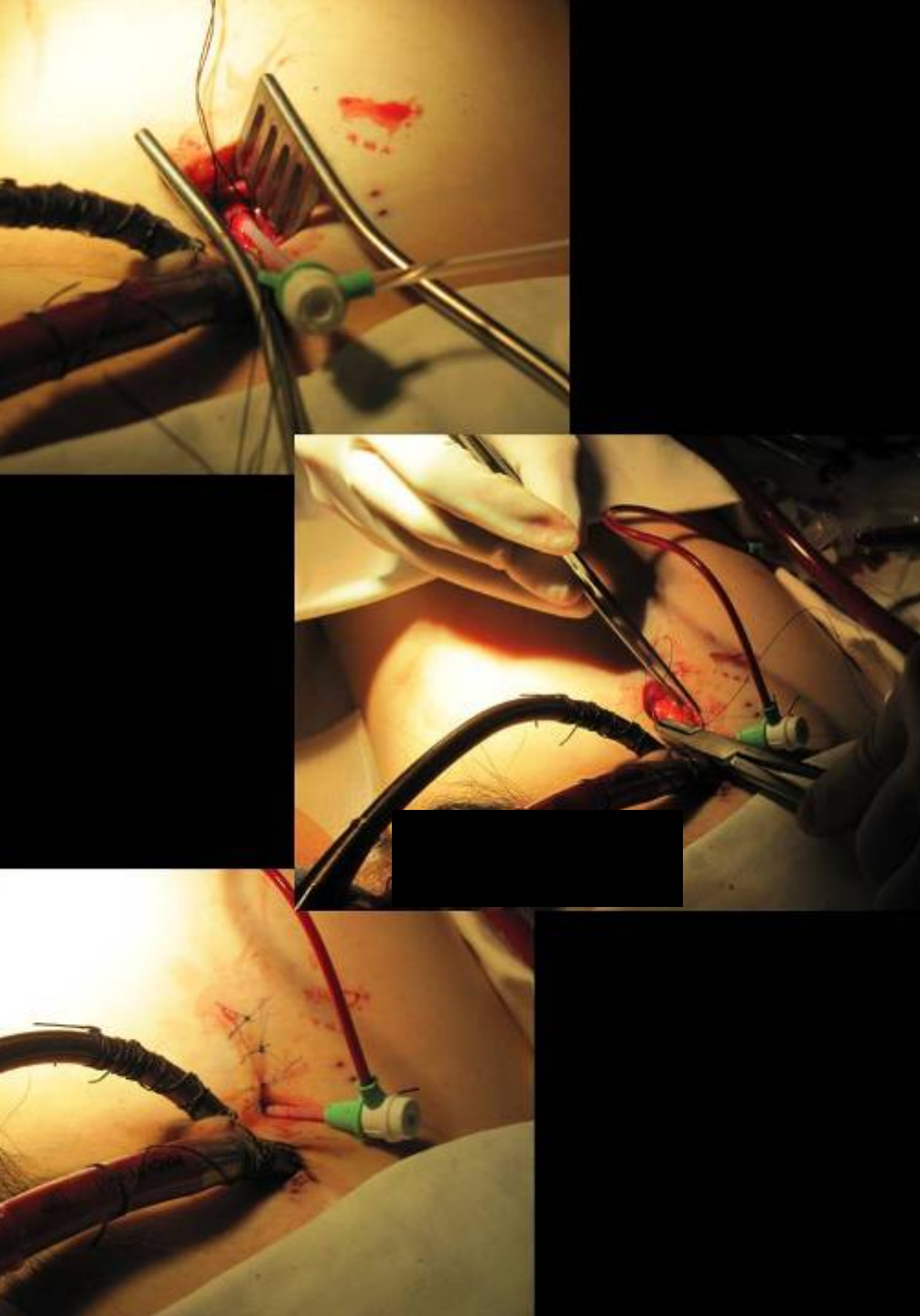
Unconfirmed diagnosis.



Upon admission to ward



During CPR and ECMO cannulae insertion



Backflow cannula to right superficial femoral artery was inserted by surgeon at bedside

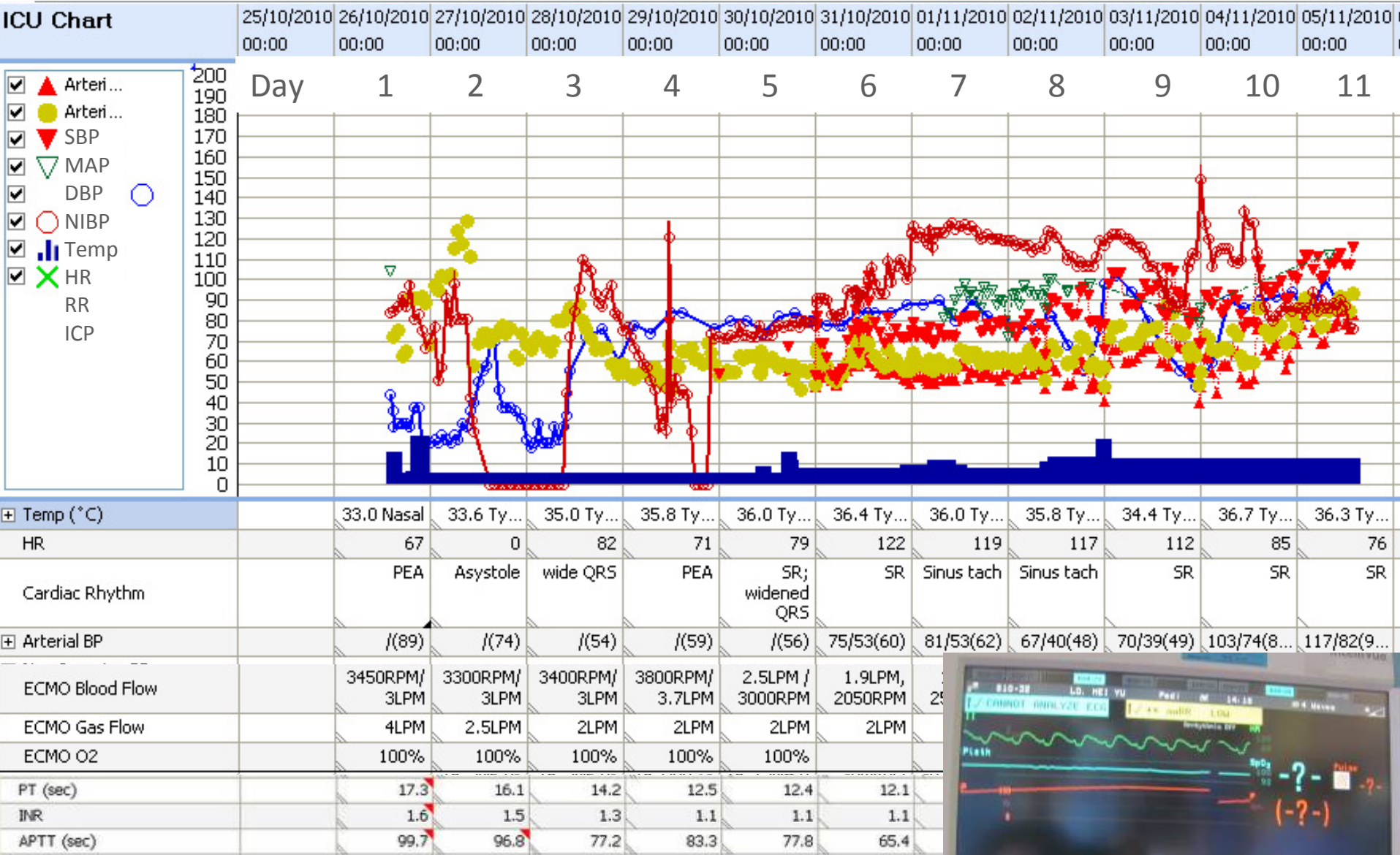
Backflow
cannula to
superficial
femoral
artery



Before



After



cm kg / mmHg

Medication 1:

Medication 2:

Room No.

Vent. rate 98 bpm
PR int. 136 ms
QRS dur. 90 ms
QT/QTc int. 336/ 391 ms
P/QRS/T axis 24/ 58/ -46 °
RV5/SV1 amp. 1.310/ 1.175 mV
RV5+SV1 amp. 2.485 mV

1100 Sinus rhythm

4068 Nonspecific Twave abnormality [flat T or negative T (II, aVF, V3, V4, V5, V6)]

0102 ARTIFACT PRESENT

0104 ELECTRODE(S) DETACHED ... Repeat ECG is requested

9130 ** borderline ECG

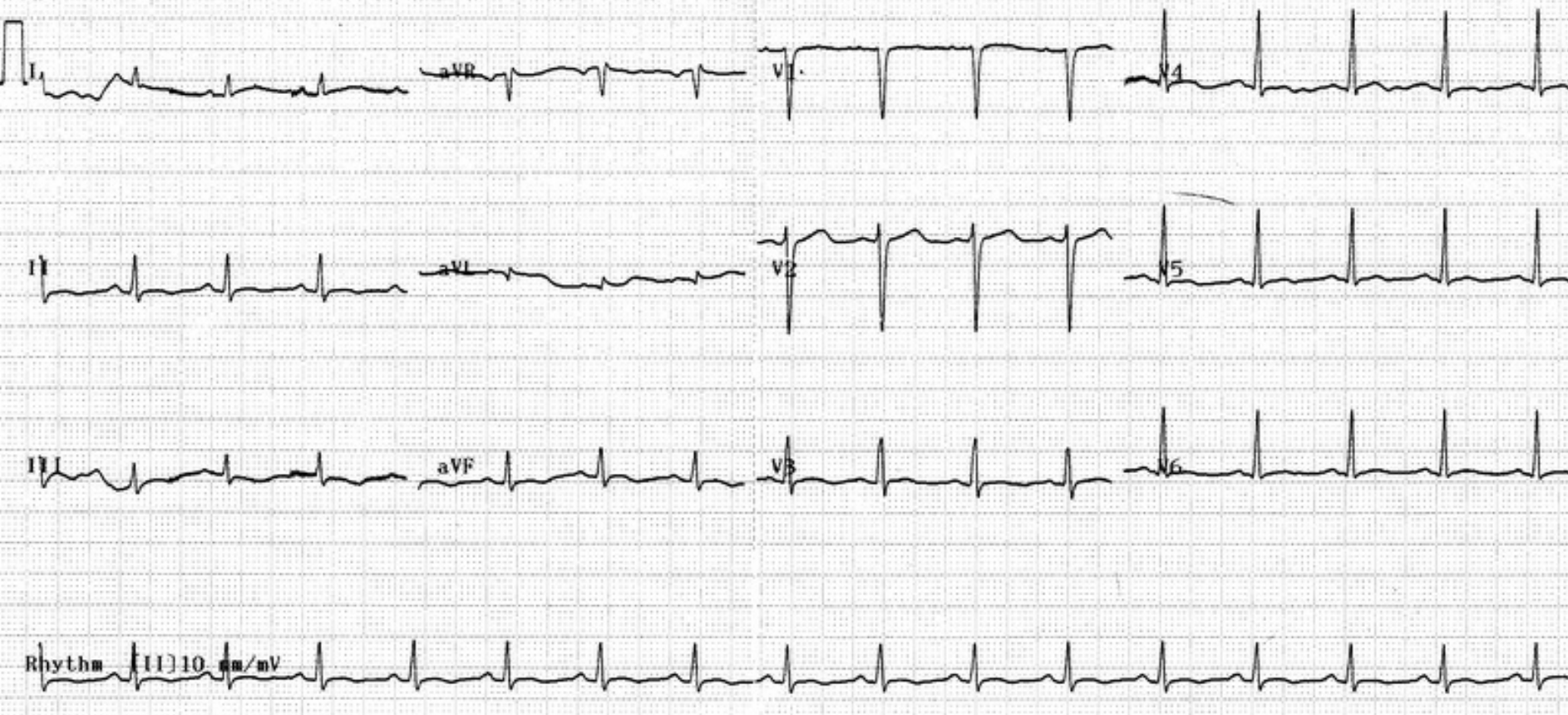
Unconfirmed Report

Reviewed by:

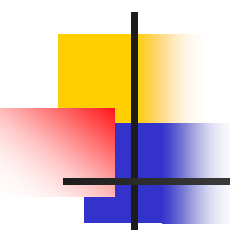
10 mm/mV 25 mm/s Filter 35 Hz H 50 d 10 mm/mV

10 mm/mV

10 mm/mV



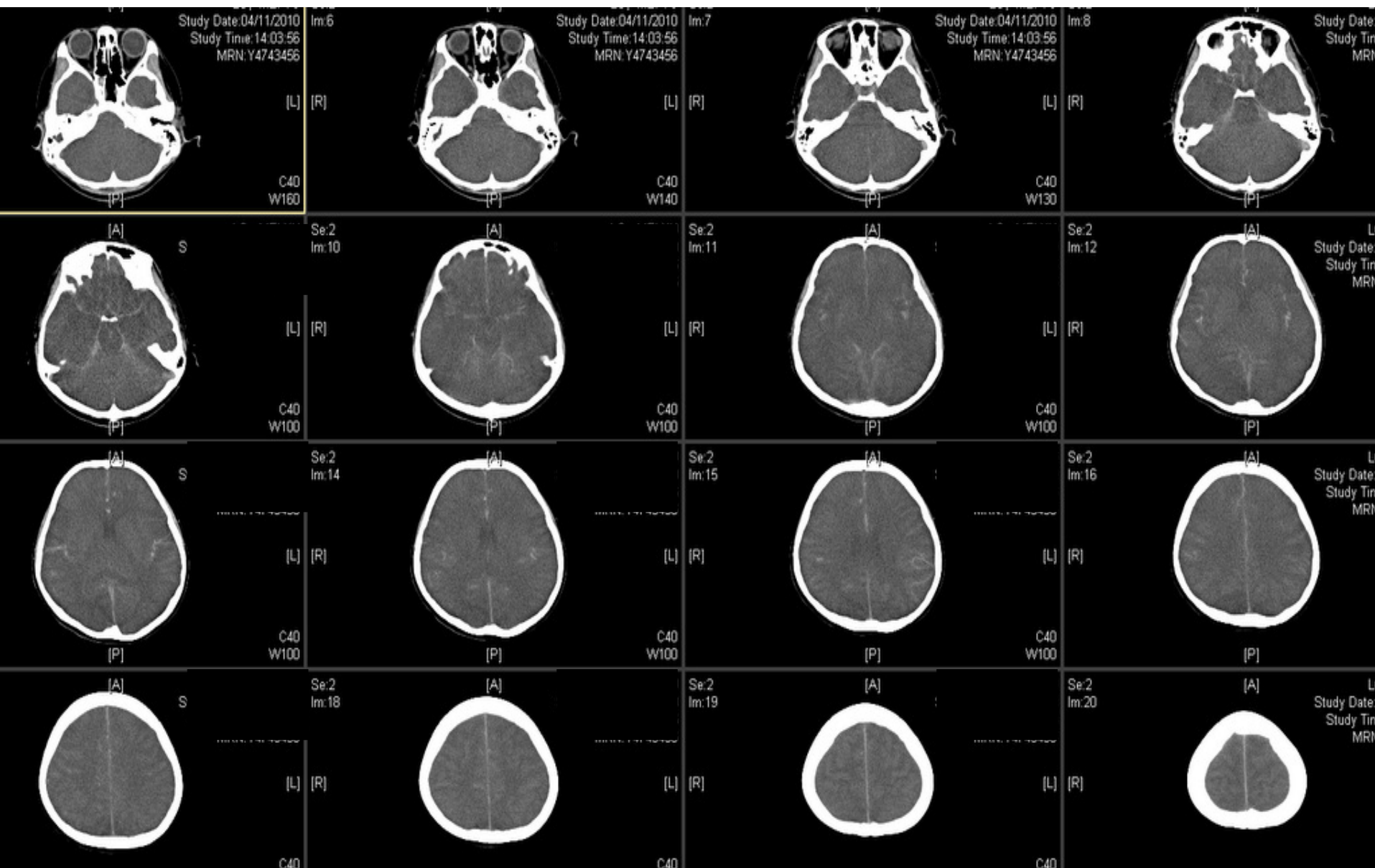
Day 6 Return of sinus rhythm



Weaning of VA ECMO

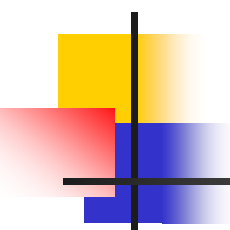
- Trial of ECMO weaning on Day 7
- ECMO flow reduced, noradrenaline and dobutamine infusion increased to facilitate weaning
- Ventilator support and anticoagulation increased
- Successfully weaned off ECMO and decannulated on Day 8 (ECMO duration: 7 days)

- 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

Visit to Taipei Veterans General Hospital

30 October 2010



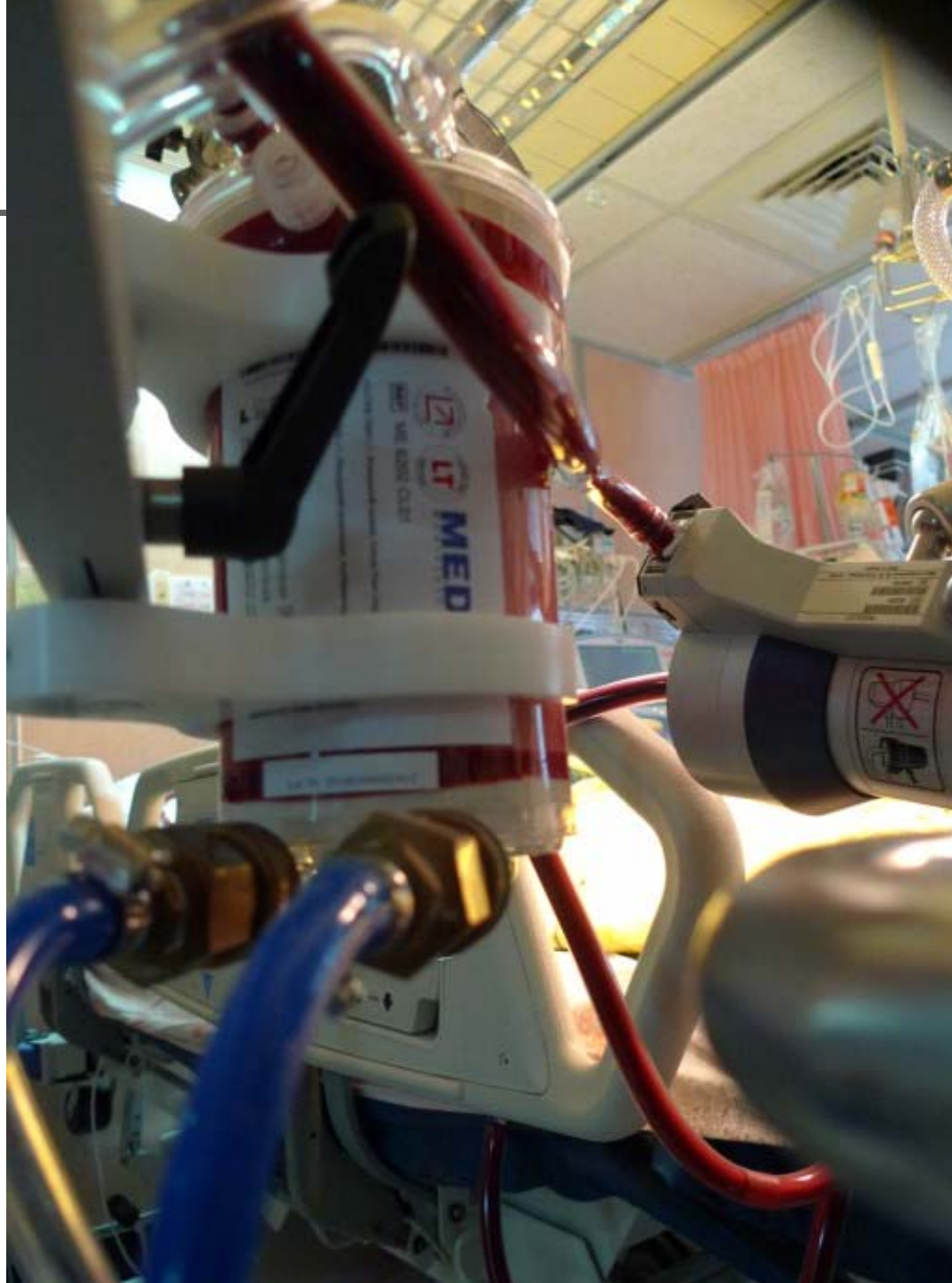
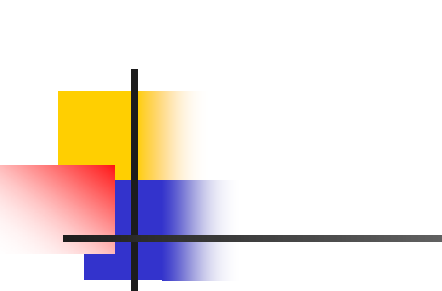










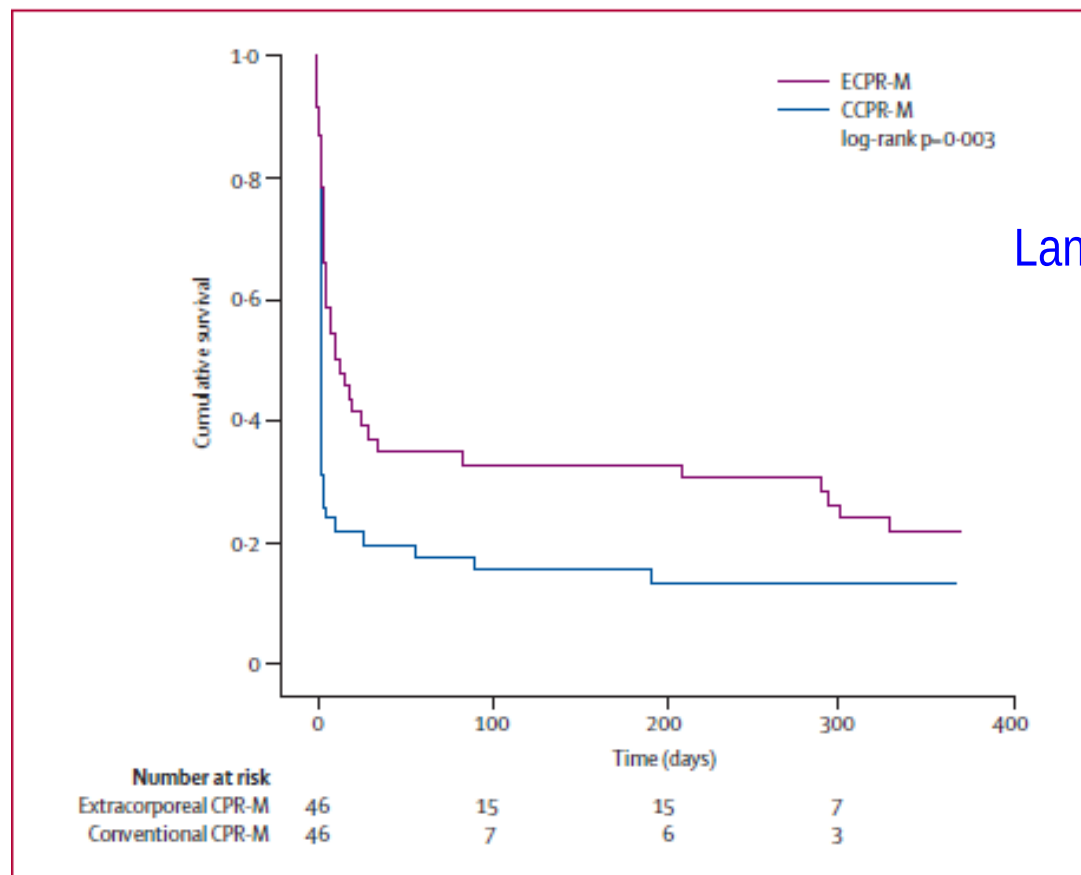




- Experience in Taipei Veteran General Hospital
 - Structured
 - Considered for CPR >10 mins
 - Determined within 10 mins
 - Onsite setup in another 10 mins (i.e. eCPR setup within 30 mins)
 - A primed ECMO circuit is available at all times
 - Early recognition of complications and aggressive management
 - 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

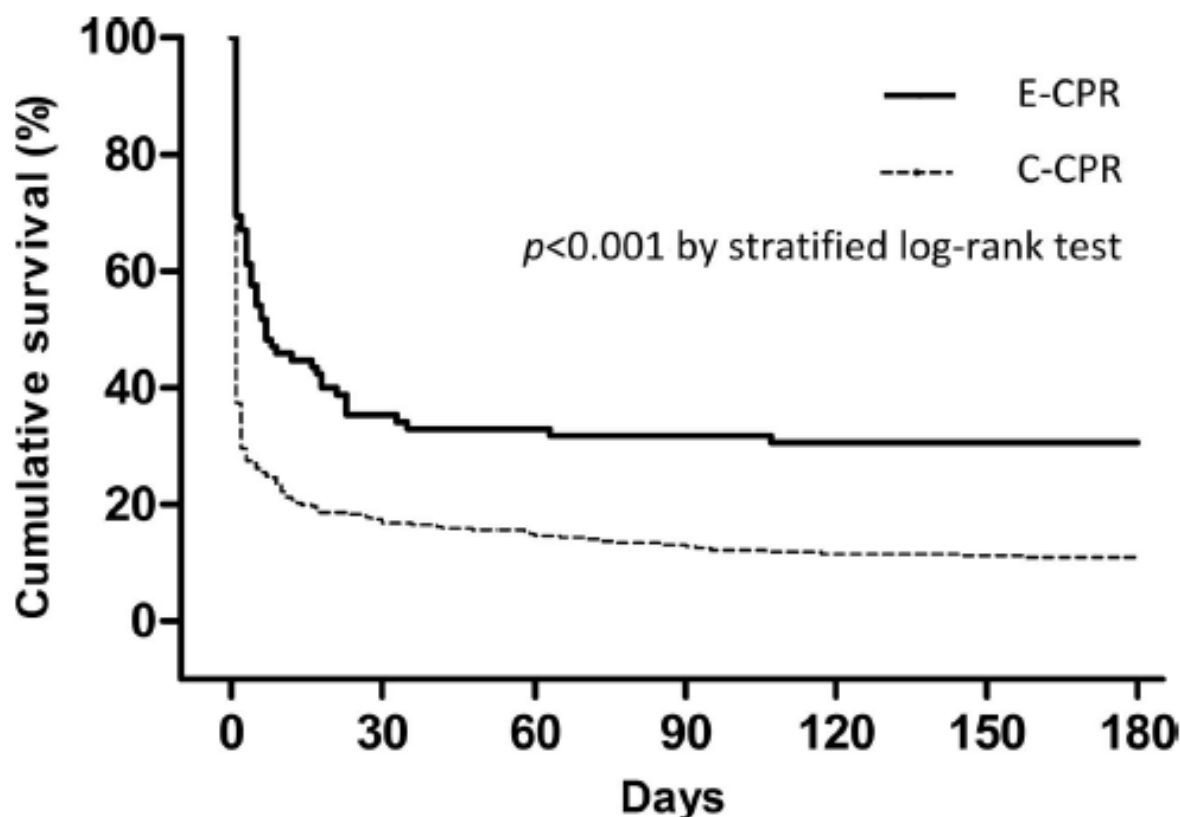
Yih-Sharng Chen*, Jou-Wei Lin*, Hsi-Yu Yu, Wen-Je Ko, Jih-Shuin Jerng, Wei-Tien Chang, Wen-Jone Chen, Shu-Chien Huang, Nai-Hsin Chi, Chih-Hsien Wang, Li-Chin Chen, Pi-Ru Tsai, Sheoi-Shen Wang, Juey-Jen Hwang, Fang-Yue Lin



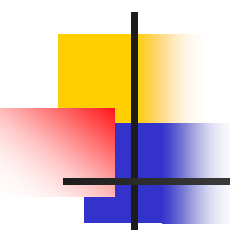
Lancet 2008;372:554-61

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; Hyung Gon Song, MD, PhD; Yeon Kwon Jeong, MD, PhD; Yong-Bien Song, 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



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%)

Xu L etal; Zhongguo Wei Zhong Bing Ji Jiu Yi Xue. 2010 Mar;22(3):150-2

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

Duan DW etal; Zhongguo Wei Zhong Bing Ji Jiu Yi Xue. 2010 Mar;22(3):161-3

CCM Inter-hospital Grand Round



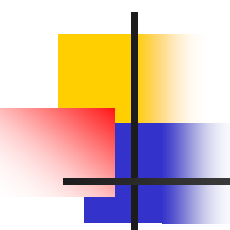
Speaker: Dr. Anfernee Yim
(Medical Officer, PWH)

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,

....

體外膜肺氧合快速建立血管通路方法的探討

吳桂深

實用醫學雜誌

2010/03

心臟移植術后體外膜肺氧合支持治療的監護

吳榮中

華護理雜誌

2010/01

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

龍村

中國循環雜誌

2007/05

無泵體外膜肺氧合治療急性呼吸窘迫綜合征的實驗研究

梁海龍

中國急救醫學

2007/09

體外膜肺氧合技術支持治療期間患者血乳酸濃度及其預后

李景文

中國組織工程研究與臨床康復

2007/18

機械循環支持治療病毒性心肌炎研究進展

李小明

實用兒科臨床雜誌

2007/01

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

陶立堅

中國危重病急救醫學

2004/12

體外膜肺氧合技術救治心肺衰竭患者監護要點

蘇潔

第四軍醫大學學報

2004/20

非常規呼吸支持技術治療呼吸衰竭

解立新

中華醫學雜誌

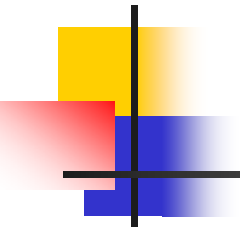
2004/10

體外膜肺技術臨床應用進展

甘小莊

中國實用兒科雜誌

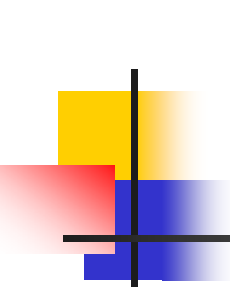
2004/01



ECMO in Macau

- Under planning as in May 2010
- Good prospect with strong government support





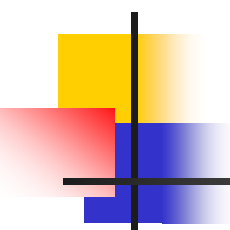
Likely future indications for ECMO in Hong Kong ICUs

- 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



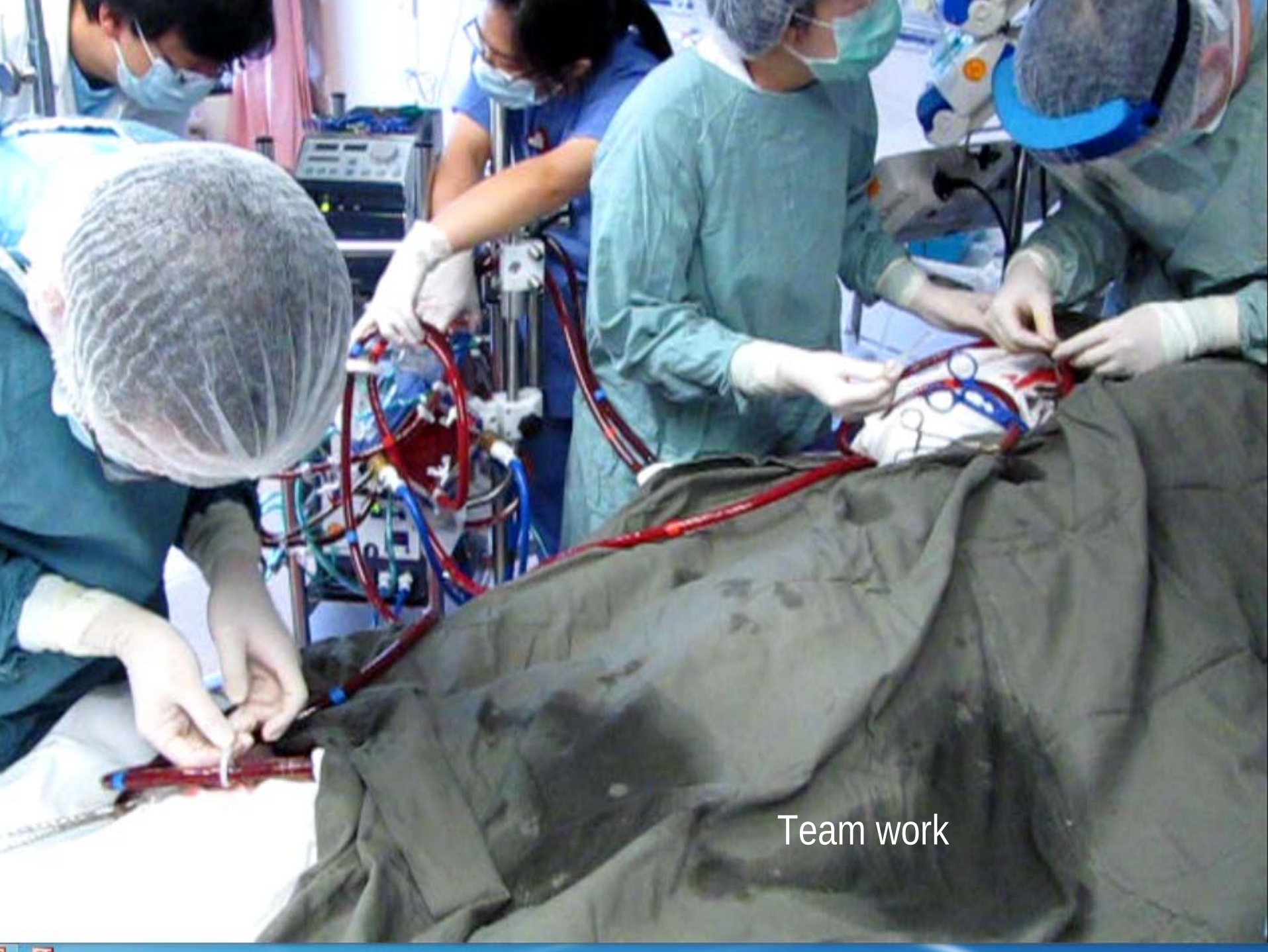
Drugs having “membrane stabilising activity” with potential for severe cardiotoxicity

FJ Baud et-al, Critical Care 2007,11:207

Class 1 anti-arrhythmics	Flecainide, disopyramide, propafenone, quinidine, lignocaine, procainamide
Beta-blockers	Propranolol, acebutolol, nadolol, pindolol, labetalol, oxprenolol, metoprolol
Polycyclic antidepressants	Imipramine, desipramine, amitriptyline, clomipramine, doxepine
Selective serotonin reuptake inhibitors	Venlafaxine, citalopram
Dopamine and noradrenaline uptake inhibitors	Bupropion
Anti-epileptics	Carbamazepine, phenytoin
Phenothiazines	Thioridazine
Opioids	Dextropropoxyphene
Antimalarial agents	Chloroquine, quinine
Anaesthetic-recreational agents	Cocaine



Team work



Team work



Learn together through practice



Learn together through practice



Learn together through practice



Continued Education

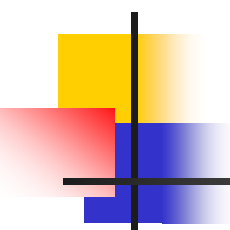


Continued Education



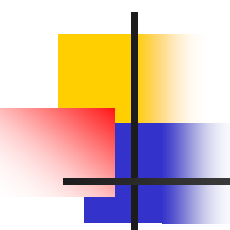
Continued Education





Conclusion

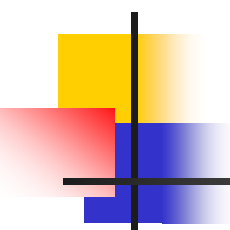
- ECMO is Life saving and should be provided to indicated patients
- Hong Kong is able to provide ECMO service
 - Adventist H, HKSH, PWH, PYNEH, QEH, QMH, UCH
- Hong Kong should catch up in this area



Acknowledgements

- PYNEH hospital management
 - Dr Loretta Yam, CCE, HKEC
 - Dr CC Lau, DHCE, PYNEH

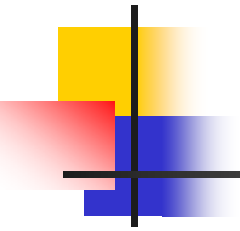
- PYN ICU doctors
 - Dr Chan King Chung, Kenny, AC
 - Dr Lau Chun Wing, Arthur, AC
 - Dr Lam Sin Man, Grace, AC
 - Dr Shum Hoi Ping, AC
 - Dr Wu Hiu Lam, RS
 - Dr Leung Yuk Wah, Natalie, RS
 - Dr Kwan Ming Chit, Arthur, RT
 - Dr Tam Oi Yan, Jackie, RT
 - Dr Chang Li Li, Lily, RT



Acknowledgements (2)

■ PYNEH ICU nurses

- Chan, Shuk Ching, Christine, DOM,
- Kwok, Lai-ping Nora, WM,
- So, Hang-mui, NS,
- Lau, Lan, NO,
- Lui, Kam-cheung, NO,
- Chan, Shiu-kee Danny, NO,
- Kwan, Yuen-fan Eva, NO,
- Lau, Yuk-yin, APN,
- Fok, See-kee, APN,
- Lee, Chun-heung, APN,
- Chiu, Mei-chun, APN,
- Lo, Wan-Po Joanna, APN,
- Ng, Ching-ping, APN,
- Li, Siu-chun, RN,
- Lui, Wai-king RN,
- Chan, Siu-cheung RN,
- Tang, Wai-yan RN,
- Wong, Wo-ming RN,
- Yeung, Mei-wa RN,
- Tam, Yuen-fan RN,
- Cheung, Wai-han RN,
- Chan, Yuet-king RN,
- Fung, Mei-lan RN,
- Chung, Hing-yea RN,
- Yeung, Chau-kwan RN,
- Po, Pui-chun RN,
- Chan, Yim-yu RN,
- Wong, Hoi-lee RN,
- Liu, Yan-chi Kylie RN,
- Chun, Yuen-kwan Emily RN,
- Liu, Sing-kwan Benjamin RN,
- Cheung, Yin-pui Shirley RN,
- Chau, Hau-yan RN,
- Mok, Chi-man RN,
- Leung, Ka-yue RN,
- Wong, Sze-ting RN,
- Ip, Tsui-yuk Joey RN,
- Luk, Wai-Ha Veronica RN,
- Lai, Siu-cheong RN,
- Chang, Lai-fan RN,
- Mui, Sze-yuen Kevin RN,
- Wong, Tang-tat RN,
- Hung, Pui-yan RN,
- Wong, Hoi-yan RN,
- Wong, Pui-yan Pauline, RN ,
- Wong, Wickon RN,
- Chin, Sau-wai RN,
- Tong, Wing-yam RN,
- Wong, Chun-fai RN,
- Wang, Mei-kei RN,
- Yiu, Man-ching RN,
- Ng, Sze-wah RN,
- Cheung, Wah-ling RN,
- Wong, Ka-po RN,
- Yeung, Kai-jone RN,
- Au, Pui-man RN,
- Lam, Yin-yu RN,
- Hon, Hiu-shan RN,
- Mak, Hiu Yan RN,
- Chow, Pik-ki RN,
- Wong, Hoi-ching RN,
- Yu, Hoi-lam RN,
- Chan, Peggy RN,
- Ho, Yin-ting Stephanie RN,
- Wong, Chui-ying Caroline RN



Thank you for your attention.

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