

A Long, Hard Winter...

2 Unique ECMO Case studies



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ECMO...



Extracorporeal Membrane Oxygenation for ARDS

**Prolonged cardiopulmonary support; other names:
extracorporeal life support or extracorporeal lung assist**

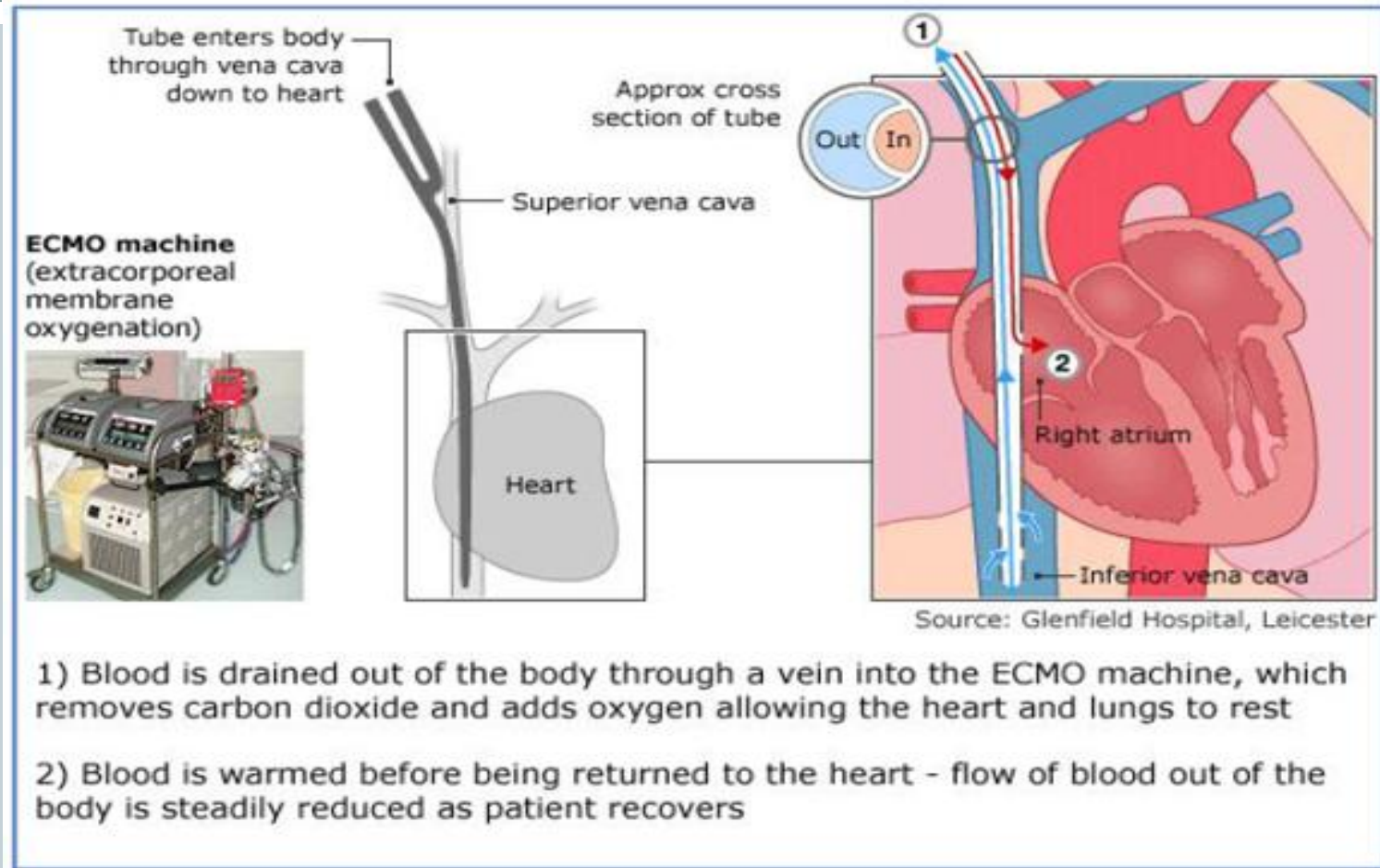
Criteria for the initiation of ECMO: acute severe cardiac or pulmonary failure that is potentially reversible and unresponsive to conventional management

Clinical situations include:

- **Hypoxemic respiratory failure despite optimization of vent settings**
- **Hypercapnic respiratory failure, pH <7.20**
- **Refractory cardiogenic shock**
- **Failure to wean from cardiopulmonary bypass after cardiac surgery**
- **Bridge to cardiac transplantation or placement of a ventricular assist device**

Veno-Venous ECMO

provides respiratory support, but patient is dependent on their own hemodynamics

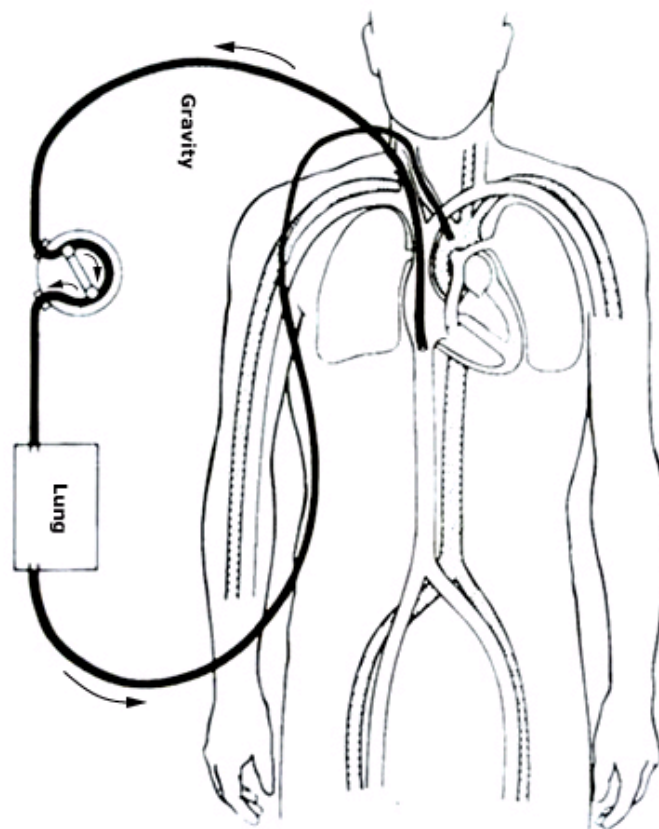


During VV ECMO, blood is extracted from the inferior vena cava, circulated through the artificial membrane, and returned via the superior vena cava to the right atrium.

Veno-Arterial ECMO

provides both respiratory and hemodynamic support

Veno-arterial (VA) ECMO for cardiac and/or respiratory failure



The blood is extracted from the right atrium and returned to the arterial system, bypassing the heart and lungs

Demonstrated here with right internal jugular vein drainage and right carotid artery infusion.

Reproduced from: Van Meurs, K, Lally, KP, Peek, G, Zwischenberger, JB. ECMO: Extracorporeal Cardiopulmonary Support in critical care, Extracorporeal Life Support Organization, Ann Arbor 2005.

How does ECMO affect the Blood Bank?



- The biggest risk of ECMO is **bleeding** due to the continuous running of **Heparin** (danger of clots forming in the circuit)
- Bleeding from cannula placements and old puncture sites
- Most dangerous – in or around the brain
- **Bleeding** can happen anywhere in the body
- Other risks: embolus and/or circuit failure

ECMO Blood Utilization/Component Need

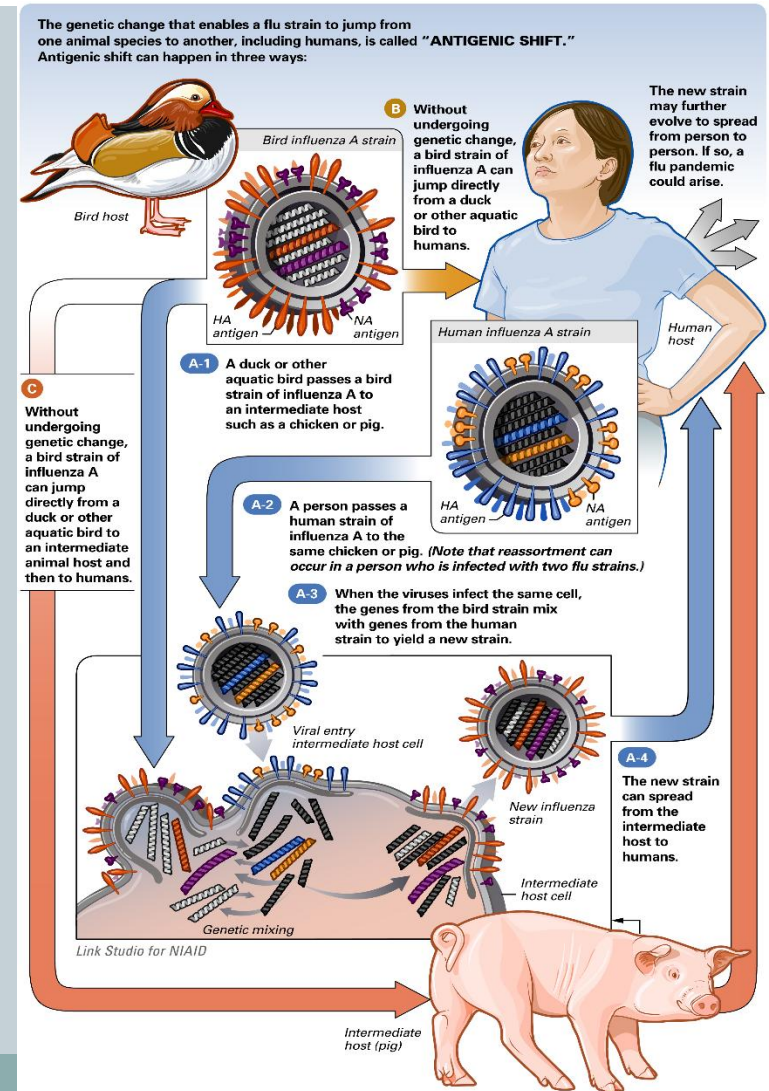


- SLH Blood Bank staff was noticing an increase of **blood** support for patients on ECMO
- No other indication
- CBC was inquiring on the ordering practice by SLH for product
- Many were meeting the requirement as a *massively transfused patient*
- Notification developed with Perfusion team to identify patients on ECMO

Case #1:

Young Healthy Male, meets Deadly H1N1

- **Swine-origin influenza A virus**
- Cause of febrile respiratory outbreaks since 2009
- Reemerged as the dominant cause of influenza during 2013-2014
- Genes from human, swine and avian influenza A viruses
- **Symptoms:** fever, cough, sore throat, shortness of breath, headache, myalgias, fatigue, vomiting, diarrhea
- Majority of patient fully recover in one week
- ***A small subset of patients develop a very severe progressive pneumonia which can be fatal- leads to organ failure***
- **In severe cases, patients deteriorate in 3-5 days, progressing to respiratory failure**



Case #1:

Young Healthy Male, meets Deadly H1N1



- **44-year old male**
- Past medical history: **hypertension**
- **Day 1:** presents to SLH ER with complaints of respiratory symptoms for approx. 1 week: ***shortness of breath*** and worsening ***abdominal pain***
- **Initial vital signs: stable**
- Blood Bank sample: **O positive, negative ABSC**
- ***Suddenly went into cardiac arrest*** (CPR started)
- TEE revealed moderate pericardial effusion with suspicious tamponade
- Transferred to CV ICU- required multiple blood products for persistent coagulopathy (***9 rbcs, 5 ffp, 2 pheresis plts***)
- Bilateral groins cannulated for **VA ECMO**

Case #1:

Young Healthy Male, meets Deadly H1N1



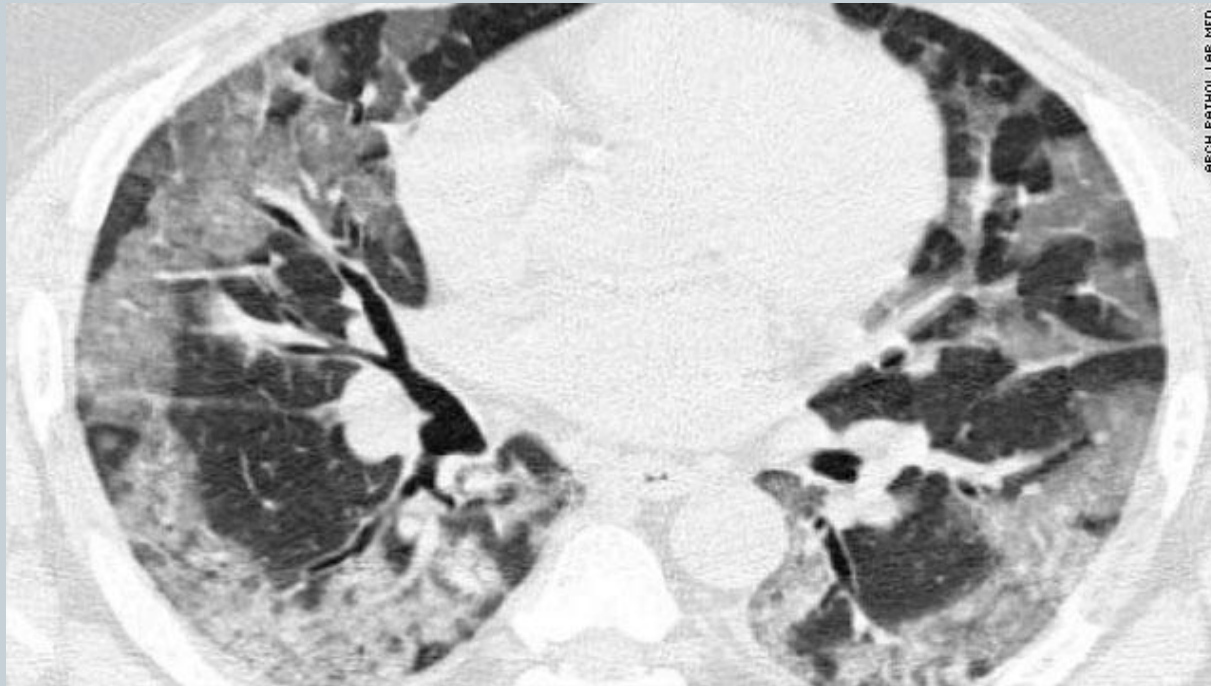
- **Day 2: Back to CVOR** for bilateral groin exploration
- Placed on continuous renal replacement therapy: worsening lactic acidosis and anuria
- Pt. in cardiogenic shock: **full VA ECMO support**
- ***Strep Pneumonia*** identified
- **Days 3-5:** lost perfusion in the bilateral lower extremities (no pulses found): ***back to CVOR***
- **Developed HIT-** all heparin products stopped, started Bivalirudin
- **Neurology concerns: anoxic encephalopathy**
- **Day 6:** family decision to stop ECMO and place on comfort care, ***patient expired at 15:34 with family at the bedside***

Case #1:

Young Healthy Male, meets Deadly H1N1



- **Damaged lung tissue** is seen as light gray and healthy lung tissue is seen as dark gray in this cross-sectional CT scan of a deceased patient with pulmonary bacterial infection caused by the H1N1 virus. The other organs are white



Case #1:

Component Therapy over 6 days



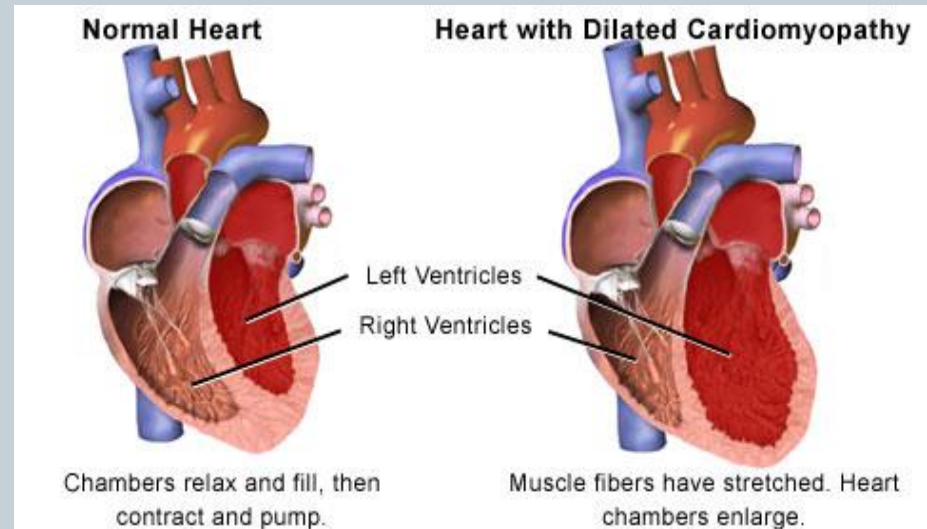
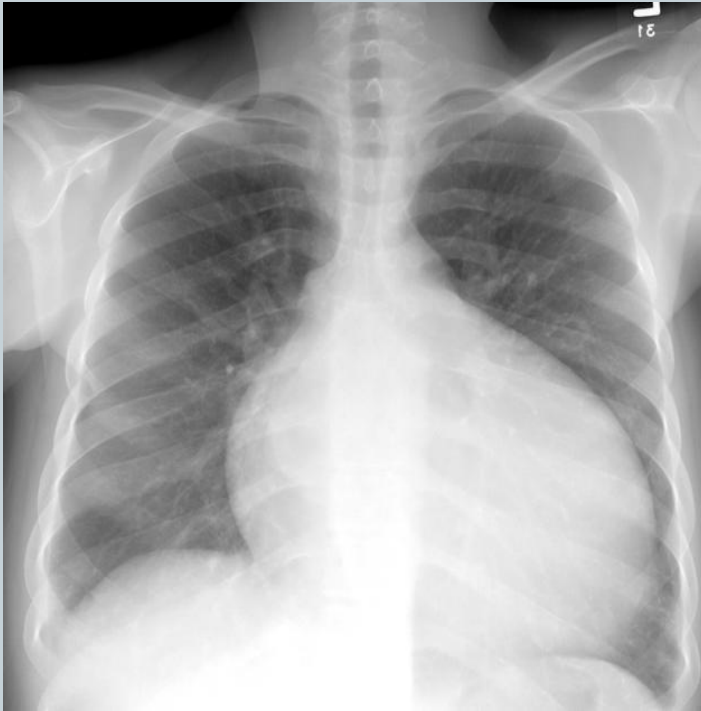
Product	Red Blood Cells	FFP	Pheresis Platelets	Cryo
Case #1	25	14	8	10

***** From 12-25-13 thru 1-24-14, SLH had 8 patients on ECMO due to Influenza ARDS. The mean age of the patient was 49 years, and the mean time on ECMO was 22 days.***

Case #2: Quadruple Whammy!!



- 36-year old male with a history of a **dilated cardiomyopathy** awaiting transplantation



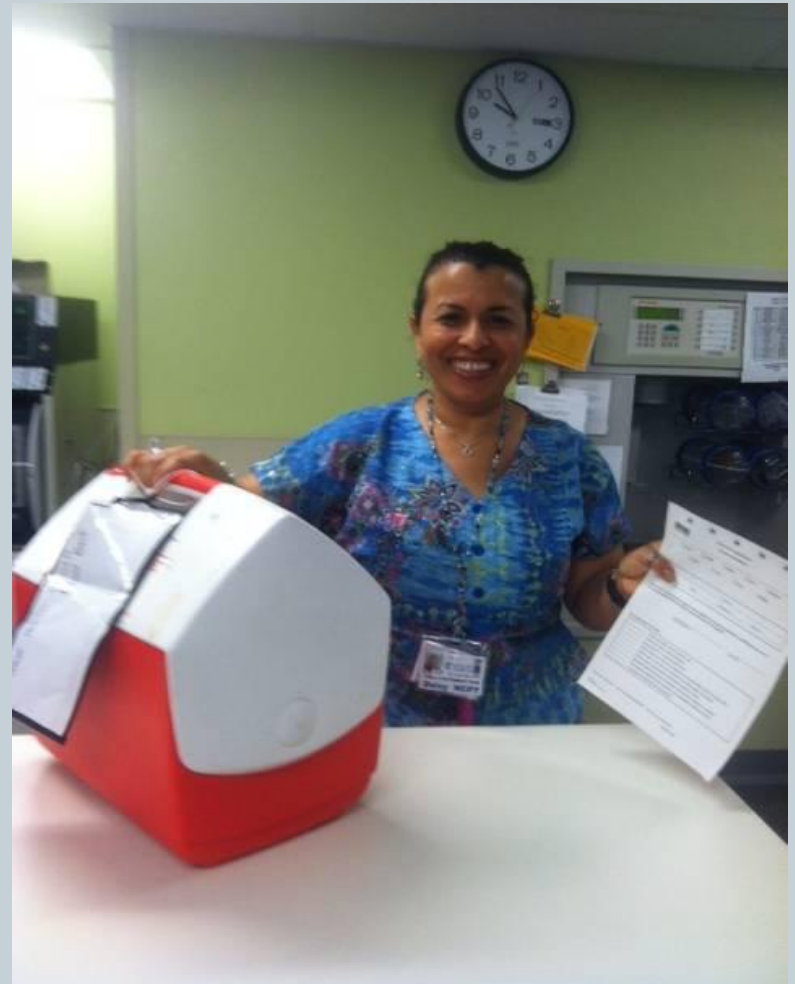
Blood Bank History



- First time we saw him at our institution: **7-31-12**
- Patient types as **O negative with a positive ABSC**
- Antibody panel reveals **anti-Fya**
- Worked up as Type and Screen only, evaluation for **Heart Transplant**
- **2-16-14: Heart Transplant Surgery (Sunday!)**
- Received 2 O neg, Fya neg units prior
- Sunday night into Mon morning- in OR, 4 more units of rbcs
- By noon on Monday, it got crazy!!!
- **Left ventricular hypertrophy- transplant rejection!**

SLH Massive Transfusion Protocol

- Replacement of an adult's blood volume within 24 hours **or** replacing 50% of the estimated blood volume within 3 hours or less **or** the administration of more than 10 units of packed RBCs in 24 hours
- At SLH **any attending staff** may initiate the MTP
- Upon notification, the SLH Blood Bank staff sets up **6 units RBCs/6 FFP/1 single donor platelet**
- **Laboratory support** will deliver the products
- **Blood Bank will continue to set up and issue until the MTP is discontinued**



Decision Time!!



- By 1:00 p.m., one day post transplantation, patient went back to CVOR, and had received:
11 units O neg, Fy^a negative blood, 12 FFP, 5 pheresis platelets, and 4 (5 packs) pooled cryo.

- **Rh dilemma; SLH MTP on Rh:**

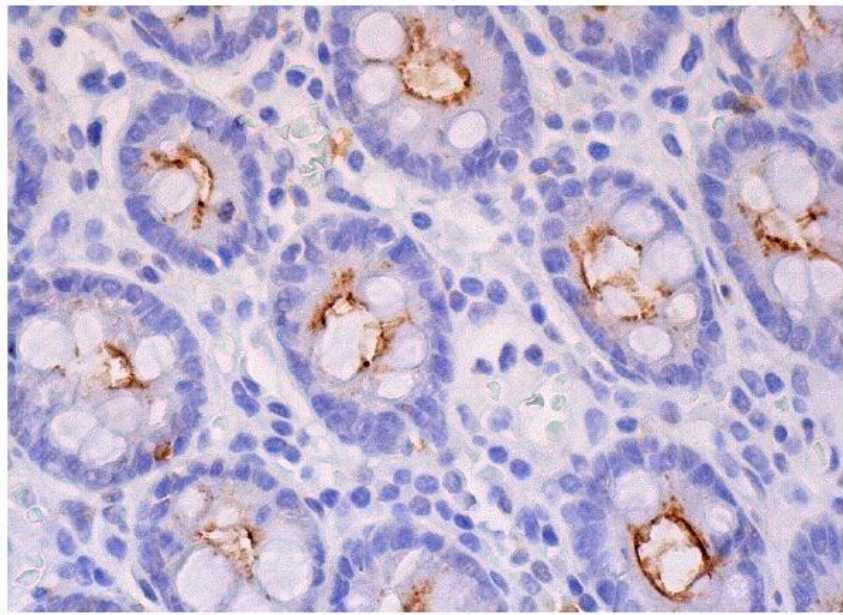
“Issuing Rh Positive Blood to an Rh Negative patient in a crisis situation: When the patient is Rh negative, the blood supply may not allow for a massive transfusion of Rh negative blood. After 5 units of Rh negative blood are issued, except for women under the age of 50, the patient may be switched to Rh positive blood until the immediate crisis is over and the patient is stable.”

Decision Time!!



- Over the next 14 hours, he did continue to bleed, and used **12 O positive**, (still Fya negative) units!
- His ABSC was checked at **24, 48 and 72 hours**
- ***ABSC was negative... no anti-D formed***; anti-Fy^a had been diluted out!
- Over the next 2 1/2 weeks, he continued to use blood (average of 2 units/day) and CBC was able to provide **Oneg, Fy^a neg blood**
- 8 days after giving the O positive blood, his ABSC returned to ***positive***, only showing the **anti-Fy^a**

Was the donor heart rejected due to anti-Fy^a



Immunoperoxidase stain of human colon tissue showing the presence of the Fy antigen.

Mollison, 11th edition
Blood Transfusion in Clinical Medicine, p. 214

“The **Fy** glycoprotein is expressed on capillaries and **post-capillary venular endothelial cells** as well as red cells, and it has been suggested that the glycoprotein has a role in enhancing leukocyte recruitment to sites of inflammation by facilitating the movement of chemokines across the endothelium.

Duffy Dilemma



So what happens with a MTP when a patient has an antibody?? Our Emergency Release of Blood Components addresses this problem:

“Occasionally, a patient with an alloantibody may be massively hemorrhaging and there is not time to screen for antigen negative units. In this situation, the medical director of the transfusion service should discuss the case with the physician caring for the patient. The urgency of the transfusion needs to be balanced against the risk of a hemolytic transfusion reaction.”

- **Applies when pt. has received 10 units of RBCs within 12 hours**
- **Communication is critical!**
- **Different protocol for clinically insignificant & historical only abys**
- **New ABSC(diluted effect) and DAT**
- **Emergency Release form must be signed!**
- **When bleeding slows down or stops, go back to Ag negative blood**

3-31-14 was a true MTP day!!



**Dehiscence of
sternum sutures-
OHS**



Patient experienced dehiscence:

- This is a surgical complication in which a wound ruptures along a surgical suture. In our patient's case, the sutures were around the ECMO device connected to the arterial site.
- The patient massively lost blood for 4-5 hours- crazy! (155 ml/5 min) and continued bleeding for 24 hours.
- At this point the patient was receiving O positive units, *not* tested for Fy^a: approx. 32 units were given out using the MTP

MTP data

transfused units from 3-31 thru 4-1-14



Product	Red Blood Cells	FFP	Platelet Pheresis	Cryo
Case #2	45	35	11	25

The patient was disconnected from ECMO and expired on 4-2-14. The patient was septic (MRSA and candidemia which caused the dehiscence). He had been on ECMO 20 days post transplant rejection; the typical time for ECMO treatment is 7-8 days. The cause of death was anoxic brain injury and the original transplanted heart was rejected.

ECMO Blood Utilization/Cost

*****patient 10 – data does not include the MTP from 3-31-14***



Patient ID	Date on ECMO	Days on ECMO	AGE	# RBC	# PhPI	# FFP	# cryo	Total Cost	Diagnosis
1	12/25	41	38	34	1	0	0	\$7,894.90	Influenza ARDS
2	1/8	5	44	25	8	14	10	\$11,060.71	Influenza ARDS
3	1/12	27	57	11	0	0	0	\$2,379.63	Influenza ARDS
4	1/12	11	59	9	0	0	0	\$1,946.97	Influenza ARDS
5	1/14	30	52	31	5	0	10	\$9,941.23	Influenza ARDS
6	1/17	14	51	48	4	6	0	\$12,884.74	Influenza ARDS
7	1/20	35	39	33	4	2	10	\$9,948.27	Influenza ARDS
8	1/24	12	55	12	1	0	0	\$3,135.64	Influenza ARDS
9	1/28	3	29	12	12	39	0	\$11,296.29	Heart transplant rejection
10	2/17	7**	36	36	13	27	40	\$18,489.93	Heart transplant rejection
11	3/1	2	56	13	5	4	10	\$6,275.41	Cardiogenic Shock

ECMO Blood Utilization/Summary

**** doesn't include Patient 10 (case #2), MTP data from 3-31**



- n= 11
- **5/11 expired**
- Days on ECMO **2 to 41 days**
 - Median 12 days
- Patient age: 29-57 years
- RBC use 9 – 48 units/patient
 - **10/11 patients used >10 units**
 - **Median 25 units**
- Pheresis Platelet use: 0 – 13 units/patient
 - **9/11 patients used platelets**
 - **7/9 patients used >1 unit**
 - **Median 5 units**
- FFP use: 0 – 39 units/patient
 - **6/11 patients used FFP**
 - **3/6 patients used >10 units**
 - **Median 14 units**
- Average component cost: **\$8897.83/patient**

In Summary...



- Be aware that patients being placed on ECMO have a high probability of using **blood and components**
- Communicate with the nursing staff/doctors what the expected “on hold” orders are
- Communicate with the **Blood Supplier**
- Have a MTP in place including covering Rh and antibody issues
- Pray that dehiscence won't happen!

E-extra C-consideration M-manage O-orders (blood)