The Heart Link / ECMO Programme

ECMO Protocols

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The Heart Link / ECMO Programme

Title: **Admission Of Patients For ECMO (Specialist Action)**

Description: To ensure the smooth running and efficient admission & cannulation of a patient onto ECMO

Personnel:

- ECMO Specialist
- ECMO Co-ordinator
- ECMO Director
- Transfer Team
- Paediatric / Cardio-Thoracic SHO
- On-call MLSO
- Perfusionist
- Nurse
- Theatre Team
- Anaesthetist
- ECMO Fellow
- Haematologist On-call

Equipment:

- ECMO Cart
- ECMO Trolley

ECMO Specialist Action:

1) Collect information on patient from ECMO Co-ordinator prior to patient admission - age, weight, condition, referral hospital, estimated time of arrival (ETA).

2) Liaise with ECMO Co-ordinator for updated information.

3) Check and prepare essential equipment & ECMO cart.

4) Prepare ACT Heparin infusion:-
   5,000iu Heparin in 50mls 5% Dextrose for Neonates / Small Paeds
   10,000iu Heparin in 50mls 5% Dextrose for Larger Paeds
   25,000iu Heparin in 50mls 5% Dextrose / Normal Saline for Adults

   Prepare bolus dose Heparin to administer during cannulation:-
   75iu Heparin/kg administered as directed by RKF/AWS/GJP

   Prepare infusions as prescribed with Bedside Nurse / prescribed by ECMO Fellow.

5) Prepare all necessary documentation:-
   - Admission Form
   - ECMO Specialist Evaluation Form
   - ELSO Form
   - Parameter Sheet
   - ECMO Chart

   NB: Be aware of documentation for any research studies.

6) Prepare all necessary equipment for ACT monitoring.

7) Assist Perfusionist, as per Perfusionist's instructions.

8) When patient arrives, ensure unit of X-matched blood is available and checked with Perfusionist.

9) Ensure Nurse takes patient's blood for analysis.

10) Order appropriate blood products and ensure X-matching is performed.

11) Assist Nursing / Theatre / Medical / Perfusion Staff where needed, document time of cannulation / type of cannulas used and handover from Perfusion.

12) Following cannulation, ensure antibiotic cover at cannulation is administered, as prescribed.

13) ACTs need to be monitored every 15 minutes for 2 hours, then every 30 minutes for 1 hour and every hour thereafter if ACTs are stable.

Commence Heparin between 20 – 60iu/kg/hr until within the desired range, then titrate accordingly.

Commence Heparin infusion once ACT is <250 secs

14) Ensure ECMO Co-ordinator completes Parameter Sheet & it is signed by ECMO Consultant.

15) Ensure ECMO Fellow documents procedure in the patient's notes.

16) Perform a complete circuit check and document accordingly.

17) Monitor blood gases as required and maintain within prescribed parameters by adjustments to flows / sweep.

18) Ensure all necessary documentation is completed.

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Title: **Admission Of Patients For ECMO (Nurse Action)**

Description: To ensure the smooth running and efficient admission & cannulation of a patient onto ECMO

Personnel: Nurse allocated to patient referred for ECMO

Nurse Action:

1) Bed
Ensure appropriately-sized bed for patient is functioning for elevation to maximum height.

2) Ventilator
Ensure appropriate ventilator is in position & ready for use and emergency re-intubation equipment is available.

3) Suction
Ensure that all suction equipment is set up and functioning.

4) Monitoring
Ensure GE PRN 50-M monitor is in situ and set up.

5) Drugs
Ensure emergency drugs are available (Crash Sheet for neonatal / paediatric patients) and assist ECMO Specialist with all necessary infusions prior to arrival of the patient.

6) Documentation
Ensure all necessary documentation is ready, as per documentation protocol.

7) Patient Arrival
Assist in the safe transfer of the patient from a Patient Safety Transporting Bed to an ITU bed / cot and ensure ventilation is continued until ECMO has commenced.

8) Connect to appropriate monitoring.

9) Record baseline observations.

10) Send blood samples for ABGs, clotting screen, U&Es, CRP, cross matching, LFTs, Amylase, Cortisol levels etc.

11) Assist in positioning the patient for cannulation.

MRSA & MC&S

Ensure full MRSA and MC&S screens are performed & blood cultures taken within the first 24 hours of a patient's arrival.

Monday:
Blood Cultures – from patient and circuit – MC&S
All MRSA to include wound sites and ECMO cannulae.
Also swab the ECMO cannulae for MC&S.

Only swab wounds and other invasive sites if they look infected.
Compulsory - Send urine, sputum and swabs for MC&S.

Thursday:
Urine, blood CULTURES FROM CIRCUIT AND PATIENT & sputum for MC&S only.
Collect MC&S swabs if any wound or invasive site looks infective (WCC & Differential)

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Title: **Documentation Protocol**

Description: To ensure all Specialists are familiar with and know how to complete the ECMO Specialist Documentation

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Document:

ECMO Patient Admission Form

To be used for each patient on admission for ECMO.
All appropriate sections to be completed by the Specialist on duty at the time of admission or the Specialist retrieving the patient at referral centre (as some details need to be gained from staff at the referral centre).

The family details section should be completed in order that relatives can be contacted quickly in an emergency.

The reverse of the form is to document existing IV lines or skin damage etc that the patient arrives with, any IV lines that remain in once cannulated and any other relevant information.

ECMO Specialist Evaluation Form

One form to be completed by the Specialist for the shift worked.
Pages 1 & 2 should be completed at the beginning of the shift, following the initial circuit check.
Page 3 is to document any changes or problems during the shift.
Page 4 is an hourly checklist to document the circuit checks performed throughout the shift and any problems encountered with the circuit.

ECMO Chart

This is for hourly recording of patient and circuit observations.
Details concerning cannulation should be completed at the time of cannulation and transferred to each chart appropriately.
ECMO hours and arterial blood results should be written in red ink.
Mixed venous gas should be written in black ink.
Post oxygenator gases must always be performed each shift (or more frequently if required).
Results must be documented on the ECMO Chart.

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Parameters Form / Physicians Orders

To be completed daily by the ECMO Co-ordinator.

Trial Off Form

This form documents each trial off ECMO and is completed by the Specialist during and after each trial off.
Page 2 is to be used as a reminder of when procedures need to be completed for VA ECMO and a tick box provided to note when the task has been completed.
Page 3 is to note all the blood gas results.

ELSO Registry Form

Should be completed for each ECMO patient by the ECMO Co-ordinator.

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Title: **ECMO Emergency Cart Supply**

Description: Check list for Specialist

Personnel: ECMO Specialist

Equipment:

Raceway (Super Tygon 1/4", 3/8",1/2")	Cable Tie-Gun
Sterile Scissors	Tie-Straps
500ml bag of 0.9% Saline	Spare Pigtails
Perfusion: Rapid Access IV Giving Set	Three-way Taps
Small Sterile Towel	Sterile Gloves
50ml Luer Lock Syringes	Betadine Solution
Connectors appropriate to tubing in use	Pink Spray

ECMO Specialist Action:

Action:	**Rationale:**
Ensure supplies are checked at the beginning of shift	To ensure cart supply is ready in case of an emergency
Ensure above supplies are available and at hand at all times in case of circuit emergency	For immediate use in circuit emergency
Ensure absent items are replaced	To minimise delay in an emergency

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Title: **Performing The Activated Clotting Time (ACT)**

Description: To perform the ACT test each hour or as required

Personnel: ECMO Specialist

Equipment:

ACT Test Tube (White Cap)	1ml Syringe
2ml Syringe	Actylyte
Steret	Gloves

ECMO Specialist Action:

Action:	**Rationale:**
Gather equipment	
Wash hands	
Clean sample port using street	
Attach a 2ml syringe to the three-way tap	
Turn tap on & aspirate 2mls, turn tap off	The pigtail contains dead-space
Set aside this syringe and replace with 1ml syringe. Turn tap on and withdraw 0.5ml, then remove & replace with original 2ml syringe	
Take sample to Actylyte machine & tap test tub on solid surface	
Simultaneously place 0.5ml of blood into test tube whilst pressing ‘start’ on machine	To start timing immediately blood starts to clot
Flick the base of the tube	To ensure blood mixes with activator

Place the bottle into the Actylyte machine and twist clockwise until a green light comes on	To ensure detector is functioning
Return to sample port and return 2mls of dead-space, ensuring no air is injected	Reduces the need for blood transfusions
Dispose of equipment properly	Health & safety
When machine bleeps, the test is complete – record result on the ECMO Chart	

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Title: **Heparin Management**

Description: To ensure safe & smooth running management of continuous Heparin infusion into the ECMO circuit

Personnel: ECMO Specialist

Equipment:

Heparin (Non-Bactericide)	1,000iu/ml
Syringe Pump	50ml Syringe & Infusion Line
Blue / Green Needle	Actylyte Machine
ACT Bottles (0.5mls)	

ECMO Specialist Action:

Action:	Rationale:
Ensure designated port for administration of Heparin is labelled & dated at all times (2nd pigtail)	Designated port post sample port to prevent it affecting the ACT result
Ensure Heparin infusion is being delivered according to ACTs and concentrations, as detailed below:-	To ensure correct dose & strength of Heparin is being administered, as prescribed

Heparin Concentrations

5,000iu in 50mls 5% Dextrose for Neonates
10,000iu in 50mls 5% Dextrose for Paeds
25,000iu in 50mls 5% Dextrose or 0.9% Normal Saline for Adults

NB: Above concentrations may need to be revised for patients with severe coagulopathies and therefore management is dependent upon the individual ACT results and written parameters – as directed by the ECMO Director / ECMO Co-ordinator / ECMO Fellow

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Ensure Heparin is being delivered at all times *NB: normal rang is 20iu → 60iu/kg/hr*	To prevent coagulation of the circuit
ACTs need to be monitored every 15 minutes for 2 hours, then every 30 minutes for 1 hour and every hour thereafter if ACTs are stable. *NB: Never discontinue a Heparin infusion – this is a <u>Consultant only</u> decision and must be documented in the patient's notes*	To prevent clot formation in the circuit
Ensure aware of written ACT parameters	Changes may be made, depending on the patient's status
Ensure aware of compatibility / reaction of other drugs, when used in associated with Heparin infusion	
If ACTs fall below the prescribed parameters, Bolus should be given as well as an increase in dose and ACTs checked at least ¼ hourly until within parameters	Prevent clots forming
Any concerns, contact the ECMO Co-ordinator	For Senior Specialist advice and instruction

<u>Minimum Bolus</u>

0.5ml plus an increased Heparin infusion rate for Neonates / Small Paeds

1ml plus an increased Heparin infusion rate for Larger Paeds / Adults

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Title: **Emergency Communication Protocol**

Description: To ensure the Specialist is aware of the procedure for obtaining assistance if an ECMO emergency occurs

Personnel: ECMO Specialist
Nurse
On-call ECMO Team
- ECMO Director
- ECMO Co-ordinator
- Perfusionist
- ECMO Fellow

ECMO Specialist Action (in the event of an ECMO emergency):

1) Call for assistance.
At least three people are required:-
- One Nurse to hand ventilate & monitor the patient
- One person to telephone for support / instructions
- One person to assist the Specialist

Each person should be aware of his / her responsibilities and directed by the Specialist.

2) The Specialist should attempt to deal with the cause of the emergency immediately wherever possible e.g. commence repair of the circuit in the event of a ruptured raceway.
If a problem cannot be resolved without help from members of the ECMO Team, all attempts should be made to maintain the circuit whilst waiting for backup.

3) Telephone numbers and on-call rotas are held at Switchboard.
In the event of circuit failure, call 2222 and ask for the ECMO Team to be called.
State “ECMO emergency”.

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Title: **Fire & Explosion Risk**

Description: To prevent fire or explosion in the event of surgical procedures where diathermy apparatus is used

Personnel: ECMO Co-ordinator
ECMO Specialist
Nurse
Anaesthetist
ECMO Fellow

ECMO Specialist Action:

Action:	**Rationale:**
During cannulation, decannulation or surgical procedures there should be no source of free flowing oxygen, other than that minimally required to maintain patient oxygenation	Oxygen is flammable in the presence of Betadine skin prep & diathermy and may cause an explosion
Bag / mask should be labelled “No oxygen flow during surgery”	To ensure all staff involved are aware of risks
Anaesthetic presence should ensure safe placement of the oxygen administration equipment away from diathermy and related electrical apparatus	The Anaesthetist would be the main user of such equipment during surgical procedures

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Title: **Dressing Cannulation Site**

Description: To apply dressing to cannula site following cannulation & redress PRN

Personnel: ECMO Specialist
Nurse

Equipment: Dressing Pack
Clear Occlusive Dressing
Betadine
Normasol

ECMO Specialist Action:

Action:	**Rationale:**
Clean trolley with water & detergent, wash hands and set up trolley as per UHL policy	Observe universal precautions
Remove existing dressing	
Observe cannula site	
Ensure cannula sites are sutured securely	
Clean wound with Normasol, observing asepsis	As above
If cannula site is oozing, apply pressure with small folded gauze & call the ECMO Fellow for further assessment regarding potential surgical intervention	To try to reduce oozing
Apply tegaderm dressing using a piece large enough to ensure the cannula is secure	Clean dressing to enable observation of site

Dispose of waste & ensure patient comfort	
If there is excessive bleeding from the cannula site, perform a clotting screen and inform Surgeon	Surgical / medical intervention may be required
If cannula site is red or infected, take a swab – see Infection Screen Protocol	

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Title: **Flushing The Patient Bridge**

Description: Releasing the Bridge Clamp to maintain patency of the Patient Bridge

Personnel: ECMO Specialist

Equipment: Bridge Clamp

ECMO Specialist Action:

Action:	**Rationale:**
Every 10 – 15 minutes the bridge clamp should be opened for approximately 5 seconds, then re-clamped in a different position on the bridge. *NB: More often if separation is occurring* This action must be documented on the Observation Chart / Hourly Checklist Chart	To prevent clot formation in the bridge and undue pressure on one part of tubing
Each time the clamp is released, the bridge tubing should be inspected for clots or marks on the tubing	Ensure the clamp is fully closed and prevent damage to tubing

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Title: **Clamping On & Off ECMO**

Description: Clamping patients onto and off ECMO in the event of an emergency situation or an elective period off ECMO

Personnel: ECMO Co-ordinator
ECMO Specialist
Nurse
ECMO Fellow

Equipment: Clamp
Hand Ventilation Equipment
Emergency Drugs (as required)

ECMO Specialist Action (for elective period off ECMO):

Action:	**Rationale:**
Ensure relatives have been informed of procedure	To avoid undue anxiety
Ensure Nurse is aware of procedure and is able to hand ventilate the patient throughout or mechanical ventilation is increased appropriately	To maintain patient oxygenation off ECMO
Ensure any emergency drugs (which may be required) are available and that IV lines are accessible	To maintain patient stability throughout the procedure
If the procedure is to be performed, gather all supplies in advance	To minimise time off ECMO
<u>Clamp off</u> Venous – Bridge – Arterial Clamp the venous drainage tubing above the patient bridge, release the bridge clamp and use it to clamp the arterial return tubing again above the patient bridge	To prevent blood draining out of the patient and allow a little to return

<u>Clamp on</u> Arterial – Bridge – Venous Release the clamp on the arterial tubing, clamp the patient bridge and release the clamp on the venous tubing	To avoid a sudden drainage of blood with no return
<u>Routine procedures:</u> Routine procedures e.g. walking the raceway & a routine pigtail change require Venous – Bridge – Arterial	

ECMO Specialist Action (in an emergency):

Action:	**Rationale:**
<u>In an emergency</u> Arterial – Bridge – Venous The tubing should be clamped immediately and then help called for Hand ventilate the patient and give emergency drugs etc The order is always A-B-V *NB: The Bedside Nurse must always be taught to clamp off Arterial – Bridge – Venous in an emergency situation*	To avoid blood loss or air to the patient

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Title: **Trans-membrane Pressure Monitoring**

Description: To replace Transducer Lines, flush Transducer Lines, recalibrate and set alarms / alarm limits on Stockert Box / Monitor

Personnel: ECMO Specialist

Equipment: 2 x 50ml, 20ml or 30ml Luer Lock Syringes for each oxygenator
Flush Bag
2 x Steret

ECMO Specialist Action:

Action:	**Rationale:**
Gather supplies	To prevent unnecessary anxiety
<u>To replace transducer sets</u> • Ensure that the transducer lines are primed. • Turn off the three-way tap at the oxygenator and attached primed transducer set to three-way tap • Ensure that three-way tap is cleaned with steret prior to attachment of transducer set	
<u>To recalibrate the Stockert Box</u> • Turn the transducer 'off' to the oxygenator and open the line to air • Press the 'zero' button on the Stockert Box and allow the box to zero • Once calibrated, turn the transducer to the 'on' position • Change the transducer lines every seven days	To calibrate

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<u>To reset the alarm limits</u> • Reset the alarm to read 50mmhg greater than the reading, by using the 'yellow' Stockert adjustment tool to adjust the alarm limits on the Stockert Box	To set alarms
<u>To flush the transducer lines</u> • Switch the three-way tap off to oxygenator • Remove the white cap off the three-way tap and clean site with steret • Place luer lock syringe onto the cleaned part of the three-way tap • Flush the line via use of the transducer to clear the line • Ensure to flush until the line is fully clear • Switch three-way tap back on to oxygenator • Clean empty port with steret and replace white bung • Dispose of waste safely • Repeat on all transducer lines (pre / post oxygenator)	To be carried out each shift and prn
<u>To zero lines and adjust alarms</u> • Set alarms as already mentioned above	

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Title: **Administration Of Drugs & Blood Products**

Description: The safe & appropriate administration of prescribed drugs & blood products and the use of UHL policy

Personnel: ECMO Specialist
Nurse
Member of the ECMO Medical Team
Paediatrician / Surgical SHO or Registrar

Equipment:

Drug	Filter
Dilutant	Giving Set / Syringe
Needle / Syringe / Giving Set	Three-way Tap Connector
Blood Product	

ECMO Specialist Action:

Action:	**Rationale:**
Check prescription chart	For correct patient, correct date & time, correct dose, any allergies and signed by doctor
Check product	For correct dose, correct dilution, expiry date, correct blood product & correct blood group
<u>Prepare drugs</u> As per UHL policy <u>Prepare blood products</u> Using appropriate filter and giving set	
Use a suitable port on the ECMO circuit to administer drugs / blood products i.e. Blood into bladder ports (HAS 4.5% + 20% Albumin) All clotting factors post-oxygenator	To infuse as quickly as is required To prevent destruction in oxygenator

Bolus drugs into drug port and infusions pre-bladder (except TPN) TPN must be administered post bladder c/o a designated pigtail Trasylol to be administered post bladder or directly to patient's central access	To reduce the risk of air embolus
Use a suitable technique to administer bolus or continuous infusion and ensure infusion pumps are checked hourly and administering correctly. *NB: Ensure strict hand hygiene and non-touch technique*	For patient safety
Observe for side effects & reactions and stop infusions / inform Medical Staff as necessary	For patient safety

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Title: **Procedure For Applying & Removal Of Tie-straps**

Description: Apply initial Tie-straps post cannulation, assess Tie-strap security at prescribed intervals and remove & replace as required (in the event of Tie-straps becoming loose, falling off or not being present)

Personnel: ECMO Specialist

Equipment: Tie-straps
Tie-strap Gun

ECMO Specialist Action:

Action:	**Rationale:**
All tie-straps are to be checked at the beginning of each shift and at appropriate intervals thereafter during the shift (i.e. Specialist's Hourly Checklist)	To check the security of each tie-strap regularly
Check tie-straps by supporting tubing using both hands and examine each tie-strap by twisting gently with thumb & finger to see if secure	
If tie-strap is loose, prepare for replacement	
Gather supplies	To prevent undue anxiety
Place tie-strap in gun, support the connector & tubing and secure a tie-strap with the gun *NB: Do not use scissors in tie-strap removal – seek assistance from the ECMO Co-ordinator*	For a tight & secure fit

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Title: **Walking The Raceway**

Description: Prevent any one segment of ECMO tubing from prolonged exposure to compression in the Roller Head / to prevent rupture of the tubing

Personnel: ECMO Specialist
Bedside Nurse
ECMO Fellow
ECMO Co-ordinator

Equipment: 2 x Clamps (3 x if a third cannula is inserted)
Marker Pen
Emergency Drugs

ECMO Specialist Action:

Action:	**Rationale:**
Ensure the ECMO Team is present and gather equipment needed	To ensure the Specialist is prepared and has adequate support, if needed
Inform relatives of the procedure	To avoid undue anxiety
Mark the tubing close to where it enters the pump raceway (left-hand side of the pump)	To show the length of tubing needed to be walked through the raceway
Ventilation is increased or patient is hand-ventilated by the Nurse or Doctor in 100% oxygen	To pre-oxygenate the patient and obtain good SaO_2 prior to procedure
Take the patient off ECMO (clamping V-B-A) and turn off the pump	Unable to perform the procedure with the pump rotating
• Open the boot lid • Place pump head in 12 o'clock position • Undo the gates, holding the tubing securely	To ensure a completely new piece of tubing is now positioned in the raceway

Remove & advance the tubing (in the same direction as pump flow) through the pump head until the marked tubing is out of the boot	*NB The identification mark will always be on the right-hand side of the pump*
Ensure the tubing is well-positioned in the boot of the pump and is securely held by the gate clamps	To ensure correct positioning and even occlusion of the tubing
Check the circuit is correctly configured and there is no air or kinks in the circuit	For patient safety prior to returning to ECMO support
Turn on the pump to previous settings and unclamp A-B-V	
Recommence IPPV at previous settings	
Record the date, time, personnel involved, HR, BP, SaO_2 & any problems in the patient's notes and also document & sign the Parameter Sheet	

Comments

Each circuit should be assessed and the raceway checked hourly & under constant supervision by the ECMO Specialist. Any concerns about the raceway should be discussed immediately with the ECMO Co-ordinator & Perfusionist and action taken if needed. In the event of an emergency, the 2222 ECMO Crash Call must be instigated.

One clear length of raceway tubing (approx' 40" in length) must always be left at the end of the raceway, to be used in the event of a raceway rupture. This nominated length of tubing will be marked clearly with white tape indicating the nominated line and must not be walked beyond this line in any circumstances, apart from rupture. This enables one single straight connector to be used - allowing the ECMO Specialist to perform the procedure quickly, safely & efficiently with minimal instability to the patient.

Frequency Guides To Walking The Raceway:

The frequency the raceway needs to be walked depends on the patient – please see rough guides below:-

Adult Raceway:

NB: Adult patients need the raceway walking more frequently than Paediatrics or Neonates, due to the increased number of revolutions per minute (RPM).

RPM	Frequency the raceway needs walking
< 80	Every five days
> 80	Every three days
> 90	Alternate days
> 100	Daily

Paediatrics (3/8" Raceway):

Flows (ml/min)	Frequency the raceway needs walking
< 1400	Every five days
1400 - 1600	Every three days
>1600	Daily

Neonates (1/4" Raceway):

Flows (ml/min)	Frequency the raceway needs walking
< 400	Every five days
400 - 500	Every three days
>500	Daily

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Title: **Use Of The Hand Crank**

Description: To use the Hand Crank to continue ECMO flow in the event of pump or power failure or if transferring a patient short distances / for transfer to the Catheter Suite, Theatre, CT Scan or within ITU

Personnel: ECMO Specialist
Nurse
ECMO Fellow

Equipment: Hand Crank

ECMO Specialist Action:

Action:	**Rationale:**
Always check a hand crank is present on the cart at the beginning of a shift	To ensure one is available in an emergency
Always note the direction the pump is rotating and the revolutions per minute (RPM)	To ensure a quick response and avoid incorrect direction of hand cranking
<u>If power supply fails:</u> • Turn off the pump • Lift lid to roller pump & insert the hand crank in one of the holes on the roller • Immediately start to turn the roller in the direction of flow and maintain previous patient flow rates *NB: Bladder / circuit pressures (pre / post oxygenator) must be observed at all times throughout this procedure*	To maintain patients stability / safety and circuit flow To prevent clotting of the circuit & cannulae

<u>If power is off for more than a few seconds:</u> • Call in the ECMO Team • Dial 2222: stating 'ECMO emergency'	For medical support / backup
<u>If the pump fails:</u> • Proceed as per 'If the power supply fails' & 'If the power is off for more than a few seconds' • Assist the Perfusionist in changing the pump *NB: The ECMO Specialist role is only to <u>assist</u> Perfusionist*	
Ensure you are aware of the patient's condition at all times – ask the Nurse to tell you what the oxygen saturations, blood pressure, heart rate etc are *NB: Ensure the duration of the event is noted*	To recognise whether adequate support is being maintained

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Title: **Changing A Pigtail "Two Man Technique" (Pre-Pump Only)**

Description: To replace an ECMO circuit Pigtail

Personnel: ECMO Specialist
Nurse
ECMO Fellow
ECMO Co-ordinator (if required)

Equipment: 3 x Clamps
1 x Pigtail
1 x Three-way Tap
5mls Syringe Flush
Gloves

ECMO Specialist Action:

Action:	**Rationale:**
Gather supplies and inform Nurse & relatives	To have everything at hand for quickness
Wash hands and put on gloves	To observe universal precautions
Attach three-way tap to the pigtail and flush, leaving the syringe on the three-way tap	To prevent air embolus
Turn pump off	Clamping tubing whilst the pump is on may cause the circuit to rupture
Instruct the Nurse to clamp tubing on either side of the pigtail (keeping hold of the clamps to steady tubing)	To prevent blood loss when the old pigtail is removed
Disconnect the old pigtail and connect the new pigtail with the three-way tap & syringe attached	
Instruct Nurse to remove the clamp nearest the bladder, draw back to de-bubble, turn tap off to circuit & release second clamp	

Check circuit for air, ensure no clamps are on the tubing, then restart pump	To ensure it is safe to return the patient to ECMO

Comments

1) There are two types of Pigtails:

   - Normal-sized (thin bore) Pigtails
   - Haemofiltration (large bore) Pigtails

   Haemofiltration Pigtails are only to be used in the event of haemofiltration

2) Do not tighten three-way taps with a clamp - they need to be hand tight only

3) Do not loosen affected Pigtails prior to removal

4) If clamping a Pigtail post-pump, please follow protocol for one man Pigtail technique

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Title: **Changing A Pigtail "One Man Technique"**

Description: To replace an ECMO circuit Pigtail

Personnel: ECMO Specialist
Nurse
ECMO Fellow
ECMO Co-ordinator

Equipment: 5 x Clamps
1 x Pigtail
1 x Three-way Tap
5mls Syringe Flush
Gloves

ECMO Specialist Action:

Action:	**Rationale:**
Gather supplies and inform Nurse & relatives	To have everything at hand for quickness
Wash hands and put on gloves	To observe universal precautions
Attach three-way tap to the pigtail and flush, leaving the 5ml syringe on the three-way tap	To prevent air embolus
Ensure ECMO Team are present	
Turn pump off	To ensure patient safety
Ensure Nurse / Co-ordinator clamps the patient off (V-B-A) *NB: In the event of an emergency, the Nurse must clamp the patient off A-B-V*	To ensure patient safety
Clamp tubing either side of the pigtail	To prevent blood loss when the old pigtail is removed

Disconnect the old pigtail and connect the new pigtail with the three-way tap & syringe attached	
Remove the clamp nearest to the bladder (in order to de-bubble), turn tap off to circuit and release the second clamp	
Turn the pump back on, check the circuit for air and ensure no clamps are left on the circuit tubing	To ensure safe return of the patient back onto ECMO
Instruct the Nurse to remove the patient's clamps A-V-B	

Comments

1) Do not loosen affected Pigtails prior to removal

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Title: **Changing An ECMO Circuit Three-way Tap**

Description: To replace an ECMO circuit tap at prescribed intervals and in the event of cracking / clotting

Personnel: ECMO Specialist

Equipment:

- 1 x Sterile Three-way Tap
- 2 x Sterets
- Gloves
- Padded Clamps
- 3mls Flush
- 5ml Syringe

ECMO Specialist Action:

Action:	**Rationale:**
Gather supplies	
Wash hands and put gloves on	Observe universal precautions
Attach tap to syringe and flush through all the ports	To remove air from the tap
Place steret package around the pigtail, then clamp the pigtail over the packet	To protect the pigtail from damage by the clamp
Whilst holding the pigtail, remove the old tap	
Wipe lightly with steret, then attach new tap to the pigtail	Substances in plastic may be degraded by excessive exposure to alcohol
<u>If pre-pump:</u> Remove the clamp, draw back on the syringe to aspirate air, close the tap off to circuit and replace syringe with the luer lock cap	

<u>If post-pump:</u> Turn the tap on to circuit, loosen the clamp whist aspirating air & immediately re-clamp, close tap off to circuit, replace syringe with luer lock cap, then unclamp	Pigtails and taps post-pump are exposed to high pressures - the use of the clamp controls the backflow of blood into the syringe

<u>Comments</u>

1) Notify the Nurse prior to change, particularly if IV infusions will be affected

2) All taps must be turned off to the circuit when not in use

3) Taps located at the bladder stems should be changed every <u>72 hours</u>

The Heart Link / ECMO Programme

Title: **Air Bubble Removal**

Description: To remove air from the circuit

Personnel: ECMO Co-ordinator
ECMO Specialist
Nurse
Perfusionist

Equipment: Syringe (appropriately-sized to aspirate air)
Gloves

ECMO Specialist Action:

Action:	**Rationale:**
<u>If air is in bladder or bladder stems</u> • Apply gloves • Attach syringe to port with air in, turn three-way tap onto bladder & syringe and slowly aspirate air • Turn tap off to bladder, remove syringe and replace cap	
<u>If air is moving through tubing on venous side:</u> • Have a clamp at hand to clamp A-B-V whilst watching the bubble • If it settles in the bladder, do not clamp off and proceed as per 'If air in bladder or bladder stems'	Air on the venous side pre-bladder should get trapped and settle in the bladder
<u>If air is moving through tubing on arterial side:</u> • Clamp patient off A-B-V, contact the ECMO Team on 2222, time the clamp off period, hand bag the patient and de-air the circuit	Patients require isolation from the ECMO circuit due to the risk of air – a prolonged period of time off ECMO will cause the ECMO circuit to clot

<u>If air embolus settles at highest point in the circuit:</u> • Aspirate air from the nearest pigtail port • Increase pump flow, work the air through the bridge & into the bladder and aspirate out of the bladder stem three-way tap	Air rises to the highest point - this is usually post-oxygenator, near the platelet pigtail intended for platelet administration
Once air is removed and no active source of air entering circuit found, return the patient to ECMO (A-B-V)	
Return to previous IPPV	

<u>Comments</u>

1) If there a large amount of air in the circuit, clamp the patient off immediately as per the emergency procedure (A-B-V), circulate through the bridge, disconnect sweep gas and call the Perfusionist.

2) Please be aware emergency fluid may need to be administered to maintain pump flow using rapid access line

3) Once the emergency procedure has been initiated, hand bag the patient in 100% oxygen.

4) Whilst waiting for the Perfusionist, attempt to find the source of air entry & rectify

5) Once the problem has been rectified, please ensure that the sweep gas is reconnected

The Heart Link / ECMO Programme

Title: **Inserting A Connector In The Event Of A Raceway Rupture**

Description: Insertion of a connector

Personnel:
ECMO Director
ECMO Co-ordinator
ECMO Specialist
Nurse
ECMO Fellow
Perfusionist

Equipment:
Replacement Raceway
Sterile Field
9 x Clamps
Drizzle Fluid
50ml Syringe
Appropriate Connectors
Perfusion Scissors

ECMO Specialist Action:

Action:	**Rationale:**
When rupture is identified, clamp the patient off ECMO immediately (A-B-V)	To minimise blood loss and ensure no air emboli reach the patient
Alert Nurse to the problem and ensure hand ventilation is commenced or mechanical ventilation adjusted accordingly	Maintain patient oxygenation
Allocate one person to alert Switchboard of the ECMO emergency (call 2222) and obtain any equipment / drugs needed	To avoid duplication and ensure speed & efficiency
Clamp tubing at entry & exit points of the roller pump, inspect tubing and prepare to insert a straight connector into the tubing	To ensure the quickest & safest procedure is performed until backup from Perfusion is available

Ask assisting Nurse / ECMO Specialist to draw up drizzle solution into the 50ml syringe and open sterile pack & gloves	To prime the new connector – asepsis is required at all times
Apply three clamps at each point either side of the rupture, where tubing is to be cut	To prevent excess blood spillage
Swab the tubing where the cut is to be made with Betadine solution and cut the tubing closest to the end that will be discarded	To maintain asepsis and ensure sufficient tubing is available to securely fit the connector
Insert connector & drizzle solution in whilst connecting the other end	To prevent air emboli
Remove clamps and place the raceway back into the pump *NB: The raceway to be placed in the pump will be walked past the nominated white mark (white tape on raceway tubing) – this is the only occasion where the raceway will be walked past the nominated white mark*	
Start the pump slowly and circulate through the patient bridge	To ensure no air is in the circuit and allow for its removal before the patient is returned to ECMO
Return the patient to ECMO support by releasing the clamp on the arterial tubing first and using it to clamp the patient bridge, then release the clamp on the venous side of the tubing	To prevent sudden venous drainage with no return

Connect the tie straps to the inserted connector *NB: Once Perfusion arrive, elective raceway & pump change-out must be performed*	To ensure circuit and patient safety
Prepare for elective change-out of the pump / raceway in accordance with the Perfusionist's instructions	To ensure circuit and patient safety

The Heart Link / ECMO Programme

Title: **Conversion From VV – VA ECMO Or VA – VV ECMO**

Description: To ensure the safe and efficient conversation from VV to VA ECMO / VA to VV ECMO

Personnel: ECMO Co-ordinator
ECMO Specialist
Nurse
Perfusionist
ECMO Director
Theatre Team
Anaesthetist
ECMO Fellow

ECMO Specialist Action:

Action:	**Rationale:**
Ensure all members of the team (stated above) are fully aware of the planned conversion	To ensure effective communication and an efficient procedure
Ensure relatives are fully informed of the procedure	To reduce stress / anxiety
Assist the Perfusion Team, as required	To help in the event of an emergency
Ensure all necessary equipment is at hand - ready for immediate use	To reduce delay if an emergency arises
Ensure the emergency box is checked & correct	For use in an emergency
Ensure the patient is fully sedated and anaesthetised prior to conversion	To ensure patient comfort and safety
Monitor patient status throughout the procedure - informing medical staff / Perfusionist of any relevant changes	To ensure patient safety

The Heart Link / ECMO Programme

Monitor the circuit throughout the procedure	To maintain a functioning circuit
Ensure major structural changes to the circuit (e.g. two patient bridges) are documented on the Specialist Evaluation Form and verbally handed over to the next Specialist	To ensure efficient communication
Post procedure, perform a full circuit check / handover from the Perfusionist	To ensure circuit and patient safety
Post-procedure, ensure the circuit is clean & tidy	To ensure a clean & safe circuit

The Heart Link / ECMO Programme

Title: **Weaning From VA Or VV ECMO**

Description: To wean to minimal levels of ECMO support

Personnel: ECMO Co-ordinator
ECMO Specialist
ECMO Fellow

ECMO Specialist Action:

Action:	**Rationale:**
Maintain frequent arterial / mixed venous blood gases - keeping within written parameters	In order to recognise any trends present and keep the levels within written parameters
If the patient is ready to wean, reduce the ECMO flows gradually - checking saturations & gases with each reduction in flow and adjusting sweep gas accordingly	
If the arterial or mixed venous blood gases remain within their set parameters whilst on minimal support, then a trial off could be discussed with the on-call ECMO Consultant and arrangements made for a trial off to take place	

<u>Minimum Weaning Parameters:</u>

	VA ECMO	**VV ECMO**
Neonate / Small Paed	30 (mls/kg)	50 (mls/kg)
Adult	1000 (mls/min)	1000 (mls/min)

NB: The weaning parameter of a Neonate / small Paed should be no less than 10 revolutions per minute (RPM)

The Heart Link / ECMO Programme

Title: **Trial Off Veno-Venous ECMO**

Description: To manage and monitor a trial off VV ECMO, maintaining the function of the ECMO circuit and the safety of the patient

Personnel: ECMO Director
ECMO Co-ordinator
ECMO Specialist
Nurse
ECMO Fellow

ECMO Specialist Action:

Action:	**Rationale:**
Ensure ECMO Co-ordinator is aware of decision to trial off *NB: Co-ordinator must be present for trial off period, unless in the event of an overnight trial off*	
Check that any pre-decannulation ETT change is performed	It is easier to make changes to the ETT whilst the patient is not dependant on the ventilator
Ensure ventilator is changed prior to commencement of trial off, not during or immediately after	
Check that new IV / arterial access is gained	
Check the patency of the existing IV access	To assess the need for further IV access
Ventilation will be increased by the ECMO Fellow	To ensure oxygenation after membrane gas supply
Disconnect sweep gas supply to the oxygenator – documenting the time	

Increase pump flow *NB: The first ABG should be taken 30mins – 40mins post disconnection of the sweep gas, to allow for efficient mixing*	To prevent areas of stasis
Check ABGs every 20 mins for two hours and every 30 mins thereafter Ventilation to be altered according to parameters set by the ECMO Fellow	
Continue maintenance of the circuit, as per protocol	The circuit may still be needed
If ABGs are satisfactory after a prescribed amount of time - the ECMO Co-ordinator will discuss decannulation with the on-call ECMO Consultant	
Maintain the circuit without sweep gas supply until decannulation	
Keep relatives & staff informed accordingly throughout *NB: The minimum trial off period is two hours*	To reduce anxiety, ensure patient safety and make sure the patient is suitable to remove from ECMO support
Document the trial off on appropriate Trial Off Forms & ECMO Chart	

The Heart Link / ECMO Programme

Title: **Trial Off Veno-Arterial ECMO**

Description: To manage and monitor a trial off VA ECMO, maintaining the function of the ECMO circuit and the safety of the patient

Personnel:
ECMO Consultant (on-call)
ECMO Co-ordinator
ECMO Specialist
Nurse
ECMO Fellow

Equipment:
VA Trial Off Documentation
9 x Clamps (at least)
Clock
Emergency Drugs
2 x Actylyte Machines

ECMO Specialist Action:

Action:	**Rationale:**
Ensure ECMO Co-ordinator is aware of decision to trial off *NB: Co-ordinator must be present for trial off period, unless in the event of an overnight trial off*	
Check that any pre-decannulation ETT change is performed	It is easier to make changes to the ETT whilst the patient is not dependant on the ventilator
Ensure ventilator is change prior to commencement of trial off, not during or immediately after	
Check that new IV / arterial access is gained	
Check the patency of the existing IV access	To assess the need for further IV access

Prepare a new Heparin infusion (at the same concentration as the circuit Heparin) and connect to the patient's IV line - this infusion will be commenced with trial off at ½ rate of the current circuit Heparin	Need to maintain heparinisation of the patient & patency of cannulae
Transfer necessary infusions from the circuit to the patient	To keep essential drug infusions maintained
Ventilator settings will be increased by the ECMO Fellow	To ensure adequate oxygenation when off ECMO
Clamp the patient off ECMO by clamping the venous drainage tubing as near to the cannula as possible	To remove the patient from ECLS, whilst ensuring they have sufficient blood volume for their own circulation
Release the bridge clamp and use it to clamp off the arterial return tubing (V-B-A), as close to the cannula as possible	
Turn sweep gas flow off	To prevent a possible build-up of gas pressure and thus emboli
Decrease the circuit Heparin to half its original rate	This is still needed in the circuit, but at a reduced rate due to the break in patient consumption
Start patient Heparin at half the original dose	Need to maintain heparinisation of the patient & patency of cannulae
Document the time trial off commenced using the VA ECMO Trial Off Record Sheet	An accurate note of the commencement of trial off is required
Release clamps (V-B-A / A-B-V) every 10 minutes	To prevent clot formation in the cannulae and to maintain patency of cannulae & the ECMO circuit

Perform circuit and patient ACT's every 10 minutes prior to flushing the cannulaes.	
Perform arterial blood gases every 20 minutes.	
Maintain the circuit without sweep gas supply until decannulation or re-commencement of ECMO	
Keep relatives / all team members informed accordingly throughout *NB: The minimum trial off period is two hours*	To reduce anxiety, ensure patient safety and make sure the patient is suitable to remove from ECMO support
Document the trial off on designated Trial Off Form & ECMO Chart	

The Heart Link / ECMO Programme

Title: **Decannulation Protocol**

Description: To assist in the decannulation of an ECMO patient following a successful trial off

Personnel:
ECMO Director
ECMO Consultant
ECMO Fellow
ECMO Co-ordinator
ECMO Specialist
Nurse
Theatre Team (for VA or cut-down cannulation site)

Equipment:
Theatre Tray / Diathermy (if VA)
Yellow Perfusion Bin
Dressings (for Cannulae sites)
Dressing Pack (for each site)
2 x Sterile Pots (Cannula Tips)
Clamps
2 x Sutures
Stitch Cutter
Betadine Solution

ECMO Specialist Action:

Action:	**Rationale:**
Gather all supplies • If decannulating from VV ECMO, notify appropriate staff • If decannulating from VA ECMO or cut down site, the Theatre Team is also required	To ensure an efficient procedure
Ensure venous access to the patient is secure & patent and the necessary drugs are transferred to the patient & running as per prescription	To ensure satisfactory patient status & safety
Ensure emergency drugs are drawn up and at hand for immediate use	To prevent complications or patient deterioration
Ensure ventilation is correct and re-intubation equipment is ready at hand for immediate use	To ensure patient safety

Assist Surgeon with the procedure, as required	For a quick, efficient & safe procedure
Ensure cannulae tips are sent for culture	For research & awareness of sepsis
Monitor patient's status throughout the procedure	For patient safety
Dispose of the circuit, as per the ECMO equipment clean-up protocol	To maintain a clean & safe environment
Ensure all documentation is completed	For future records
Any concerns post-decannulation, contact the ECMO Fellow	To gain advice / further instructions and to make them aware of the patient's status
Seek medical advice regarding the necessity for administration of antibiotics	To reduce the risk of decannulation bactraemia

The Heart Link / ECMO Programme

Title: **Equipment Clean-up Procedure**

Description: To maintain the ECMO circuit components, day to day running of the circuit and decannulation & disposal of equipment

Personnel: ECMO Specialist

Equipment:
- Soap & Water
- Infusion Devices
- Bladder Box
- Emergency Cart
- ECMO Cart
- Stockert Roller Pump
- Actylyte Machine

ECMO Specialist Action:

Action:	**Rationale:**
Ensure the ECMO cart is cleaned on a daily basis with water / detergent (or as often as required)	To maintain a clean & safe environment
Ensure all components are in good working order – inform the ECMO Co-ordinator / Perfusion Department of any defects	To ensure the circuit is functioning properly
In the event of decannulation, all disposable components should be put into the yellow Perfusion Bin (from the ECMO Store Room) - place lid on the yellow bin & ensure it is securely sealed (dated / timed / location noted & signed)	To ensure safe disposal of the circuit
Clean all equipment & store in the ECMO Store Room	To ensure safe disposal of the circuit
Dispose of the Emergency Cart items to the allocated area	