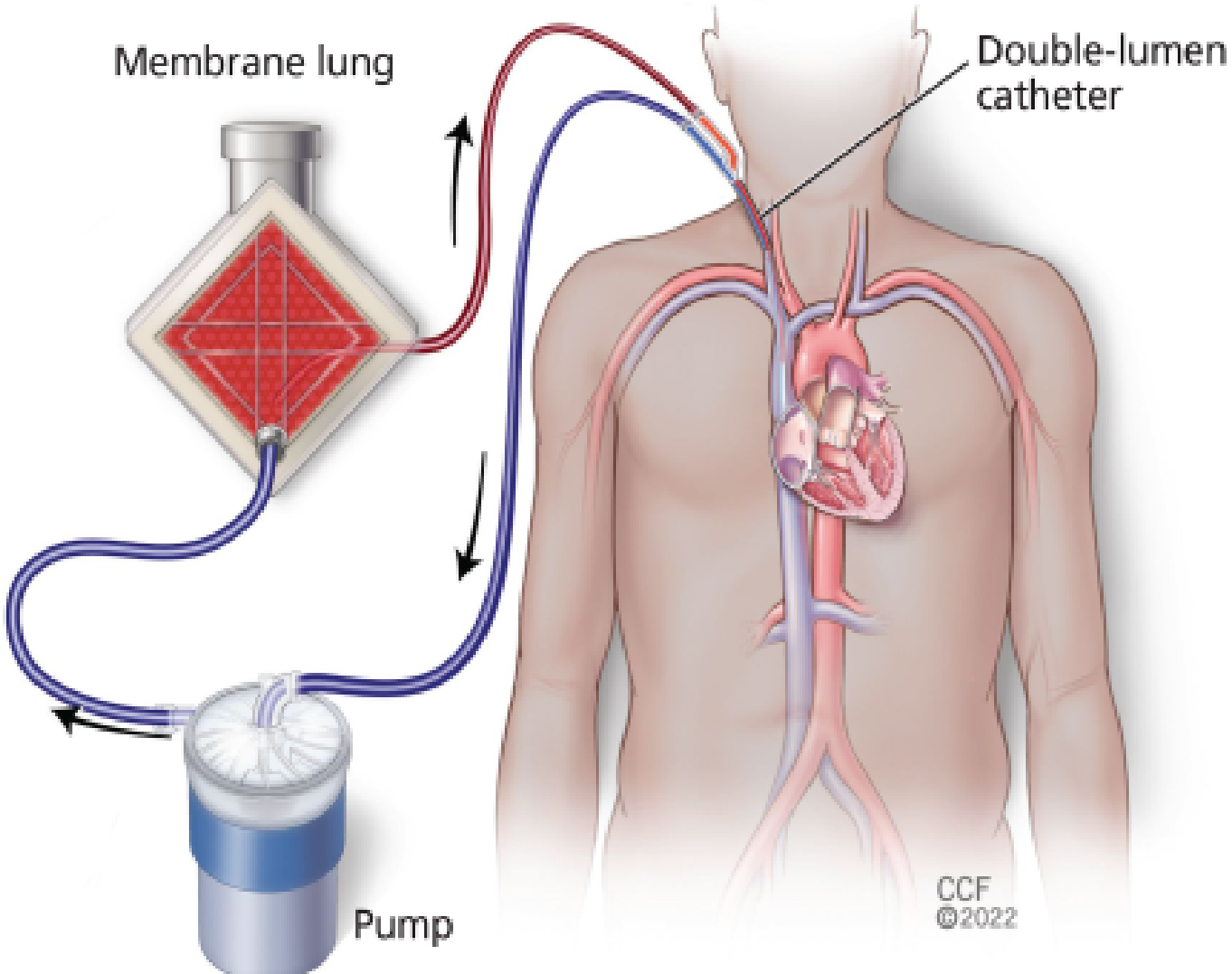
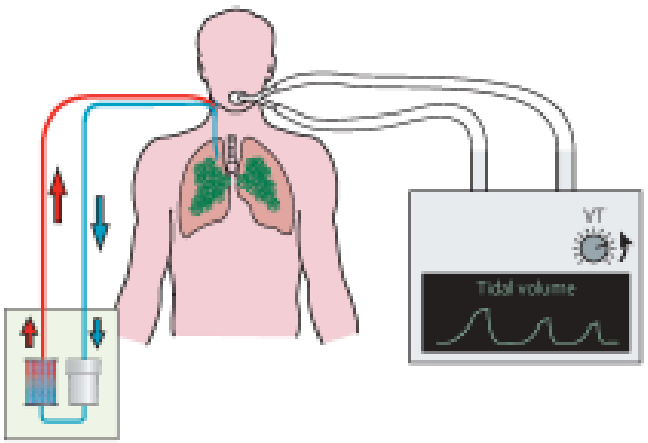
ECCO2R

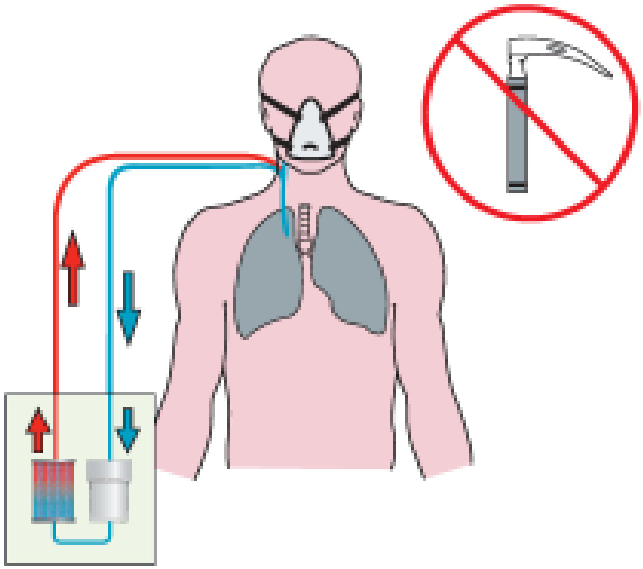
SMRHASHEMIAN@SBMU.IC.IR


Membrane lung
Double-lumen catheter
Pump
CCF
©2022

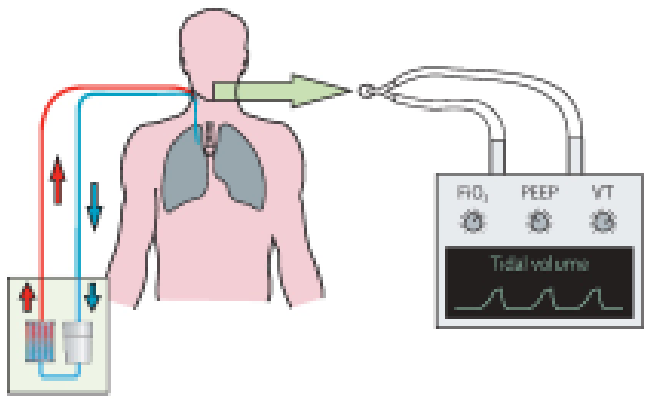
Lower tidal volume ventilation



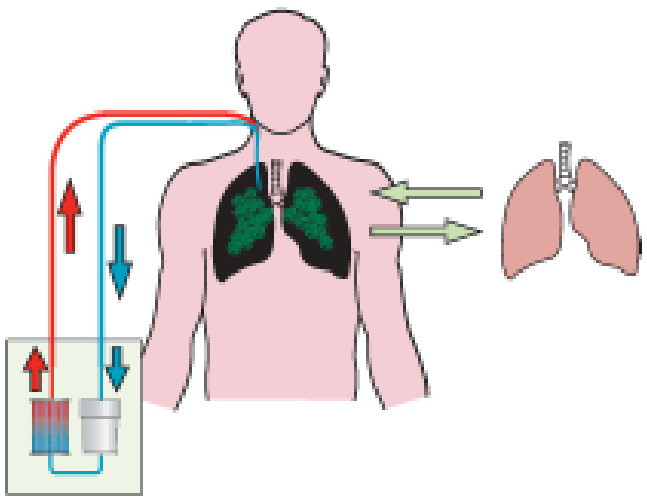
Preventing intubation



Facilitating extubation

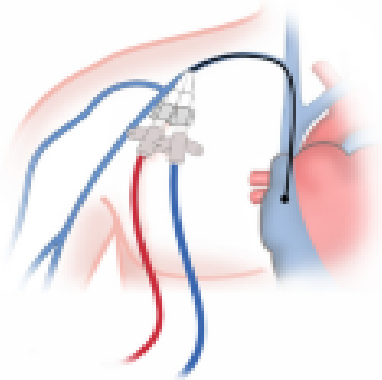


Bridge to lung transplant



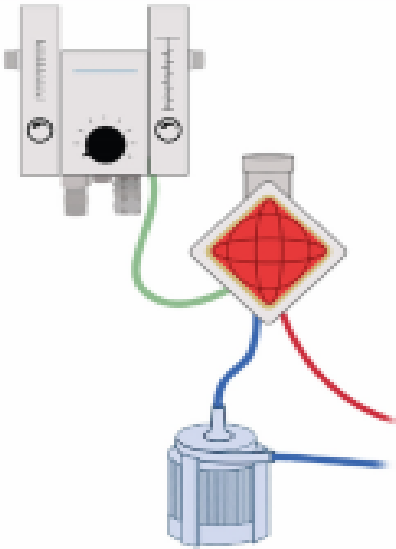
Full Anticoagulation

- Bleeding
- Brain hemorrhage
- GI bleeding
- Other bleeding
- Heparin-induced thrombocytopenia



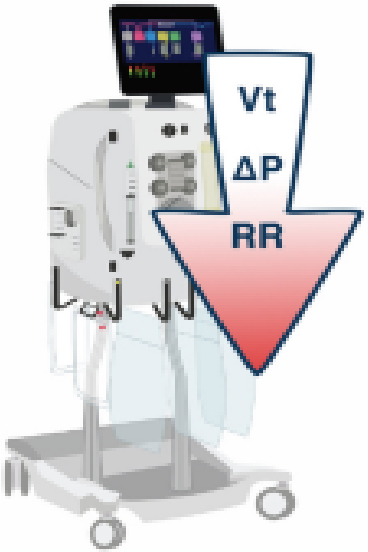
Catheter insertion site

- Bleeding (local, retroperitoneal, thoracic)
- Pneumothorax
- Infection
- Inadvertent arterial insertion
- Venous thromboembolism



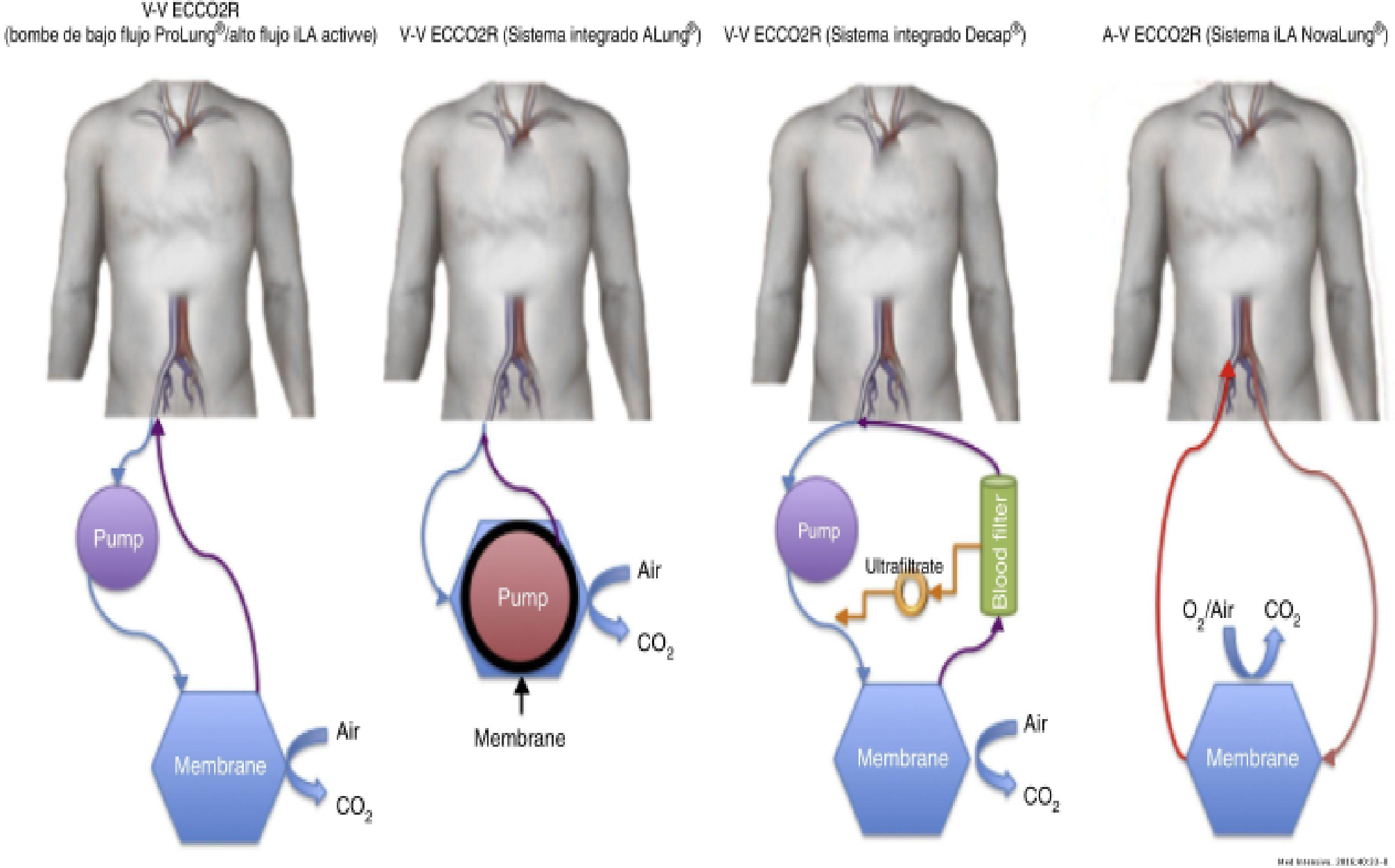
Device related

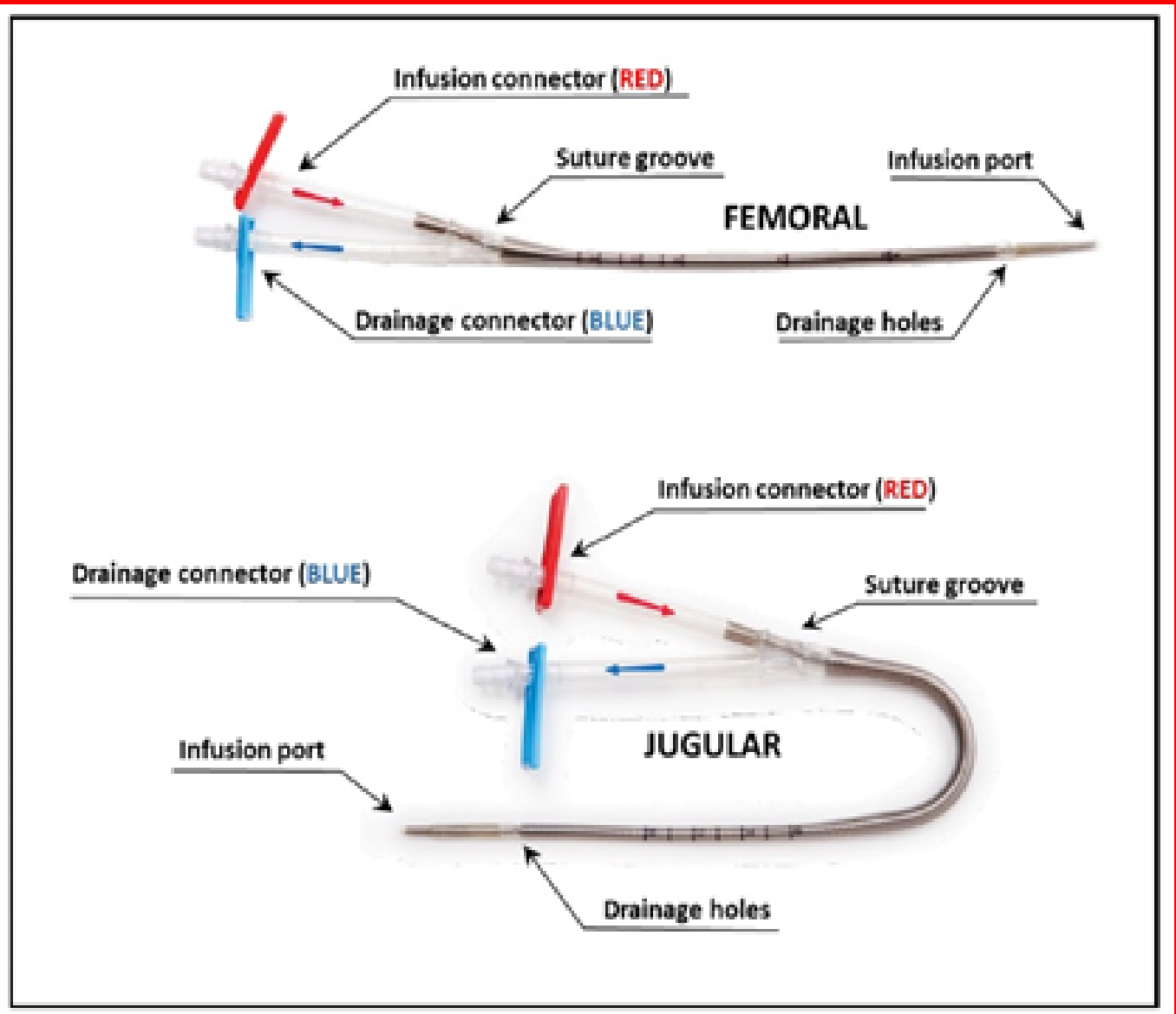
- Air embolism
- Clotting / Failure
- Hemolysis
- Disseminated intravascular coagulation
- Fibrin/coagulation factor consumption

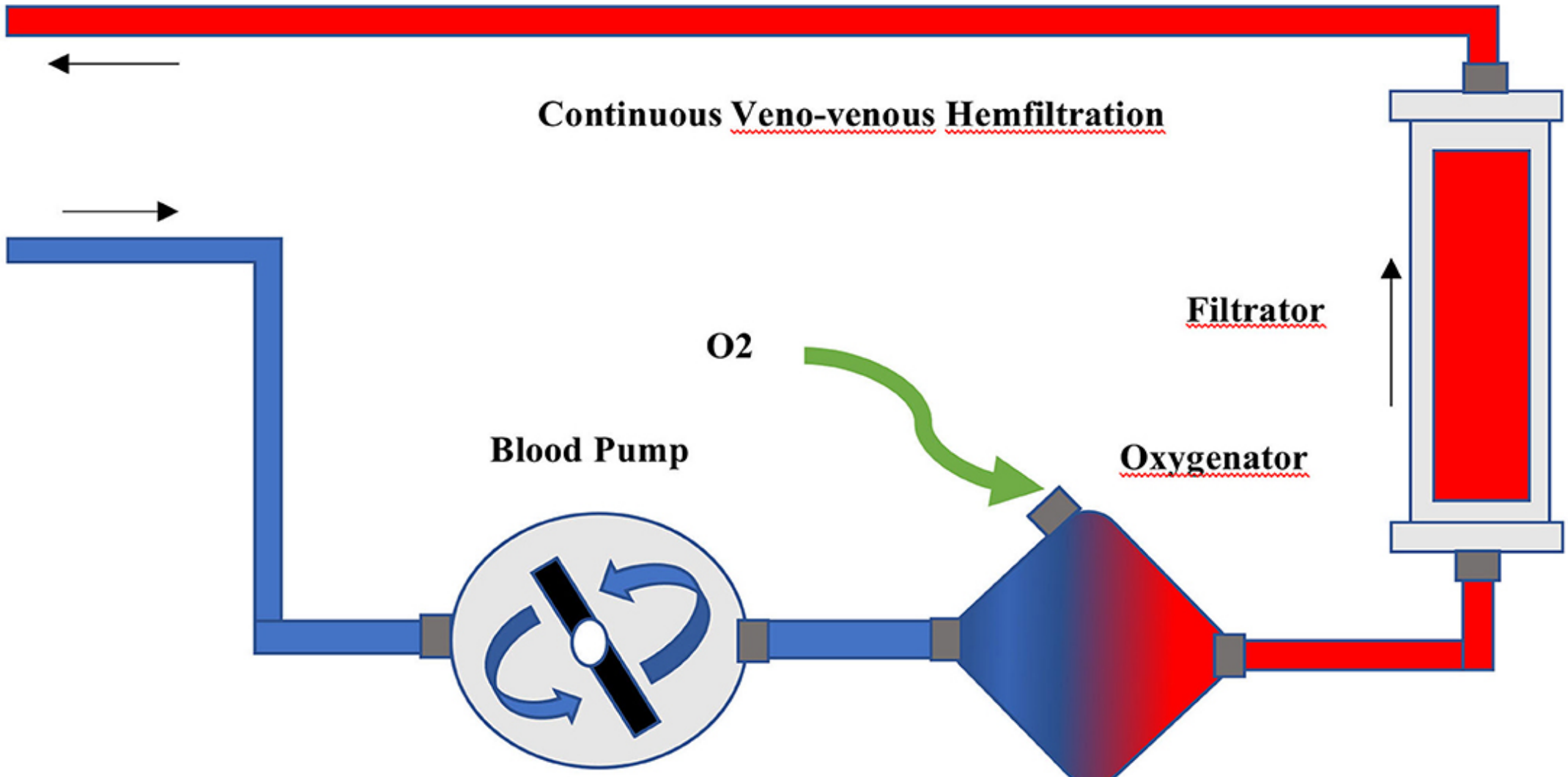


Therapy related

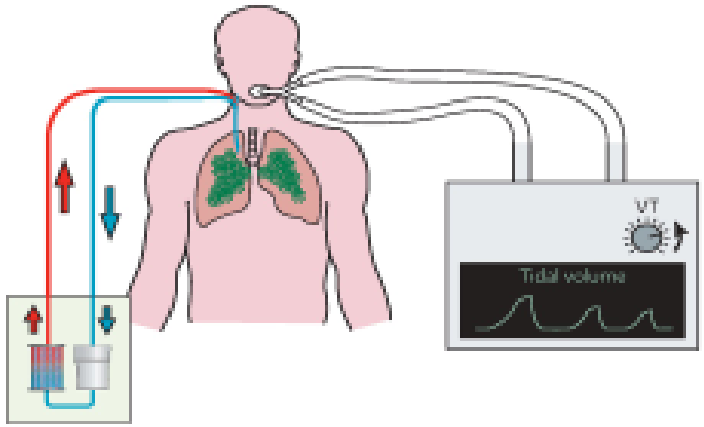
- Worsening hypoxaemia during lower tidal volume ventilation
- Prolonged mechanical ventilation
- Less access to prone positioning


V-V ECCO2R
(bombe de bajo flujo ProLung®/alto flujo iLA activve)
V-V ECCO2R (Sistema integrado ALung®)
V-V ECCO2R (Sistema integrado Decap®)
A-V ECCO2R (Sistema iLA NovaLung®)
Pump
Membrane
Air
CO_2
Pump
Membrane
Air
CO_2
Pump
Ultrafiltrate
Blood filter
Membrane
Air
CO_2
O_2/Air
CO_2
Membrane

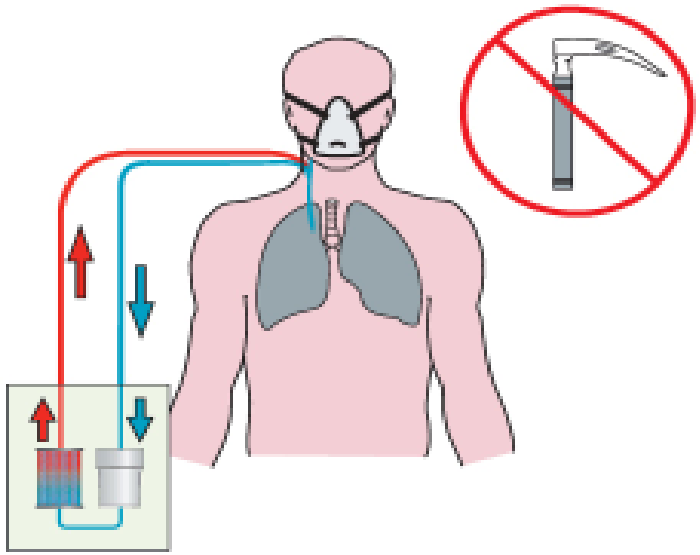

Infusion connector (RED)
Suture groove
Infusion port
FEMORAL
Drainage connector (BLUE)
Drainage holes
Infusion connector (RED)
Drainage connector (BLUE)
Suture groove
JUGULAR
Infusion port
Drainage holes


Continuous Veno-venous Hemfiltration
Filtrator
O2
Blood Pump
Oxygenator

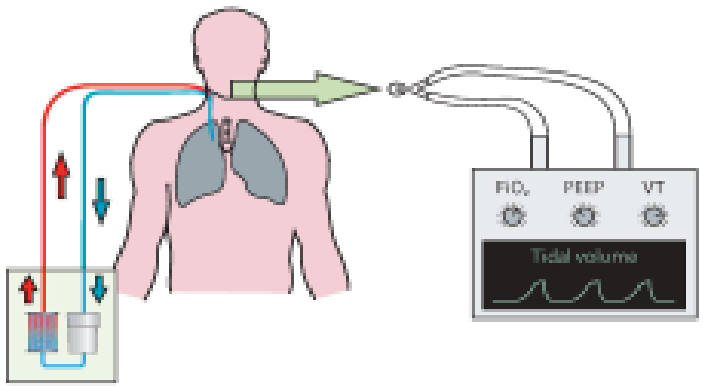
Lower tidal volume ventilation



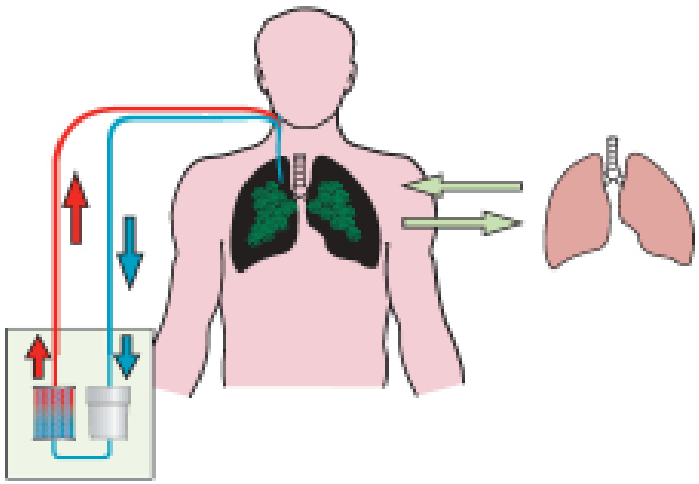
Preventing intubation



Facilitating extubation



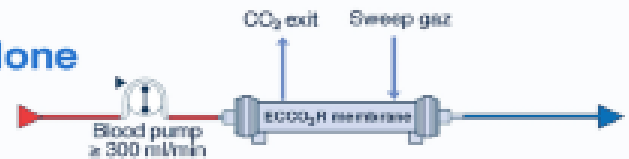
Bridge to lung transplant



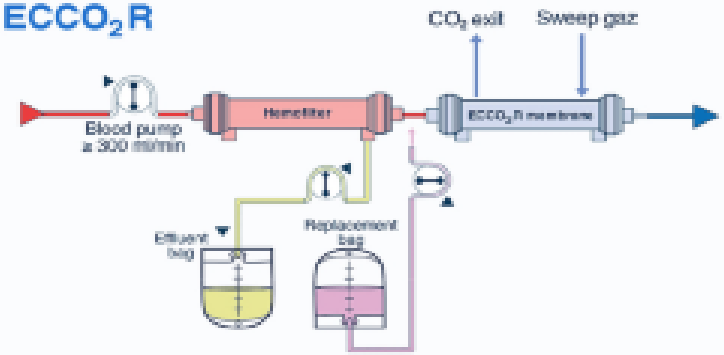
High flow $ECCO_2R$

$ECCO_2R$ Techniques

Stand alone



RRT + $ECCO_2R$



Low flow $ECCO_2R$

Acute Hypercapnic Respiratory Failure / COPD

- Control of hypercapnia/RR
- Prevention of intubation (risks of NIV failure)
- Rapid extubation (after NIV failure)

Acute Hypoxemic Respiratory Failure/ARDS

- Ultra protective MV to decrease VILI
- Less volutrauma, Less Barotrauma, Less Biotrauma
- Control of hypercapnia induced by ultraprotective MV

Other indications

- Asthma: *control hypercapnia, decrease Vt, increase expiratory time*
- Bridge to lung transplantation: *Prevent intubation/facilitate*

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Critical Care

RESEARCH Open Access

$ECCO_2R$ therapy in the ICU: consensus of a European round table meeting

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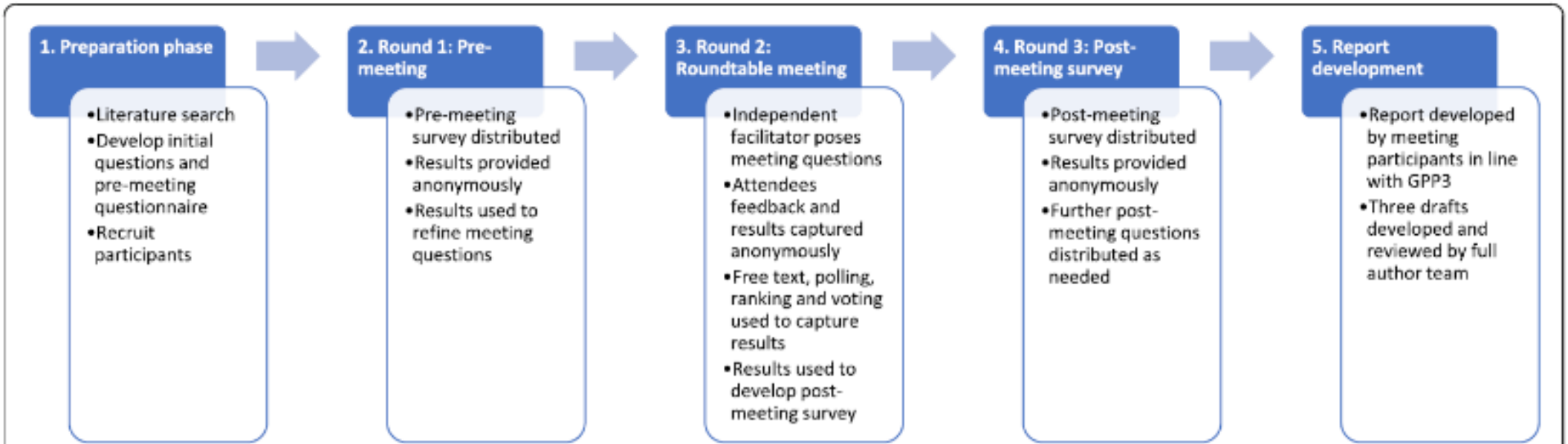

Fig. 1 Overview of the five-step Delphi method used in the Round Table Meeting. Each step was a distinct process that was completed before the following step was initiated. Results and discussions from each step were independently analysed and used to inform the direction and content of the following steps, e.g. if the group were split on a topic, then clarifying questions were crafted to guide the discussions in the following step(s) to identify and explore points of consensus or difference. GPP3, Good Publication Practice 3

Table 1 $ECCO_2R$ treatment criteria for patients with ARDS

Parameter	Target	Score	
Initiation criteria			
Driving pressure	≥ 14 cmH_2O	31	Consensus
P_{plat}	≥ 25 cmH_2O	22	Consensus
$PaCO_2$	> 60–80 mmHg	21	Majority agreement
pH	< 7.25	20	Majority agreement
Reduce V_T to < 6 mL/PBW	–	18	Majority agreement
Respiratory rate	≥ 25 to > 30	14	Majority agreement
PaO_2/FiO_2	100–200	10	Majority agreement
PEEP	–	8	No agreement
Treatment targets			
Driving pressure	< 14 cmH_2O	66*	Consensus
P_{plat}	< 25 cmH_2O	57*	Majority agreement†
Respiratory rate	< 25 or < 20 breaths/min	44*	Consensus
pH	> 7.30	39*	Majority agreement
V_T	≤6 mL/PBW	39*	Majority agreement
$PaCO_2$	< 50–55 mmHg	30	Majority agreement

Criteria for $ECCO_2R$ treatment considered to be of importance and selected from the provided list. Target describes any potential target values identified, with '–' indicating that no target parameter was provided or considered relevant. Score indicates the combined total score, with higher scores indicating a higher perceived importance. Consensus means a consensus threshold (≥ 80%) was reached, majority agreement means ≥ 50% agreed but consensus level was not reached, and no agreement means < 50% agreed

*Based on the post-meeting survey. †Note, for P_{plat}, a consensus threshold of 80% was not reached in the meeting; in the post-meeting survey, it was rated as the second most important target

Table 2 Typical characteristics for initiating $ECCO_2R$ for rescue therapy and to facilitate ultra-protective ventilation in ARDS

Parameter	Target for initiation in: Rescue	Target for initiation in: Ultra-protective ventilation
Driving pressure	> 15 to 20 cmH_2O	> 13 to 15 cmH_2O
P_{plat}	> 30 to 35 cmH_2O	≥ 25 cmH_2O
$PaCO_2$	≥ 60 mmHg	≥ 60 mmHg
pH	< 7.25–7.30	< 7.25–7.30
Respiratory rate	> 20 to 30 breaths/min	> 20 breaths/min
PaO_2/FiO_2	< 150	< 150
PEEP	> 8 to 15	≥ 8

Responses were captured during the post-meeting survey (Round 3) and general themes were identified

Table 4 $ECCO_2R$ treatment initiation criteria for patients with ae-COPD

Initiation criteria for patients at risk of NIV failure	
Parameter	
No decrease in $PaCO_2$ while on NIV	Consensus
No decrease in respiratory rate while on NIV	Consensus
Clinical signs of respiratory failure	Majority agreement
pH 7.25–7.30	Majority agreement
Baseline $PaCO_2$	No agreement
Baseline respiratory rate	No agreement
Initiation criteria for patients who are already intubated	
- Patients who look like they will not be extubated early without $ECCO_2R$	
○ Previous intubation for ae-COPD	
○ Has failed a spontaneous breathing trial due to increased dyspnoea	
○ Reintubation after first extubation attempt despite NIV	
○ Patients with severe bronchospasm who are difficult/impossible to ventilate adequately or otherwise not responding to medical treatment	
○ Patients who remain hypercapnic and not improving with MV	
- No hypoxemia preventing extubation	
- MV < 72 h	
- Patients with home NIV and good quality of life	

Criteria for $ECCO_2R$ treatment considered to be of importance and selected from the provided list. Target describes any potential target values identified. Consensus means a consensus threshold (≥ 80%) was reached, majority agreement means ≥ 50% agreed but consensus level was not reached, and no agreement means < 50% agreed
Scoring and ranking was not conducted for this section during the meeting

Table 5 $ECCO_2R$ treatment targets and weaning protocol for patients with ae-COPD

Treatment targets for patients with ae-COPD

Parameter	Target	Score
Comfortable patient	–	27
pH	> 7.35/7.30, no consensus on specific pH	23
Respiratory rate	< 20–25 breaths/min	19
Decrease of $PaCO_2$ by 10–20%	–	18
Weaning from NIV	–	9
Decrease in HCO_3^-	–	9
Maintaining haemodynamic stability	–	7

$ECCO_2R$ weaning protocol for patients with ae-COPD

1. Patient weaned from NIV for > 6 h
   a. Excluding patients on home NIV or candidates for long-term NIV
2. Intubated patients weaned from MV for > 6 h
3. SpO_2 ≥ 88% with supplemental O_2 if needed
4. Reduce sweep gas flow rate by 1–3 L/min; check arterial blood gas after 1 h for:
   a. pH ≥7.35 with respiratory rate < 25 breaths/min
   b. PaO_2 > 55 mmHg
   c. SpO_2 > 88%
   d. FiO_2 < 40%
5. Repeat sweep gas reduction until zero gas flow reached, while arterial blood gas targets maintained
6. Remove $ECCO_2R$ after 6 h of stability of the aforementioned criteria

Treatment targets for $ECCO_2R$ considered to be of importance and selected from the provided list. Target describes any potential target values identified. Score indicates the combined total score, with higher scores indicating a higher perceived importance. Consensus means a consensus threshold (> 80%) was reached, majority agreement means ≥ 50% agreed but consensus level was not reached, and no agreement means < 50% agreed. The $ECCO_2R$ weaning protocol for patients with ae-COPD was developed and voted on during the meeting, with all attendees in agreement

Table 6 Heparin anticoagulation strategy

1. Anticoagulation with intravenous unfractionated heparin, preferably applied to the extracorporeal circuit

2. Monitor aPTT or anti-Xa or both

    a. To obtain an aPTT of 1.5–2.0 times normal baseline (45–70 s), or anti-Xa activity of 0.3–0.5 UI/mL

3. Initial bolus of heparin

    a. 40–80 units/kg PBW

    b. Bolus will not be performed in patients already on full anticoagulation

    c. Bolus routinely performed when guidewires have been inserted/or after catheter insertion

4. Patients with proven HIT-2

    a. Argatroban protocol, e.g. 0.5–2.0 μg/kg/min