ECMO: MANAGEMENT AND COMPLICATIONS

Antonella Degani

Bergamo 15-16 Dicembre 2007
Corso ECMO SICCH
We need ECMO!
- Minimize contact areas
- Avoid stagnant flow areas
- Measure:
  - Venous line pressure – before pump (40–60 mmHg)
  - Pressure before Oxygenator (press. drop 40–100 mmHg)
  - Pressure after Oxygenator (160–200 mmHg)
ECMO SUPPORT

- ABGs are obtained once connected to ECMO
- Repeated after adjustments in FiO\textsubscript{2} and gas sweep
- PaCO\textsubscript{2} achieved 40-45 mmHg and pO\textsubscript{2} > 150 mmHg
- ACT150 – 180 sec, checked every 20 min, then every hour
- PT , PTT , INR
ECMO CIRCUIT MANAGEMENT

- Safety checks, alarm control checked every 2h
- Pre/Post membrane pressure
- Emogas analysis if possible on line
- Check oxygen venous saturation: sVO₂ > 70%
- Patient temperature is tightly controlled – when above 36 degrees heater cooler is put on standby
ECMO MANAGEMENT

- ABG oxygenator every 4 h
- ABG to patient every 2 hours
- $O_2$ persist low at high $FiO_2$, and Hct is $> 35\%$, flow is increased and an arterial ECMO line ABG is performed
- $pCO_2$ changes gas sweep is adjusted
- Check diuresis: hemofylter (100-150 ml /h), dyalisis
Check the gas pipe connection, when you are out of the operating room.
No external drive heating
Never change centrifugal pump
No clots

The battery life is measured in volt not in percentage
The pump says “sig”….: Add ultrasonic cream
COMPLICATIONS

- Quadrox Oxygenator: None
- Affinity Oxygenator: plasma leakage
- Maxima Oxygenator: plasma leakage
- Sci Med: bleeding of the patient
QUESTIONS

If you reach the maximum duration time of the oxygenator

- Should you change it immediately?
- Should you wait the failure of the oxygenator?
- Should you consider other parameters: platelets loss, inflammatory response....?
# DIFFERENCES BETWEEN V-A AND V-V ECMO

<table>
<thead>
<tr>
<th>Hemodynamics</th>
<th>V-A</th>
<th>V-V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemic perfusion</td>
<td>Circuit flow and cardiac output</td>
<td>Cardiac output</td>
</tr>
<tr>
<td>Art. BP</td>
<td>Pulse is damped</td>
<td>Pulse is full</td>
</tr>
<tr>
<td>CVP</td>
<td>Accurate guide to volume status</td>
<td>Not helpful</td>
</tr>
<tr>
<td>PA Pressure</td>
<td>Decrease in proportion to ECC flow</td>
<td>Not affected by flow</td>
</tr>
<tr>
<td>Gas exchange</td>
<td>V-A</td>
<td>V-V</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Arterial oxygenation</td>
<td>Sat controlled by ECC flow</td>
<td>80-95% sat common for maximum flow</td>
</tr>
<tr>
<td>CO2 removal</td>
<td>Depends of gas sweep and surface area of membrane</td>
<td>Same as VA</td>
</tr>
<tr>
<td>Decrease ventilator setting</td>
<td>Rapidly</td>
<td>Slowly</td>
</tr>
</tbody>
</table>
Low flow (A) and moderate return flows (B) delivered to the femoral artery.

High return flows (C and D) to the femoral artery and the aortic root.

Hensley: “The practice of cardiac anesthesia”
ECMO
FEMORO-FEMORAL

Femoral Venous line
Femoral Arterial line
CANNULAE

- Heparin cannulae
- Percutaneous introduction (when possible) with dilatator (diam 10F to 22F)
- Art. cann. size 17F/19F
- Vent. cann. size 19F/21F
- TEE
COMPLICATIONS

- Leg ischemia
  7F/9F Catheter connected with luer of the arterial cannula
COMPLICATIONS

- Loss of venous return
  a) Increase the volume
  b) Flow overshoot
  c) Check Venous Cannula position
  d) Check circuit integrity, kink, clamp
Cannulae positioning in V-V ECMO
ANTICOAGULATION

BLEEDING

COAGULATION
THROMBOEMBOLISM

Visible thrombus in blood pump or cannula:
- Neurologic changes
- Seizures
- Hemiparesis
- Paralysis
- Hepatic or renal dysfunction
## Anticoagulation Monitoring

<table>
<thead>
<tr>
<th>Flow</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2.5 l/min</td>
<td>160-180 sec</td>
</tr>
<tr>
<td>2-2.5 l/min</td>
<td>180-200 sec</td>
</tr>
<tr>
<td>&lt;2 l/min</td>
<td>&gt;250 sec</td>
</tr>
</tbody>
</table>
CLOTTING OF OXYGENATOR
- Check every day circuit/oxy
- Flow > 2 L/min
- Continue infusion of heparin (15-30 U/kg/die)
- ATIII >80%
- TEG
- TEE
LEFT ATRIAL DRAINAGE

Left atrial drainage cannula 14F
Central ecmo
COMPLICATIONS

- Insufficient left atrial drainage:
  Change the luer connection to ¼” connection

- Air into the left atrial drainage:
  Pay attention to cannula position, close the chest
<table>
<thead>
<tr>
<th>PUMP</th>
<th>WEIGHT</th>
<th>HANDINESS</th>
<th>SET UP</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedicus</td>
<td>☹️</td>
<td>☻️</td>
<td>☻️</td>
<td>☻️</td>
</tr>
<tr>
<td>Rotaflow</td>
<td>☻️</td>
<td>☻️</td>
<td>☻️</td>
<td>☻️</td>
</tr>
<tr>
<td>Levitronix</td>
<td>☺️☺️</td>
<td>☻️</td>
<td>☻️</td>
<td>☹️☹️</td>
</tr>
<tr>
<td>Lifebridge</td>
<td>☺️☺️</td>
<td>☺️☺️</td>
<td>☻️</td>
<td>☹️☹️</td>
</tr>
</tbody>
</table>
### PAVIA EXPERIENCE

<table>
<thead>
<tr>
<th>Assistance</th>
<th>Total</th>
<th>Average age</th>
<th>Average time</th>
<th>Total time</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECMO VENO-ARTERIOSO</td>
<td>161</td>
<td>55,99±13,67</td>
<td>3,69±2,27</td>
<td>594</td>
</tr>
<tr>
<td>ECMO VENO-VENOSO</td>
<td>14</td>
<td>49,29±7,61</td>
<td>11,07±6,66</td>
<td>155</td>
</tr>
<tr>
<td>PASSAGGIO VAD DX-ECMO</td>
<td>10</td>
<td>60,40±6,52</td>
<td>6,50±3,9</td>
<td>65</td>
</tr>
<tr>
<td>PASSAGGIO VAD SX-ECMO</td>
<td>2</td>
<td>60,50±16,50</td>
<td>3,00±1,00</td>
<td>6</td>
</tr>
<tr>
<td>VAD BIVENTRICOLARE</td>
<td>2</td>
<td>51,00±4,00</td>
<td>4,00±1,00</td>
<td>8</td>
</tr>
<tr>
<td>VAD DESTRO</td>
<td>24</td>
<td>58,13±10,24</td>
<td>4,92±2,65</td>
<td>118</td>
</tr>
<tr>
<td>VAD SINISTRO</td>
<td>3</td>
<td>55,67±11,78</td>
<td>2,33±1,78</td>
<td>7</td>
</tr>
<tr>
<td>Oxygenator</td>
<td>Total</td>
<td>Average Life</td>
<td>Oxy/ECMO change rate</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-------</td>
<td>----------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>Polimetilpentene</td>
<td>97</td>
<td>4.71 ±3.41</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Poliprolpilene</td>
<td>116</td>
<td>4.13 ±2.57</td>
<td>0.89</td>
<td></td>
</tr>
</tbody>
</table>
CONCLUSIONS

ECLS

TEAM

Patient, Tecnology, Timing, Flow, Management, Cannulation, Cost
Thank you..........