AEROMEDICAL TRANSPORT
OF THE CRITICALLY ILL
CARDIAC PATIENT

A CASE STUDY
PRESENTED BY: CORINNE DUPRAT R.N.

PATIENT HISTORY

- 37 YEAR OLD PRESENTS TO ER. WITH SOB, 1 BP, 4 SATS.

- PMHX:
  - ADMITTED TO HOSP. 4 HRS. AGO WITH DX. OF CARDIOMYOPATHY OF UNKNOWN ORIGIN
  - SMOKER
  - RECREATIONAL DRUG USE
  - OBESITY

ICCS ADMISSION:

- A/B:
  - INTUBATED
  - VENTED ON NITRIC OXIDE

- C:
  - SR
  - VASOPRESSIN
  - LEVOPHED
  - MILRINOINE
  - LVAD

- D:
  - PROPOFOL/FENTANYL INFUSION

- E:
  - COAGULOPATHY WITH H.C.T. LOSSES REQUIRING MULTIPLE BLOOD PRODUCT ADMINISTRATION & X2 RETURNS TO O.R. FOR EVACUATION OF CLOTS AND HEMOSTASIS
  - SHOCK LIVER
  - NORMAL KIDNEYS

THIS PATIENT NEEDS A TRANSPLANT, THERE IS A BED IN VANCOUVER

WHEN CAN YOU GO?
COMPONENTS OF THE INTERFACILITY AEROMEDICAL TRANSPORT

- PREPARATION:
  - STABILIZATION
  - ANTICIPATION & PREPARATION OF PATIENT, EQUIPMENT, AND SUPPLIES

- SELECTION OF TRANSPORT VEHICLE AND AEROMEDICAL PERSONNEL

- THE TRANSPORT

STABILIZATION

A:  
- #1 PRIORITY, ANY COMPROMISE MANDATES A DEFINITIVE AIRWAY PRIOR TO TRANSPORT
- ENSURE PROPER PLACEMENT AND SECUREMENT OF ETT

B:  
- PTS MUST BE ADEQUATELY OXYGENATED
- ANY RESPIRATORY EMERGENCIES MUST BE TREATED PRIOR TO TRANSPORT
  - PULMONARY EDEMA
  - HEMO/PNEUMOTHORAX

PREPARATION

HARD TO KNOW WHAT TO PREPARE FOR WHEN YOU DON'T KNOW WHERE YOU ARE GOING!

"The best flight is one where we're not going to die... We're all going to die...We'll just— Oh, say something—That's the telecom right?"

STABILIZATION

B:  
- ANY SPECIALIZED THERAPY MUST BE WEANED PRIOR TO TRANSPORT
  - NITRIC OXIDE
  - OSCILLATORS

C:  
- MIN. OF 2 LARGE BORE IV'S ON ALL SERIOUS PTS
- CENTRAL LINE PLACEMENT FOR ALL CRITICAL PTS
- HEMODYNAMICS MUST BE STABLE ON TREATMENT

D:  
- CONTROL PAIN
  - ANY INTUBATED PATIENT MUST BE SEDATED

E:  
- EVERYTHING ELSE
  - A SYSTEMATIC ASSESSMENT SHOULD BE UNDERTAKEN TO IDENTIFY ANY POTENTIAL PROBLEMS
  - NG/OG FOR ANY INTUBATED PATIENTS
  - FOLEY FOR ANY SERIOUS PTS ESP IF RECEIVING DIURETICS
  - REVIEW DIAGNOSTICS: XRAY, LAB RESULTS, EKG, ECHOS, ETC.

AVIATION PHYSIOLOGY

OBJECTIVES:

- UNDERSTAND THE LAYERS & COMPOSITION OF THE EACH LAYER OF THE ATMOSPHERE
- UNDERSTAND HOW THE GAS LAWS APPLY TO PT. CARE
- IDENTIFY OTHER STRESSES OF FLIGHT
**Earth's Atmospheric Layers**

- **Exosphere**: 275,000 ft
- **Ionosphere**: 100,000 ft
- **Stratosphere**: 35-50,000 ft
- **Troposphere**

**Composition of Standard Atmosphere**

<table>
<thead>
<tr>
<th>Gas</th>
<th>%</th>
<th>pp</th>
</tr>
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<tbody>
<tr>
<td>O2</td>
<td>21</td>
<td>160</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>78</td>
<td>593</td>
</tr>
<tr>
<td>Trace</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

**Aviation Physiology**

- **Gas Laws**:
  - Explain the relationship between temp, pressure, volume, and mass of gases

**Gas Laws**

- **Boyle's Law**
  - Volume of gas is inversely proportional to pressure, with temperature remaining constant.
  \[ p_1 v_1 = p_2 v_2 \]

**Gas Laws**

- **Dalton's Law**
  - Total pressure of a gaseous mixture is equal to the sum of the individual gases in that mixture.
  \[ p = p_1 + p_2 + p_3 + p_4 \text{ etc.} \]

**Altitude** vs **Barometric Pressure**

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Barometric Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Level</td>
<td>760</td>
</tr>
<tr>
<td>4000</td>
<td>593</td>
</tr>
<tr>
<td>6000</td>
<td>459</td>
</tr>
<tr>
<td>8000</td>
<td>384</td>
</tr>
<tr>
<td>10,000</td>
<td>313</td>
</tr>
<tr>
<td>12,000</td>
<td>249</td>
</tr>
<tr>
<td>14,000</td>
<td>191</td>
</tr>
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<td>22,000</td>
<td>84</td>
</tr>
<tr>
<td>24,000</td>
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<td>26,000</td>
<td>54</td>
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<tr>
<td>28,000</td>
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<tr>
<td>30,000</td>
<td>34</td>
</tr>
<tr>
<td>32,000</td>
<td>28</td>
</tr>
</tbody>
</table>
GAS LAWS

- Dalton's Law allows us to determine the partial pressure of O2 at various altitudes given the atmospheric pressure:
  - Barometric pp x gas concentration = gas partial pressure

PREPARATION

- Most important component of transport
- Must ensure that all potentials are looked at
- Tailor equipment, supplies to patient needs
  - Ie:
    - transport IABP
    - transport invasive monitoring
    - transport ventilator
    - STAT
    - transport LVAD(ECMO)
    - blood products

PREPARATION

- Take into account ground transport time to & from hospital along with length of flight when considering:
  - oxygen requirements
  - medications (IV infusions)
  - battery supply/power supply

- Take into account weather issues:
  - load in hangar
  - any potential for delays?

- Space issues

PREPARATION

- Ensure family updated and understanding procedure

- Ensure receiving facility updated on arrival times

- All pertinent charts, and diagnostics copied and ready to go with chart
SELECTION OF TRANSPORT VEHICLE AND CREW

- Best up to 200 km
- Vulnerable in poor weather
- Heliport advantage
- Speed/pressurization/space issues

Aerodynamic advantage: Priceless

SELECTION OF TRANSPORT VEHICLE

- Best for long distance >200 km
- May accommodate multiple patients

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**Selection of Transport Vehicle**

- Can maintain low cabin pressures at high altitude
- Very fast
- Generally can fly above bad weather
- Carry sophisticated avionics
- Necessitate the use of ground transport

**Choose Companies that Provide Complete Medical Interiors**

- Appropriate stretcher and equipment securement devices
- Multiple power outlets
- Suction heads
- Proper stretcher loading systems

**Selection of Aeromedical Crew**

- Experienced and knowledgeable staff
- Should have air safety training
- Must understand air medical considerations
- Aeromedically trained pilot crews

**Monitor and Support the Patient**

- Goal is to avoid procedures or interventions
- Coordinated and well organized
- Good communication is key
THE TRANSPORT

- Patient packaged at SBGH @ 1015 and loaded into WPG ambulance with MD, FN, and perfusionist.
- 30°C outside so decision made to load pt. in hangar.
- Pt settled and stable, ready for flight!!
- Departed @ 1140 CST

THE TRANSPORT

- In flight:
  - O2 Sats >92% with 100% FiO2.
  - Pt, remained hemodynamically stable requiring minor titration of levophed during ascent and lvad management.
  - C.t losses remained 50-60 ml/hr and patent with no manual stripping necessary.
  - Urine output>70 ml/hr.
  - Pt remained sedated with rass -3 on propofol and fentanyl infusion.

THE TRANSPORT

- Arrived YVR @ 1435 CST.
- Yvr ambulance not updated properly so waited on ramp for 30 min.
- Finally loaded on ambulance, off to hosp.
- Transfer of care completed at 1645 with patient in stable condition!!

Time to go home!!