

에크모 적용의 실제

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What is ECMO??

- ▶ ExtraCorporeal Membrane Oxygenation
- ▶ ExtraCorporeal Life Support (ECLS)
- ▶ Use of extracorporeal circulation to support heart and/or lung function
- ▶ Except extracorporeal circulation with venous reservoir for cardiac surgery

ECMO의 적응증 별 종류

- ▶ Cardiac arrest: Extracorporeal CPR
- ▶ Cardiogenic shock: VA ECMO
- ▶ Respiratory failure: VV ECMO
- ▶ Combined heart and lung failure: VVA ECMO
- ▶ Severe CO₂ retention: ExtraCorporeal CO₂ Removal (ECCO₂R)
- ▶ Organ donation: VA ECMO for DCD, Organ Care System
- ▶ Ventricular support with/without lung support: extracorporeal Ventricular Assist Device

ECPR

Case

- ▶ 72세 남성
- ▶ 내원 3일전부터 cough, dyspnea
- ▶ Local 병원 입원치료 중
- ▶ 증상 악화, cardiac enzyme 상승
- ▶ Echo EF 20%
- ▶ NSTEMI 의심 하에 SMC 응급실 전원
- ▶ CCU전동 대기 중 bradycardia, pulse 소실
- ▶ CPR

Non Cardiac cause Cardiac Arrest in Cancer patients?

- ▶ Circulatory collapse or shock → cardiac arrest (heart stops beating)
- ▶ Direct causes of cardiac arrest
 - ▶ Pure cardiac etiologies: ischemic, nonischemic
 - ▶ Secondary cardiac
 - ▶ Thrombotic process, stress & spasm (ischemic)
 - ▶ Immunocompromise, stress, Apical ballooning syndrome, lung failure, brain failure (non-ischemic)

■ 기본정보

시술일 : 2019-03-15

시술의 : 조양현, 김영수, 김신, 김명환, 이주형

삽입장소 : ER

응급도 : On CPR

■ 진단명

r/o AMI

■ 시술명

ECMO insertion

■ 시술경위 (Brief history)

시술사유 : ECPR or Post CPR hemodynamic instability

시술목적 : Bridge to recovery

■ 시술중 발견사항

Lt.femoral vein guide wire 진입이 되지 않아 3차례 시도 후 Rt.femoral vein으로 insertion 시행함

■ 시술과정

ECMO support mode : VA

Pump : SP Pump (Terumo)

Oxygenator : EBS Long-term

	Size	Type	Insertion site	Insertion technique	Cannula tip 위치
Drain 1	21Fr.	기타	Rt.Femoral	Seldinger	IVC
Perfusion 1	15Fr.	기타	Rt.Femoral	Seldinger	

Distal perfusion : No (Dorsalis pedis artery pulse check)

ECPR, Essentials

- ▶ Indications: high probability of primary cardiac and favorable neurologic outcome
 - ▶ Witnessed arrest, bystander CPR
 - ▶ Shockable rhythm (bit RCA occlusion), Echo, EKG, symptom, past history
- ▶ Contraindications
 - ▶ Asystole, no ROSC for prolonged time (>30min), airway cause
- ▶ Cannulation
 - ▶ Use ROSC! Feel pulse! Use vascular sono and Echo! See color of blood!
 - ▶ Small cannulae (15 for A, 19~21 for V)
 - ▶ Never stop CPR until proper cannulation is confirmed.
 - ▶ Heparin after vessel puncture
- ▶ 모든 invasive line을 잡을 때 ECMO cannulation을 하는 기분으로!



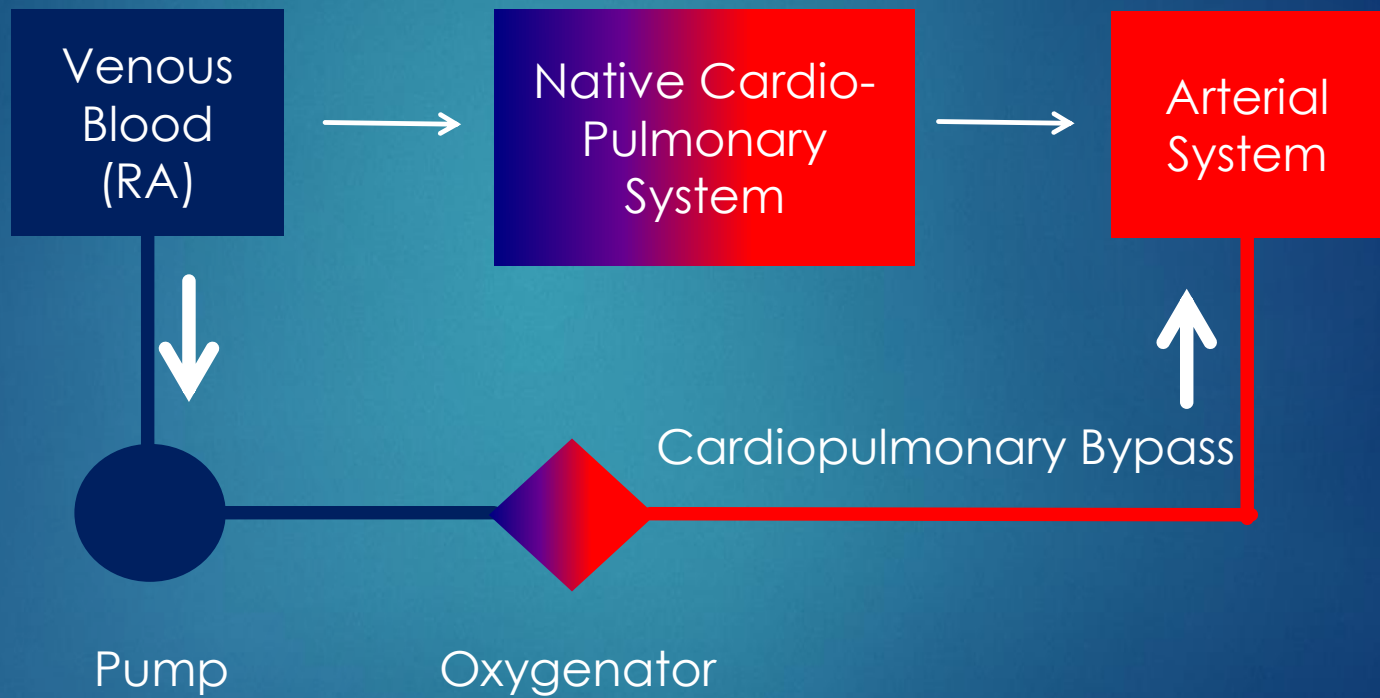
VA ECMO

ACUTE CARDIAC FAILURE

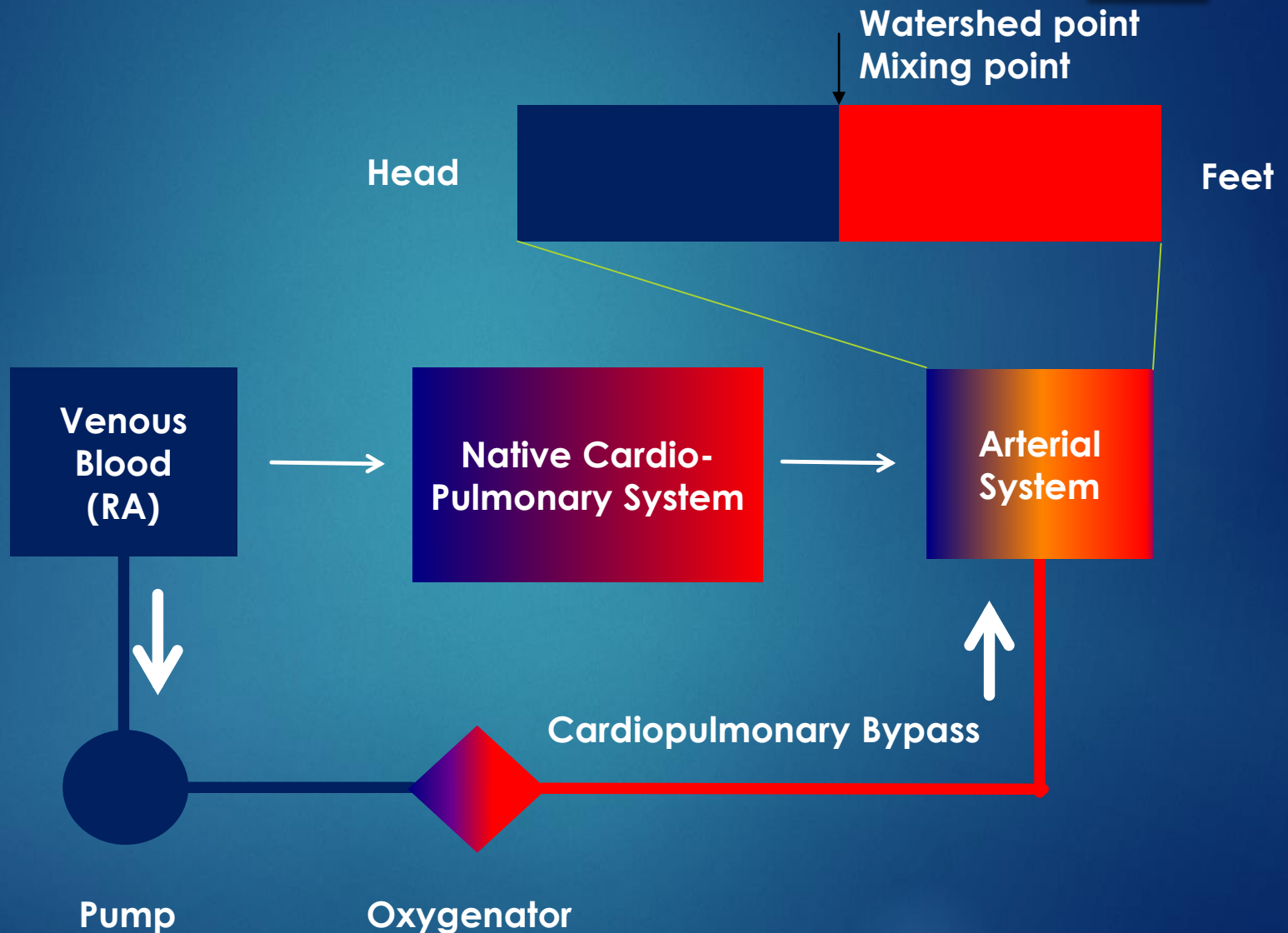
Case

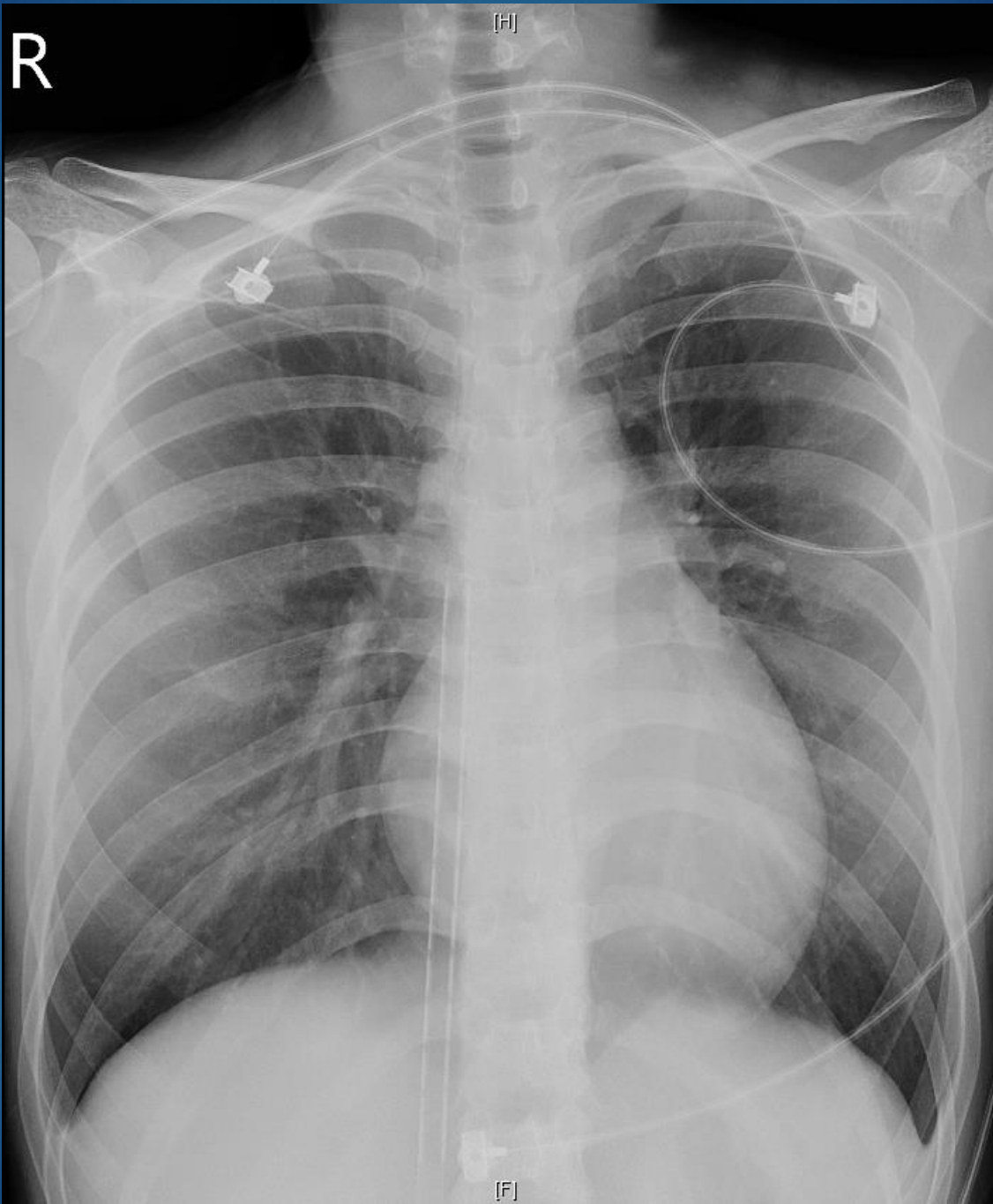
- ▶ 22세 여대생
- ▶ Chest pain and chest discomfort for 3 days
- ▶ Local clinic for nausea, vomiting, headache
- ▶ After local medication, vomiting 지속, SMC ER 방문
- ▶ Hypotension, ST change, Coronary CT (normal)
- ▶ Complete AV block, Ventricular rhythm

VA ECMO



Harlequin syndrome

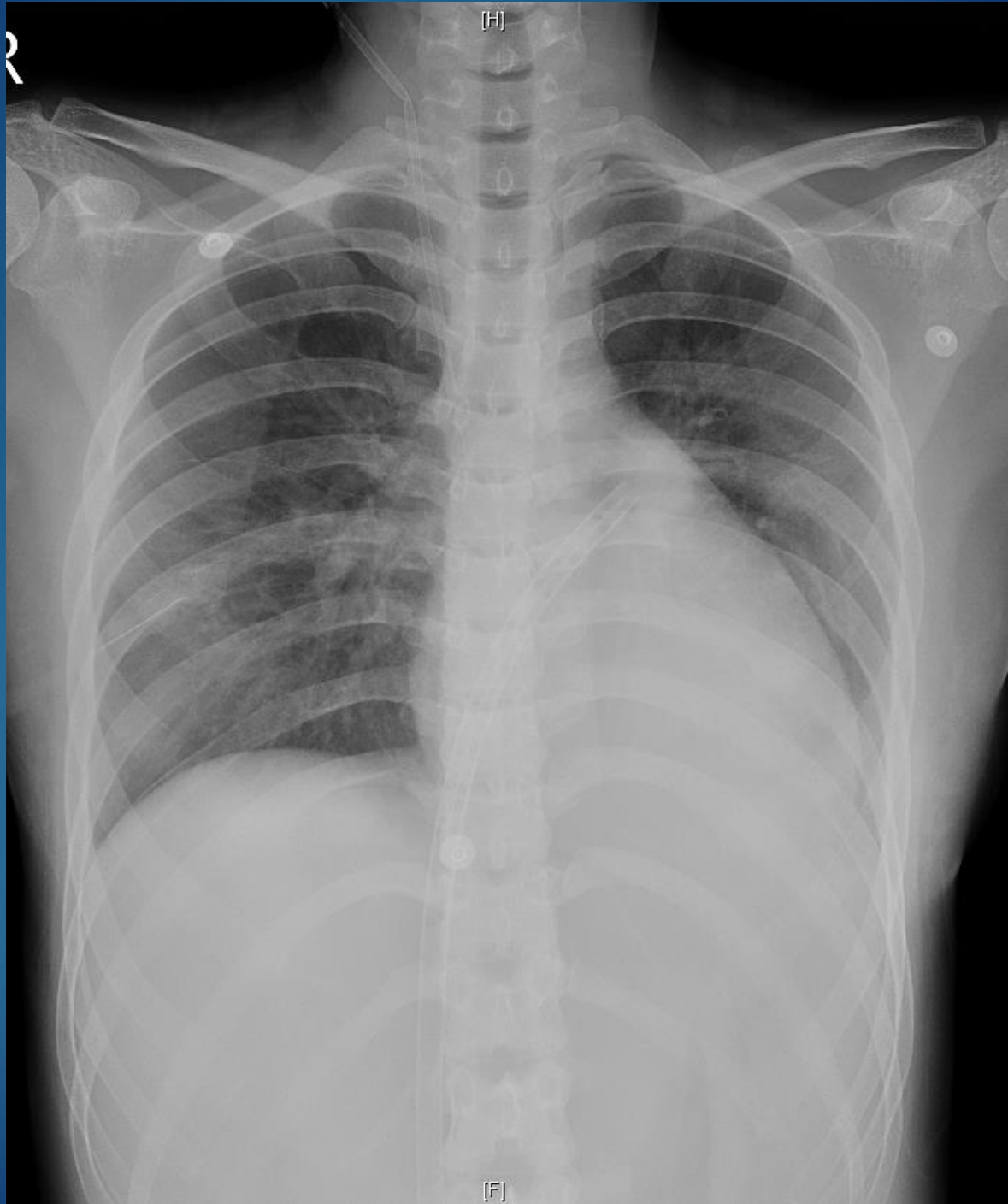




Complications of VA ECMO

- ▶ Limb ischemia
 - ▶ Irreversible change after 6 hours
 - ▶ Diagnosis?
 - ▶ Prevention & Management?
- ▶ LV distension and lung failure
 - ▶ Too sick LV
 - ▶ Diagnosis?
 - ▶ Prevention & Management?
- ▶ Upper body hypoxia (Harlequin syndrome)





VA ECMO, Essentials

- ▶ Cardiac arrest를 피해라. 불안하면 넣어버리거나 삽입할 준비를 해 둔다 (A, V sheath 삽입).
- ▶ 역시 삽입하기 어려운 큰 cannula는 꼭 필요치 않다.
- ▶ 일단 삽입한 후에는 합병증에 대비하라.
 - ▶ 예방, 진단, 치료
- ▶ Organ perfusion을 모니터 한다.
 - ▶ Mentality, skin, urine output
 - ▶ SVO₂, Lactate clearance
 - ▶ MAP

VV ECMO

Male 10 years old



■ 현병력

상기 10세 남아, 이전 병력없는 환자로

2013.07.18 아파트 단지내에서 승용차에 치인후 바닥에 쓰러진뒤 승용차가 밟고 지나가며 생긴 TA 로 고대 안산병원 응급실 내원함. 내원후 기도삽관중에도 hemoptysis 다량 보임. 이후 TS 에서 bilateral closed thoracostomy 및 ventilator care 시행함.

이후 ventilator care 하며 weaning try 하였으나 FiO2 0.6 에서 SaO2 70% 대로 유지되지 않음

2013.07.29 V-V ECMO apply (Rt.jugular vein: 14fr, Rt.femoral vein: 15fr, Lt. femoral vein, 14fr), ecmo flow 3liter 유지함

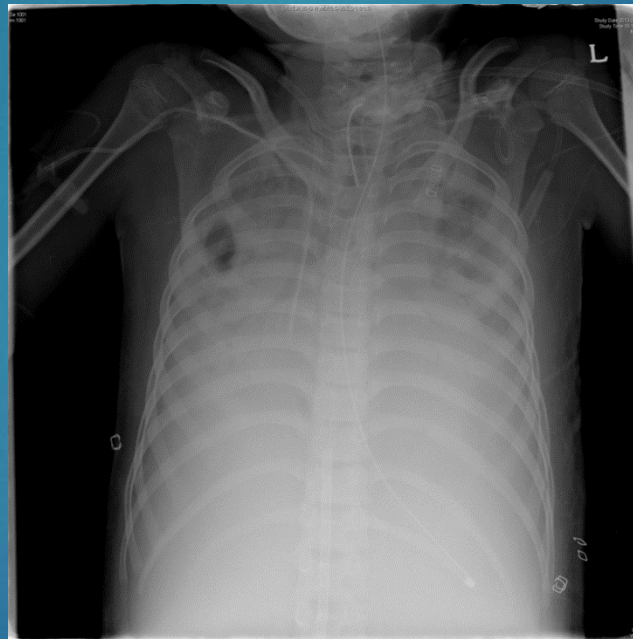
2013.07.30 thoracoscopic Lt.lung repair

2013.08.01 thoracoscopic Lt.lung bleeding control 시행함

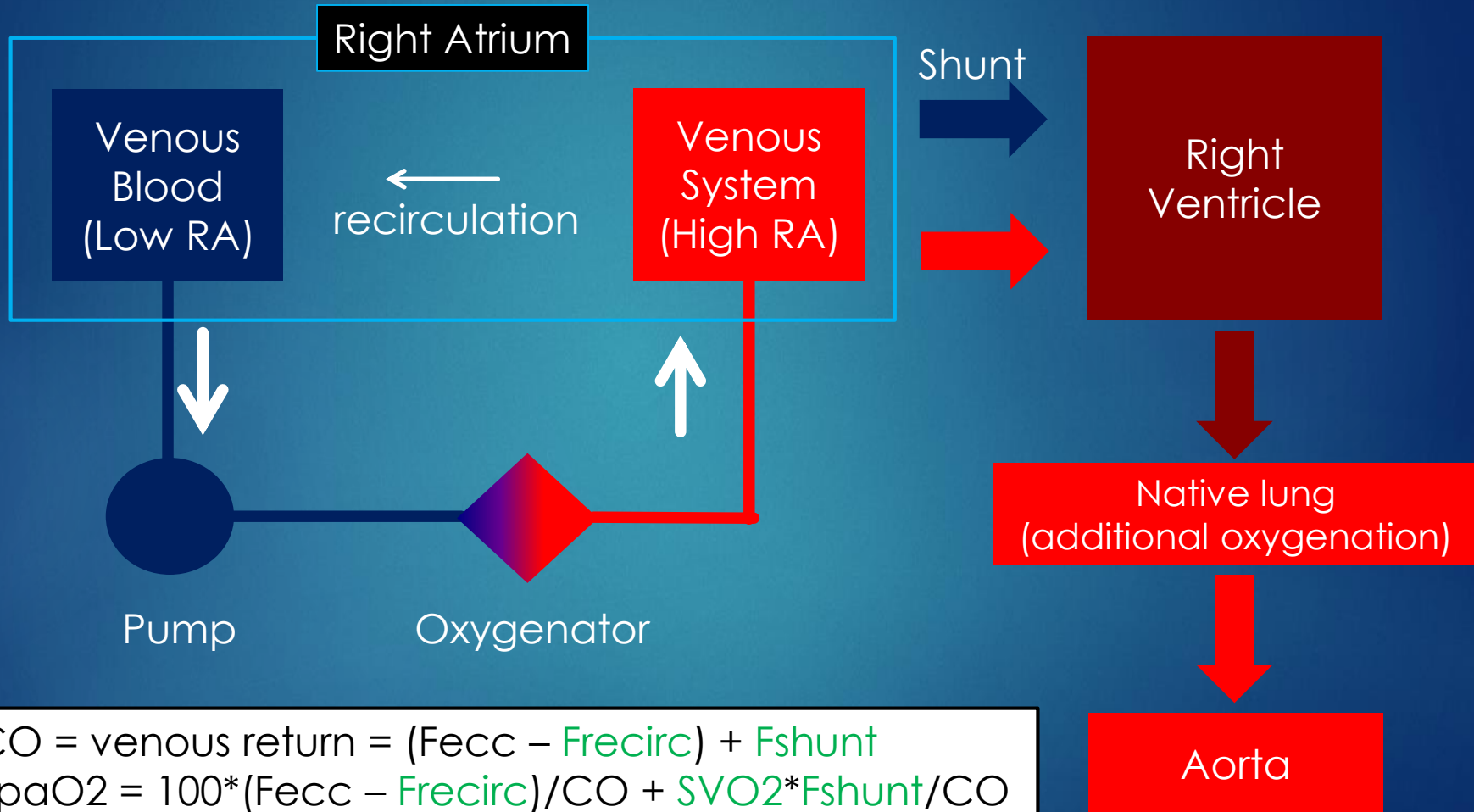
2013.08.05 환자 ECMO 시행 8일째 further management 위해 본원 전원음



About a week later...



VV ECMO



$$CO = \text{venous return} = (F_{\text{ecc}} - F_{\text{recirc}}) + F_{\text{shunt}}$$

$$SpaO_2 = 100 * (F_{\text{ecc}} - F_{\text{recirc}}) / CO + SVO_2 * F_{\text{shunt}} / CO$$

$$SaO_2 = SpaO_2 * (\text{native lung function})$$

Determinants of Oxygenation During VV ECMO

- ▶ **Extracorporeal flow fraction**
 - ▶ Fraction of cardiac output captured by circuit
 - ▶ Shunt
- ▶ **Mixed venous oxygen saturation**
 - ▶ Oxygen extraction
 - ▶ Hemoglobin
 - ▶ Cardiac output
- ▶ **Native lung function: Ventilator setting**
- ▶ Cardiac output > 60% associated with Sao₂ > 90% (Schmidt M, et al. Intensive Care Med. 2013;39:838-846.)



SJ Post ECMO #32



SJ HD #65

2014.04.05

■ 주관적 소견

doing well

달리기 포함한 운동 잘함.

URI hx : 2/month (1일만에 호전)

Summary

- ▶ ECMO의 정의, 의미, 구분
 - ▶ 산소 공급장치
- ▶ ECPR
 - ▶ Selection criteria
- ▶ VA ECMO
 - ▶ Timing of insertion
 - ▶ Complication management
- ▶ VV ECMO
 - ▶ Determinants of SaO₂
 - ▶ Lung protection!