

# 운동시 호흡곤란을 주소로 내원한 58세 여자 환자

**MD. Joo Han Song**

Division of Pulmonology,  
Department of Internal Medicine,  
Institute of Chest diseases,  
Severance Hospital,  
Yonsei University of College of Medicine,  
Seoul, Republic of Korea



## 현병력

- 내원 1개월전부터 오르막길을 오르거나 등산을 할 때 발생하는 호흡곤란과 간간히 발생하는 흉통을 주소로 타병원 진료 중 본원 심혈관외과 진료 의뢰 되어 시행한 검사상 폐동맥 고혈압을 동반한 2형 심방중격 결손증, 승모판 및 삼첨판 폐쇄부전증을 진단 받았다. 이후 심방중격 결손부위 폐쇄술, 삼첨판 재건, 폐혈관성형술 시행 하였으나 수술 6일 후 폐렴 동반되어 호흡기내과 협진 의뢰되었다.



## 과거력

- 고혈압: (-)
- 당뇨병: (-)
- 폐결핵: (-)
- 흡연력: (-)
- 음주력: (-)
- 뇌혈관 질환: (-)
- 고콜레스테롤혈증: (-)



## 전신소견

- **고열** : (+)
- 오한 : (-) 인공호흡기 치료 중으로 진정 수면 상태
- 두통 : (-)
- 인후통 : (-)
- 기침 : (-)
- **객담** : (+) 양이 많고, 분홍빛, 흐린 갈색
- 빈호흡 : (-)
- 흉통 : (+) 수술후 상태
- 오심/구토 : (-/-)
- 복통 : (-)
- 설사 : (-)
- 혈변/흑색변 : (-/-)



# 이학적 소견 (1)

- General appearance
  - Acute ill appearance
  - Sedated state: RASS -3
- Skin
  - Cold
  - No skin rash
  - Decreased skin turgor
- HEENT
  - No stiffness
  - Not palpable cervical lymph nodes
  - Not engorged neck veins
- Chest/Lung
  - Symmetric expansion
  - No chest retraction
  - Coarse breathing sound with crackles on whole lung field
  - No wheezing



## 이학적 소견 (2)

- Heart
  - Irregular heart beat without murmurs
  - No thrill and heaving
- Abdomen
  - Normoactive bowel sound
  - No abdominal tenderness
- Back and Extremity
  - No LOM
  - No CVA tenderness
  - No pitting edema



## 이학적 소견 (3)

- BP : 100~118/50~58mmHg
- Pulse Rate: 100~110 /min (Atrial fibrillation) – Digitalization
- NO inhalation
- Inotropics
  - Milrinone : 0.5mcg/kg/min
  - Norepinephrine : 0.2mcg/kg/min
  - Vasopressin : 1.2 unit/hour
  - Epinephrine : 0.05mcg/kg/min
- Sedation (Rass -2~-3)
  - Midazolam : 4 cc/hour
  - Remifentanyl : 2 cc/hour
  - Cisartcuronium : 5 cc/hour
  - Ketamine : 5 cc/hour

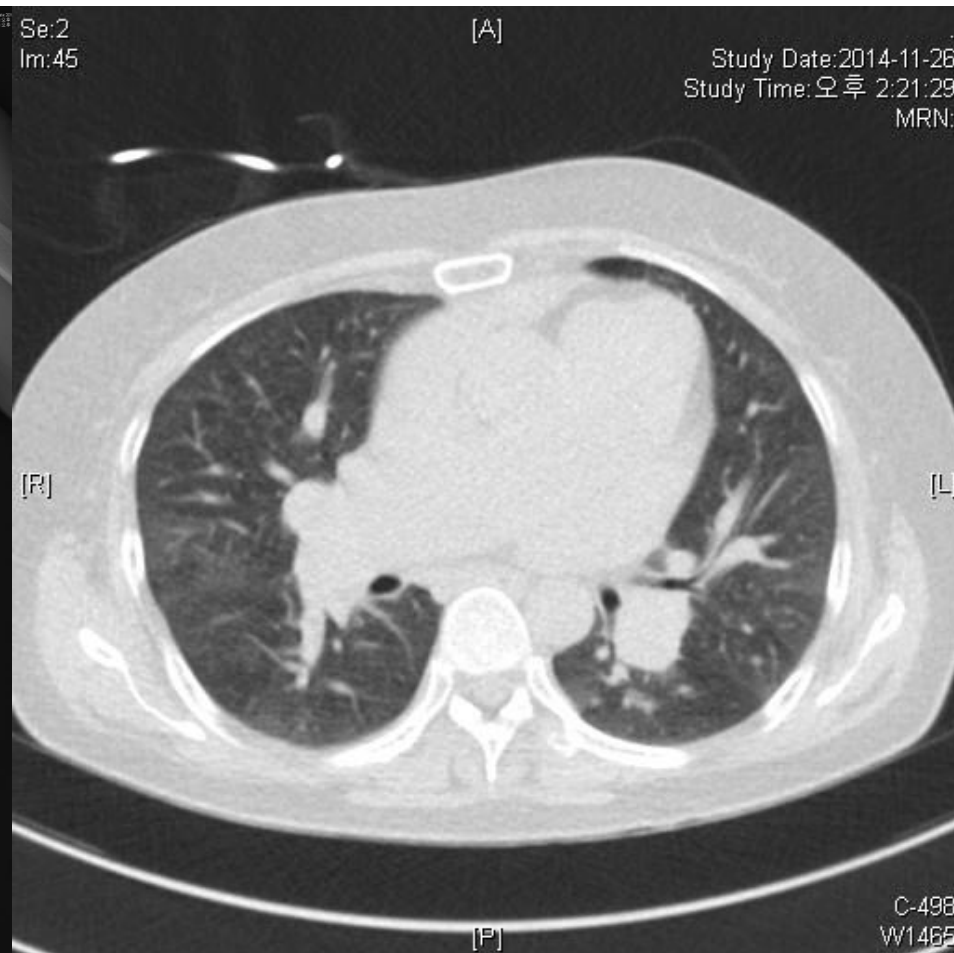


## 추정진단

- R/O Post OP bacterial pneumonia
- 
- R/O Pulmonary edema maybe d/t pulmonary hypertension
- R/O Post OP ARDS
- Atrial Septal Defect (second degree)
- Pulmonary HTN
- Atrial fibrillation



# 검사 결과 (1)- 수술전 chest X-ray and chest CT



2014-12-01 폐기능 검사 결과

FVC: 2590ml(98%)

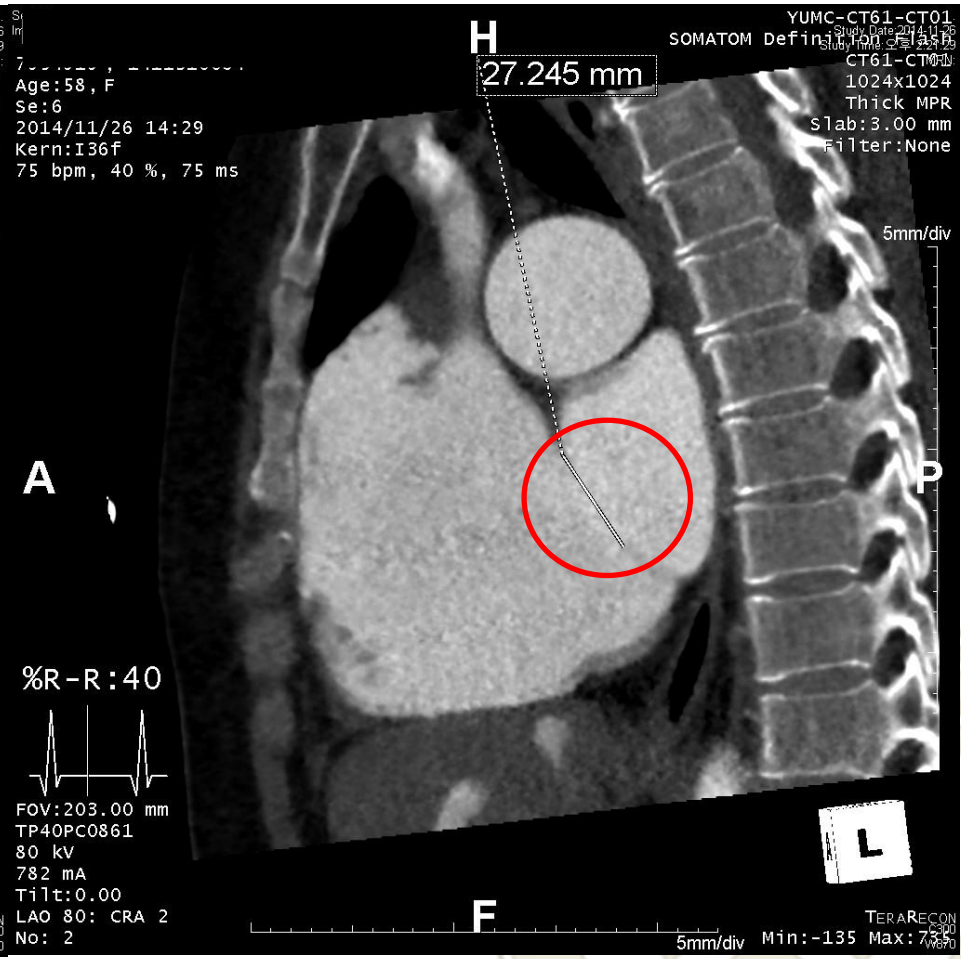
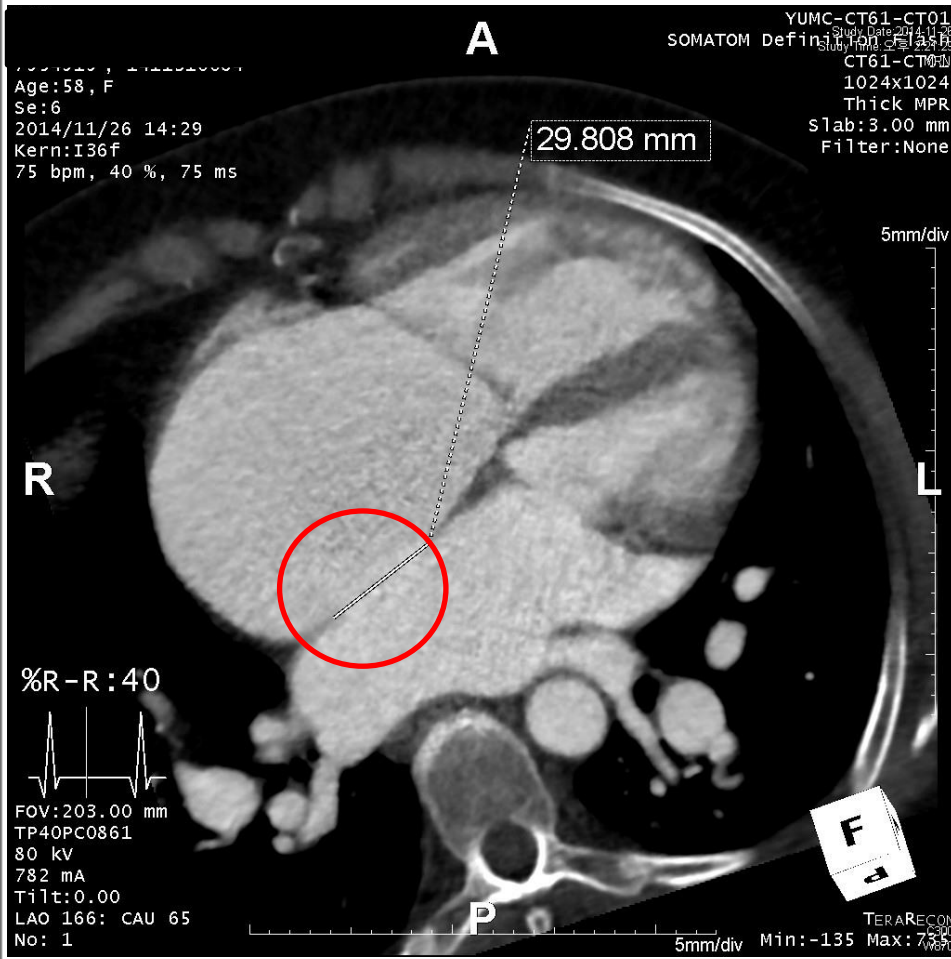
FEV1: 1760ml(90%)

Ratio: 68%

DLCO 15ml/mmHg/min

DLCO/VA 4.15ml/mHg/min/L

# 검사 결과 (2) - 수술전 Heart CT



# Heart CT

- 2014-11-26
- Large ASD secundum.
- Rt. cardiac chamber enlargement and bilateral main PA dilatation.
- Tricuspid regurgitation due to incomplete coaptation from TV annular dilatation (TV annulus; 48mm (4ch), 42.3mm (long axis), avg 44.6mm (47.5 x 21.8mm))
- LA enlargement with suspicious circulatory stasis in the LA appendage.
- RA appendage are located close to the sternum.
- Lt aortic arch with aberrant Rt. subclavian artery.
- Mosaic attenuation in both lungs.
- Coronary artery: no significant plaque or stenosis. no coronary compression.

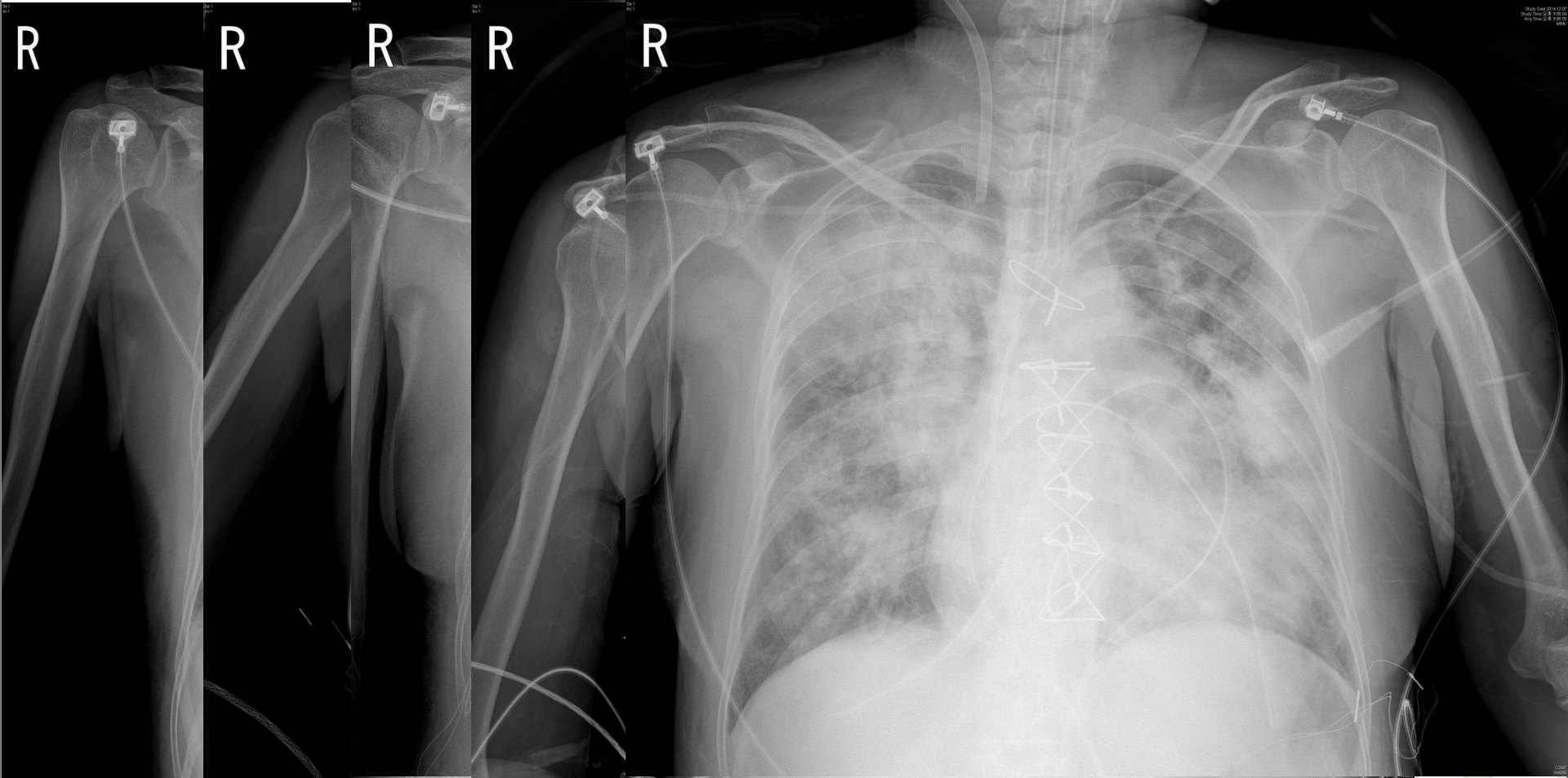


# 경과 수술 후 1일



# 경과

## 수술 후 2일 ~ 호흡기내과 협진



# 경과

## 호흡기내과 협진 당시 검사 결과

- Ventilator care
  - Mode : PRVC
  - FiO<sub>2</sub> : 0.7
  - Tidal volume : 380 ml (6~7ml/kg)
  - PEEP : 10 cmH<sub>2</sub>O
  - Respiration rate : 22 /min
  - PIP : 32 cmH<sub>2</sub>O
- ABGA : 7.454- 32.9mmHg- 64mmHg -23.3 mmol/L- 92.2%
- Lactate : 1.7 mmol/L (0.5~1.6)
- CBC : 10,350/uL- 8.2g/dL- 24.3%- 69,000/uL
- BUN/Cr. : 41.7mg/dL/0.73mg/dL
- AST/ALT/T.Bilirubin: 19IU/L/7IU/L/4.9mg/dL
- Na/K/Cl : 146 mmol/L/4.6mmol/L/112 mmol/L
- I.phosphorus/Calcium/Total protein/Albumin:  
: 2.0mg/dL/8.2 mg/dL/4.9g/dL/3.1g/dL
- Procalcitonin : 3.41 ng/mL (0~0.5)
- CRP : 180.5 mg/L (0~8)



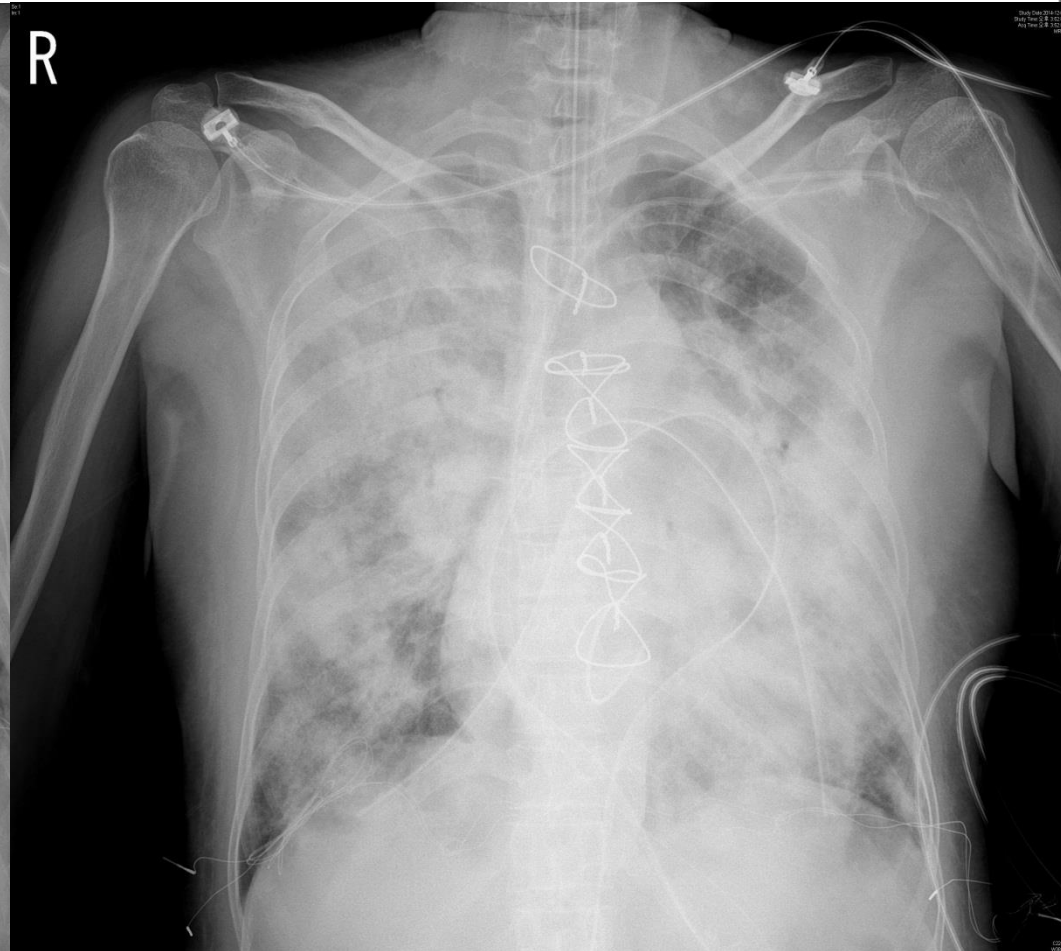
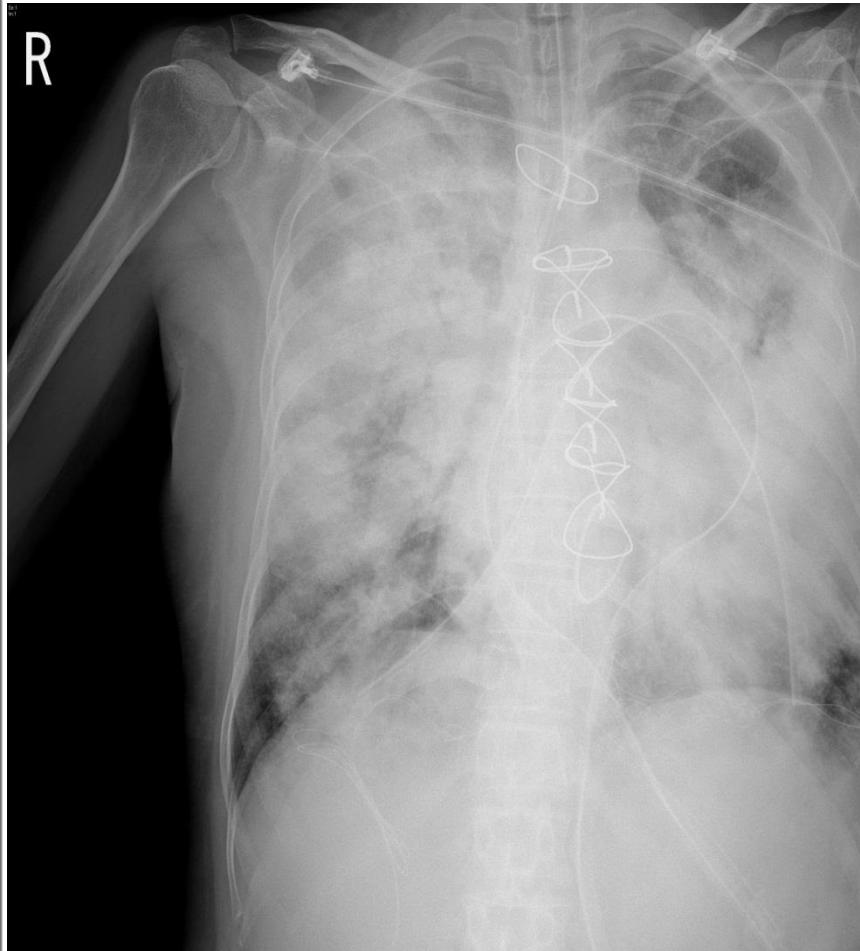
# 경과 BAL

- Bronchoscopic finding
  - Vocal cord : normal
  - Trachea : normal
  - Main carina : normal
  - Right bronchus : erythematous mucosal change  
But no active bleeding focus & prulent pinkish ~ brownish secretion
  - Left bronchus : erythematous mucosal change  
But no active bleeding focus & prulent pinkish ~ brownish secretion
  - RUL, LLL 에서 Bronchial washing 시행 후 특별한 합병증 없이 검사 종료함.
- Bronchoscopic diagnosis
  - Pulmonary edema
  - Bacteroyal pneumonia, less likely



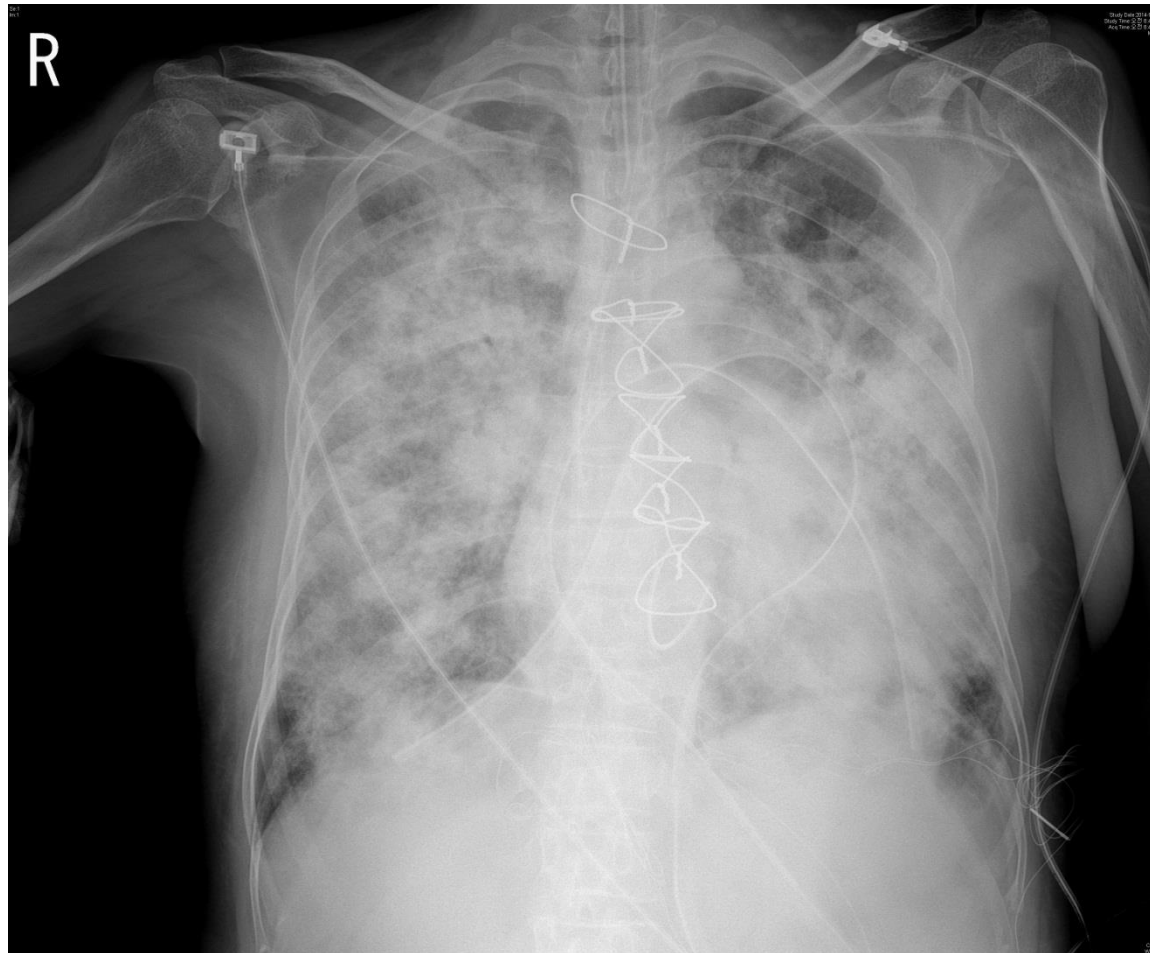
# 경과

## BAL 이후 ~ Cardiac catheterization 이전



# 경과

## 수술 후 6일째 Septosomy 시행



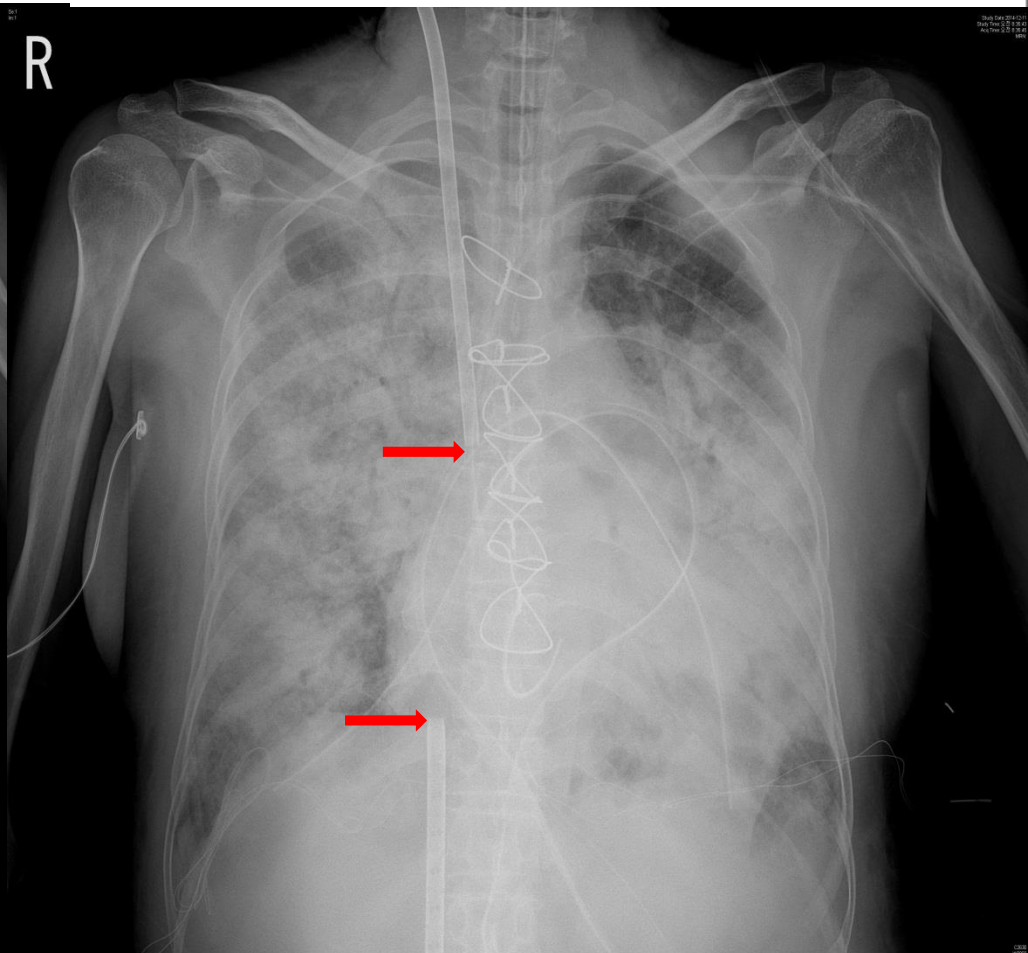
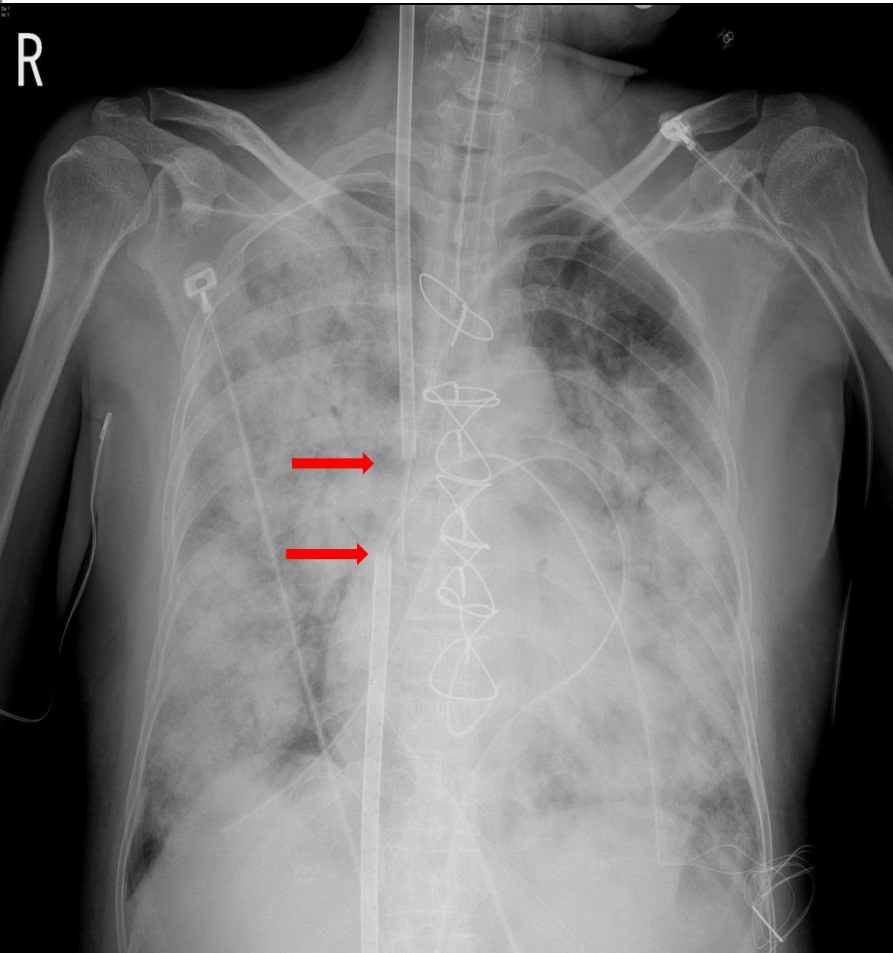
# 검사 결과

## 수술 후 폐렴 발생 ~ Septostomy 시행

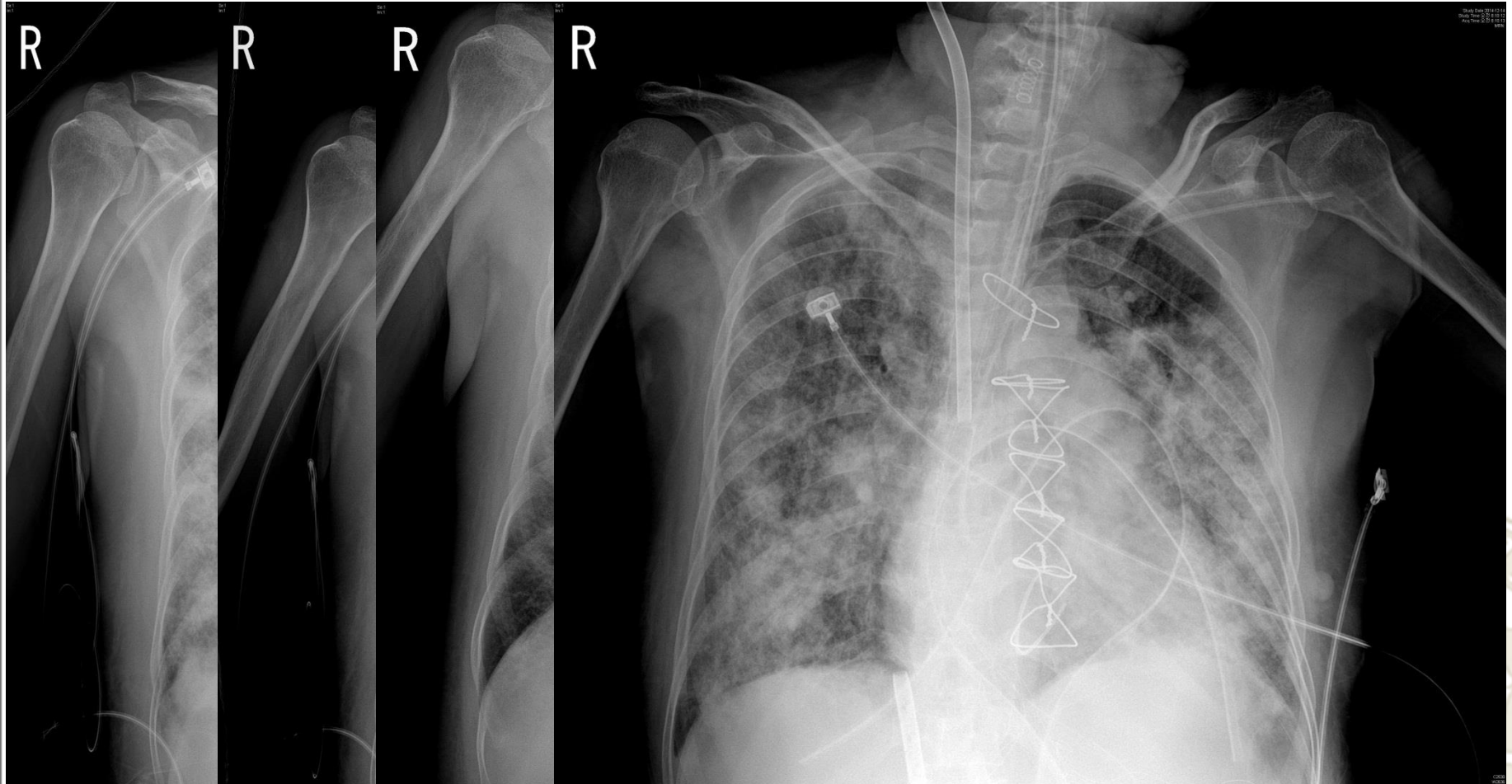
- Sputum culture : No growth (Group 6)
- BAL culture : <1,000 CFU/ml bacteria and fungi
- Echocardiography (TTE)
  - Atrial fibrillation
  - MR (trivial or grade I)
  - No TR
  - Balanced both ventricle
  - Mild RVH
  - RV ant. Wall thickening, 15mm
  - No CoA, Normal PVR
  - No pericardial effusion
  - EF 74%



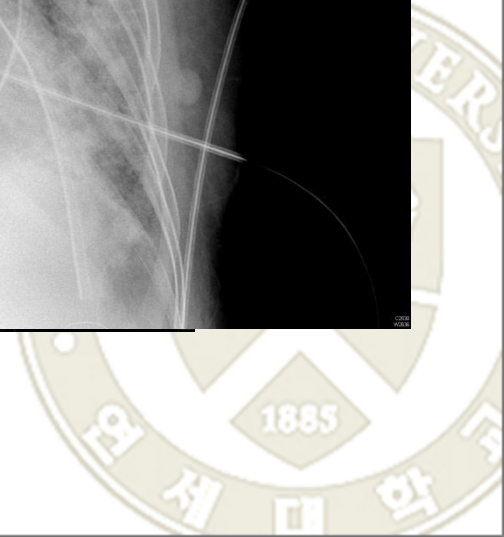
# 경과 ECMO insertion



# 경과 ECMO with Prone position

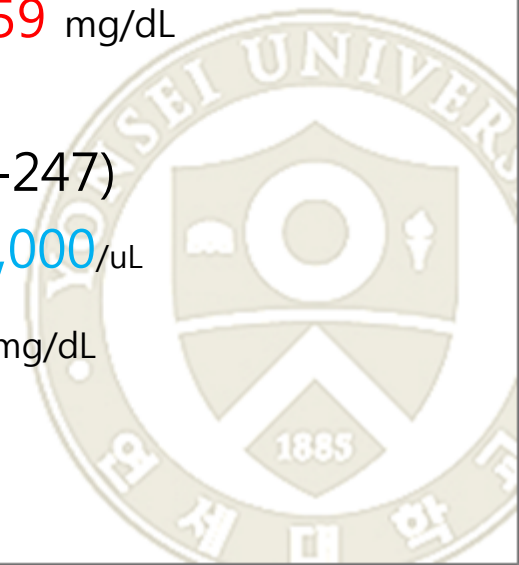


Prone position 12시간씩 4일 적용

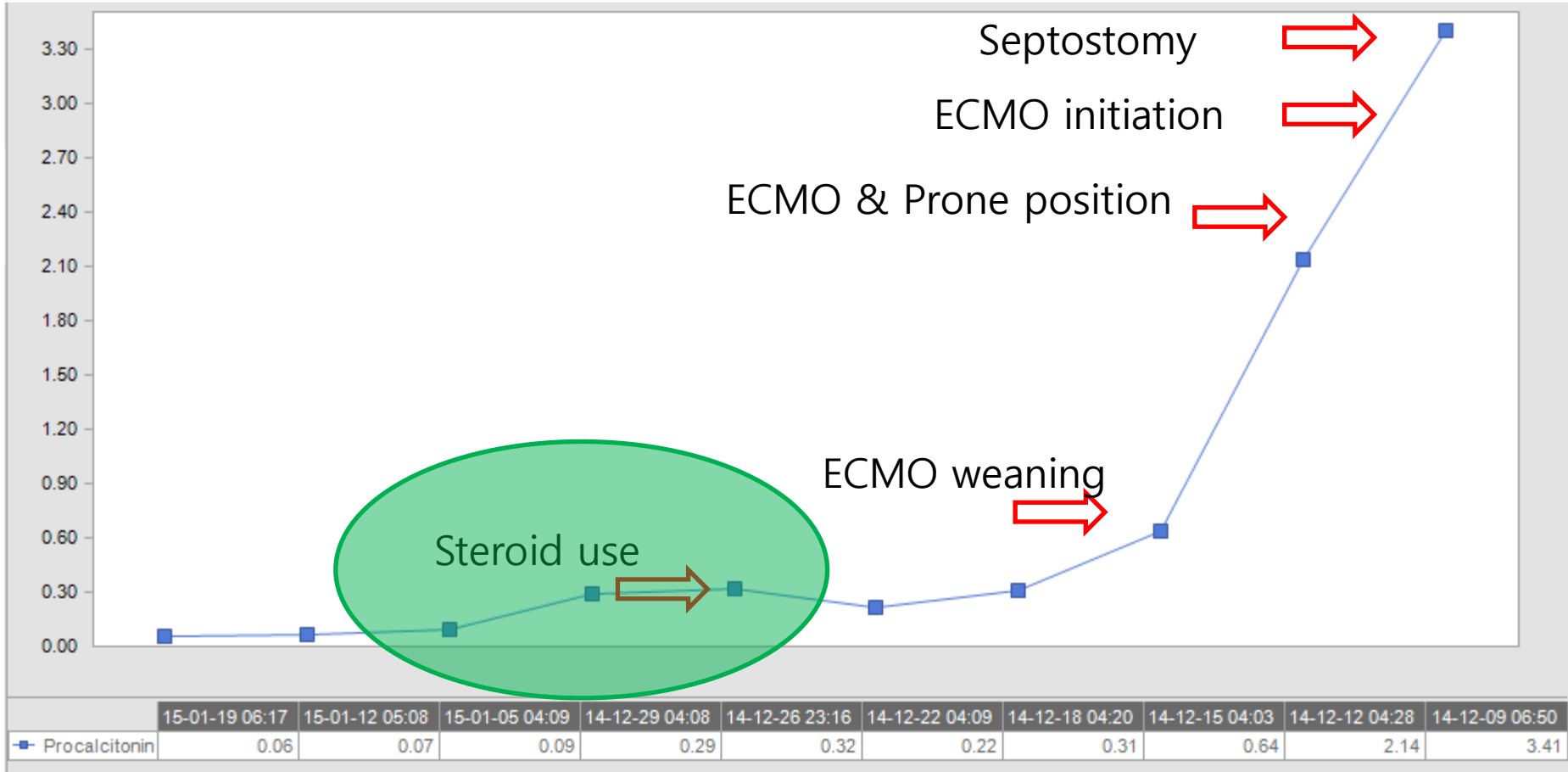


## VV ECMO 운용

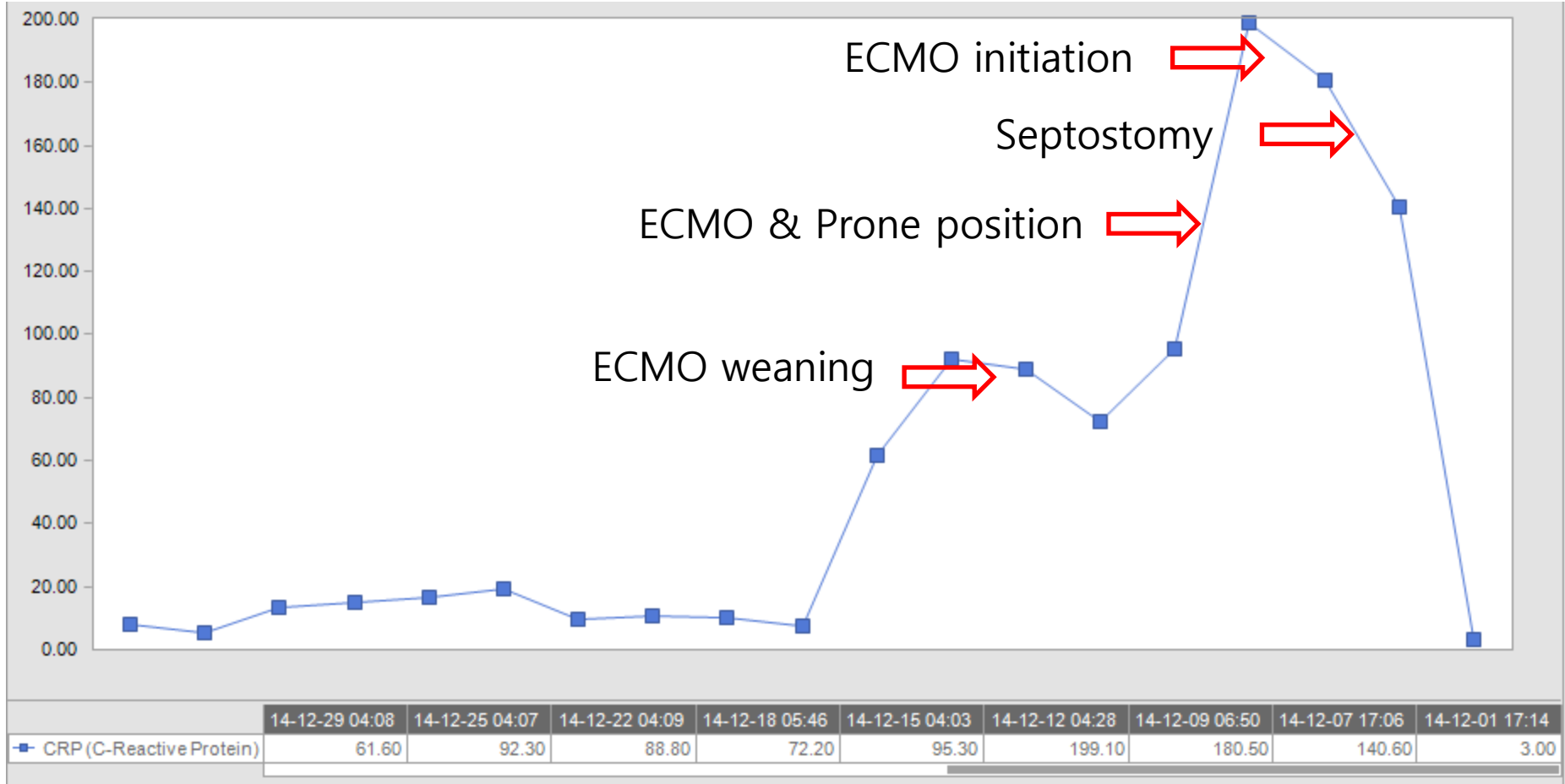
- Blood Flow : 3.5~4L/min (46.5kg)
- RPM : 3275
- Sweep Gas Flow : 3L → 2L → 1.5L
- Membrane Pressure Gradient: <30 mmHg
- ACT: Target 160~180
  
- D-dimer: 3315 ng/ml → 5760 ng/ml → 7998 ng/ml → 9137 ng/ml
- Fibrinogen: 617 mg/dL → 426 mg/dL → 390 mg/dL → 359 mg/dL
- Antithrombin III: 53% → 56% → 72%
- LDH: 373 IU/L → 292 IU/L → 375 IU/L → 436 IU/L (119-247)
- Platelet: 99,000/uL → 96,000/uL → 114,000/uL → 110,000/uL
- T.Bilirubin: 2.6 mg/dL → 2.7 mg/dL → 2.2 mg/dL → 2.1 mg/dL



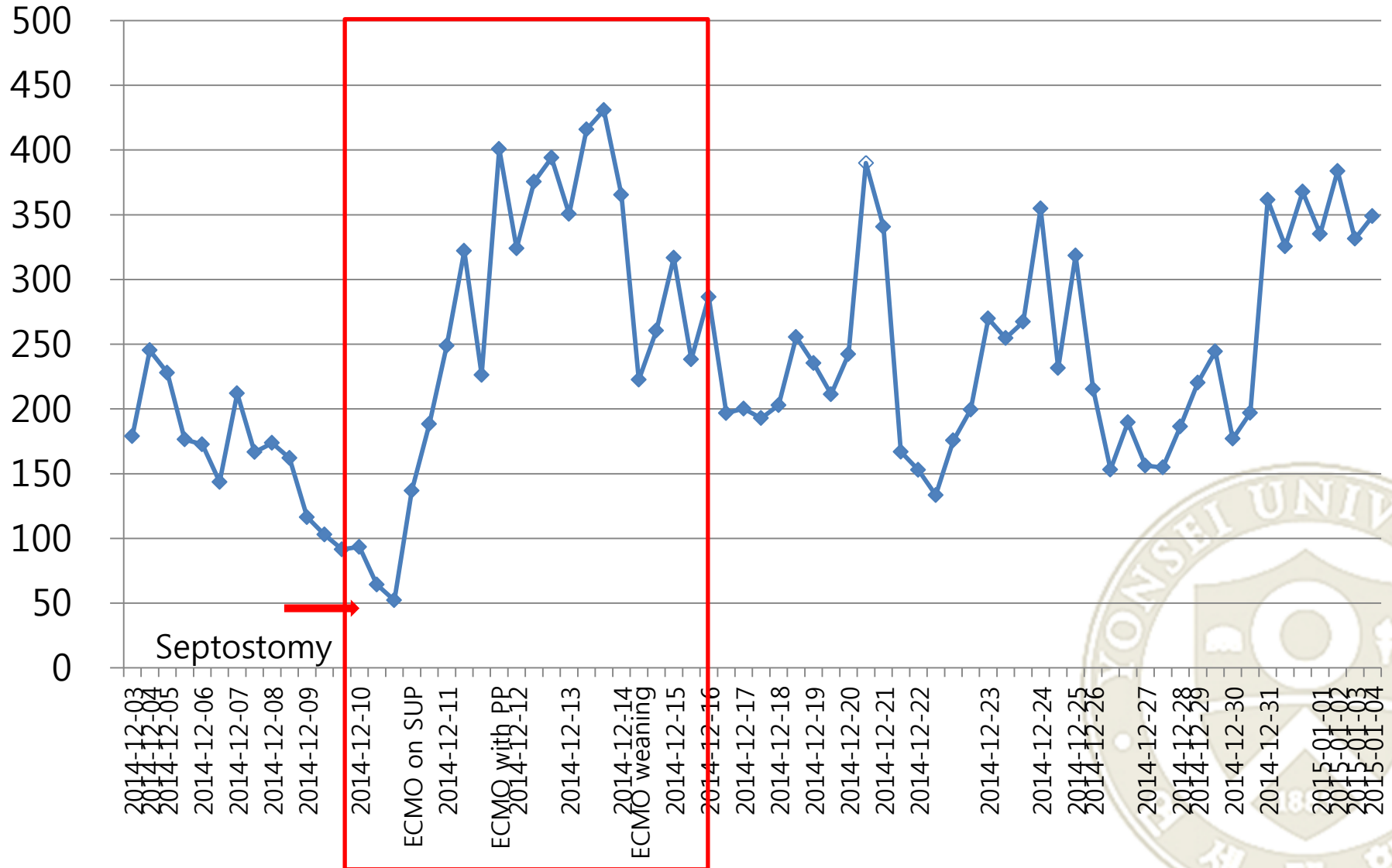
# Procalcitonin



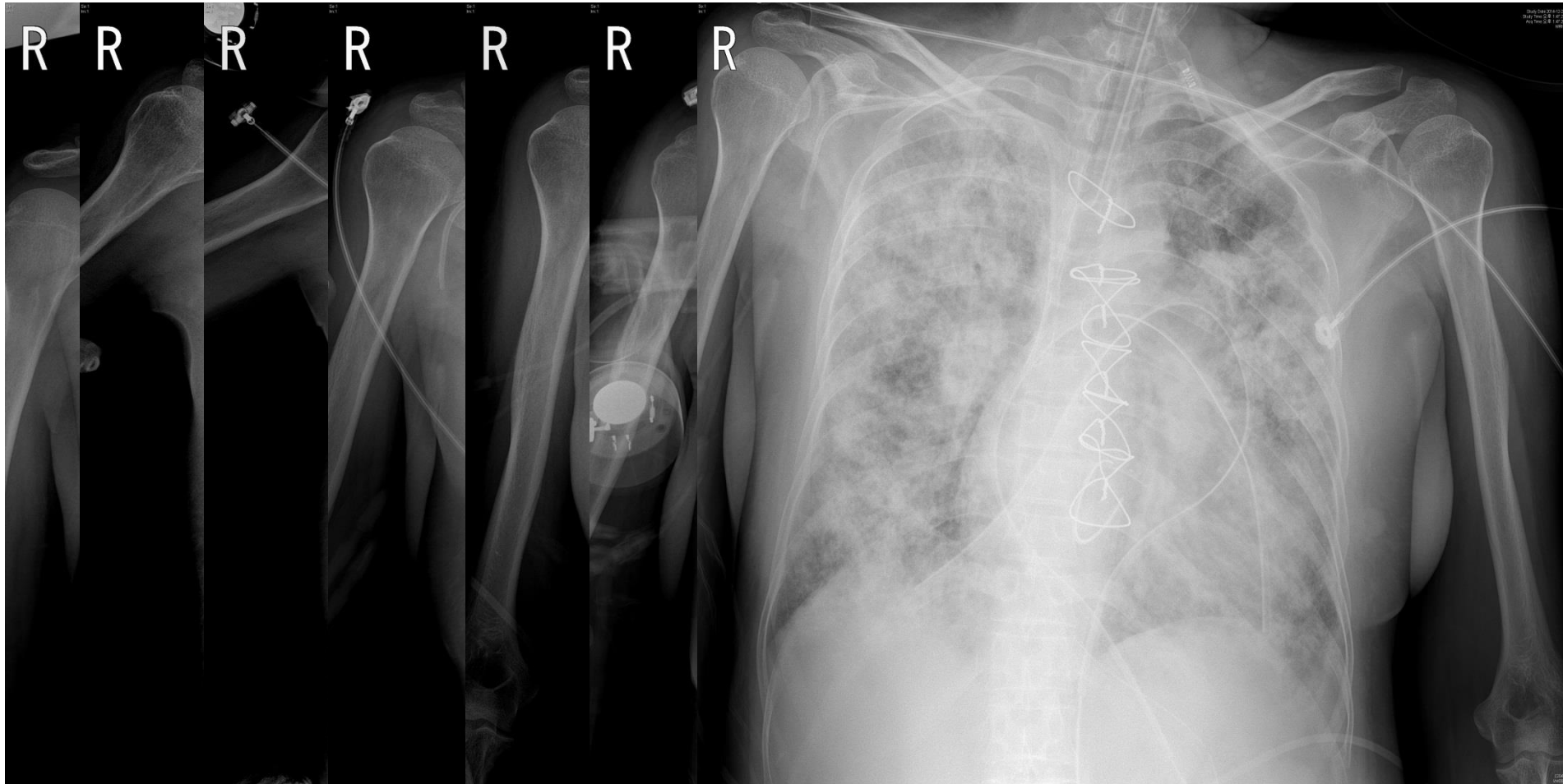
# CRP



# P/F

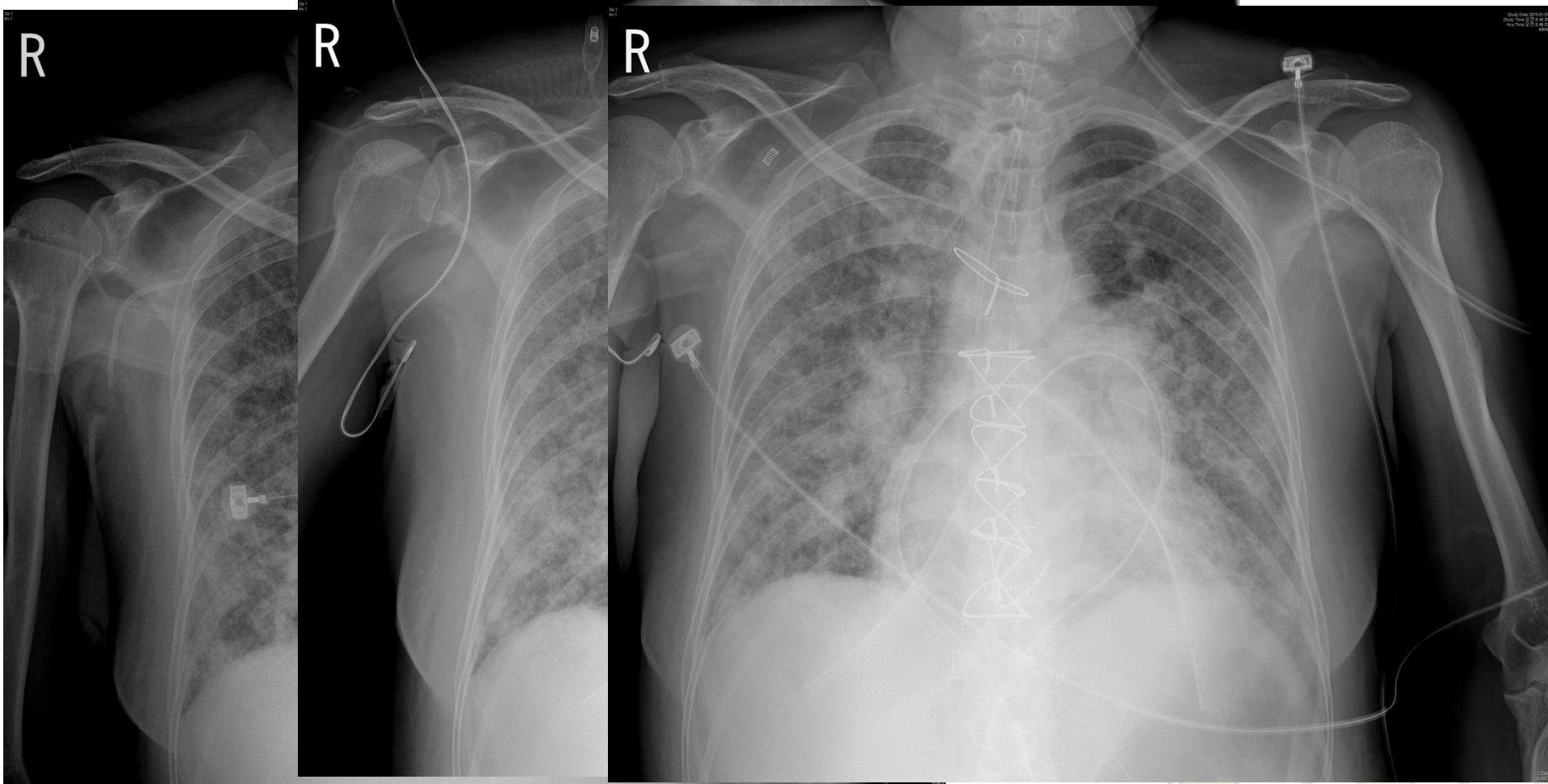


# 경과 ECMO weaning ~

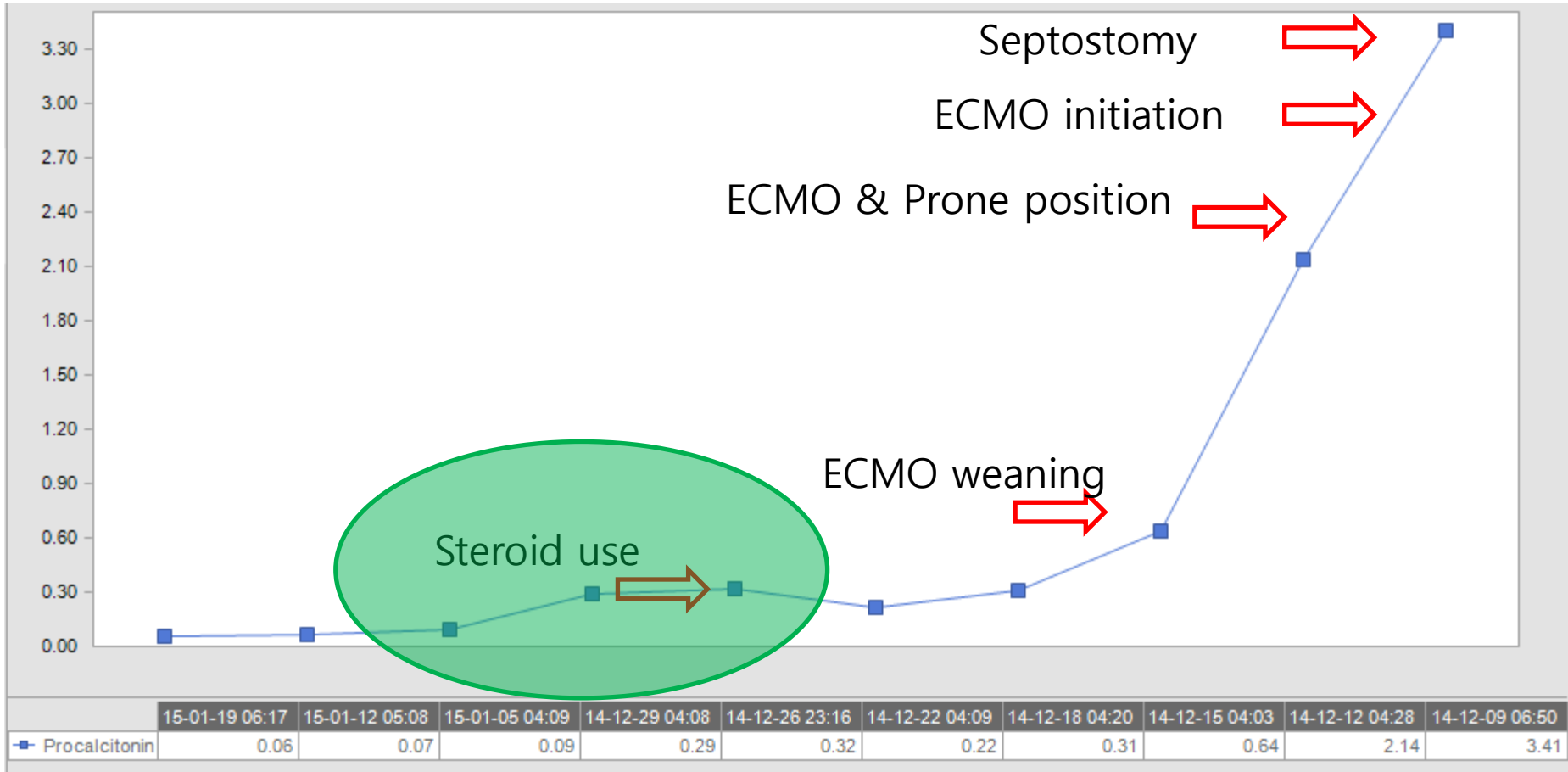


# 경과

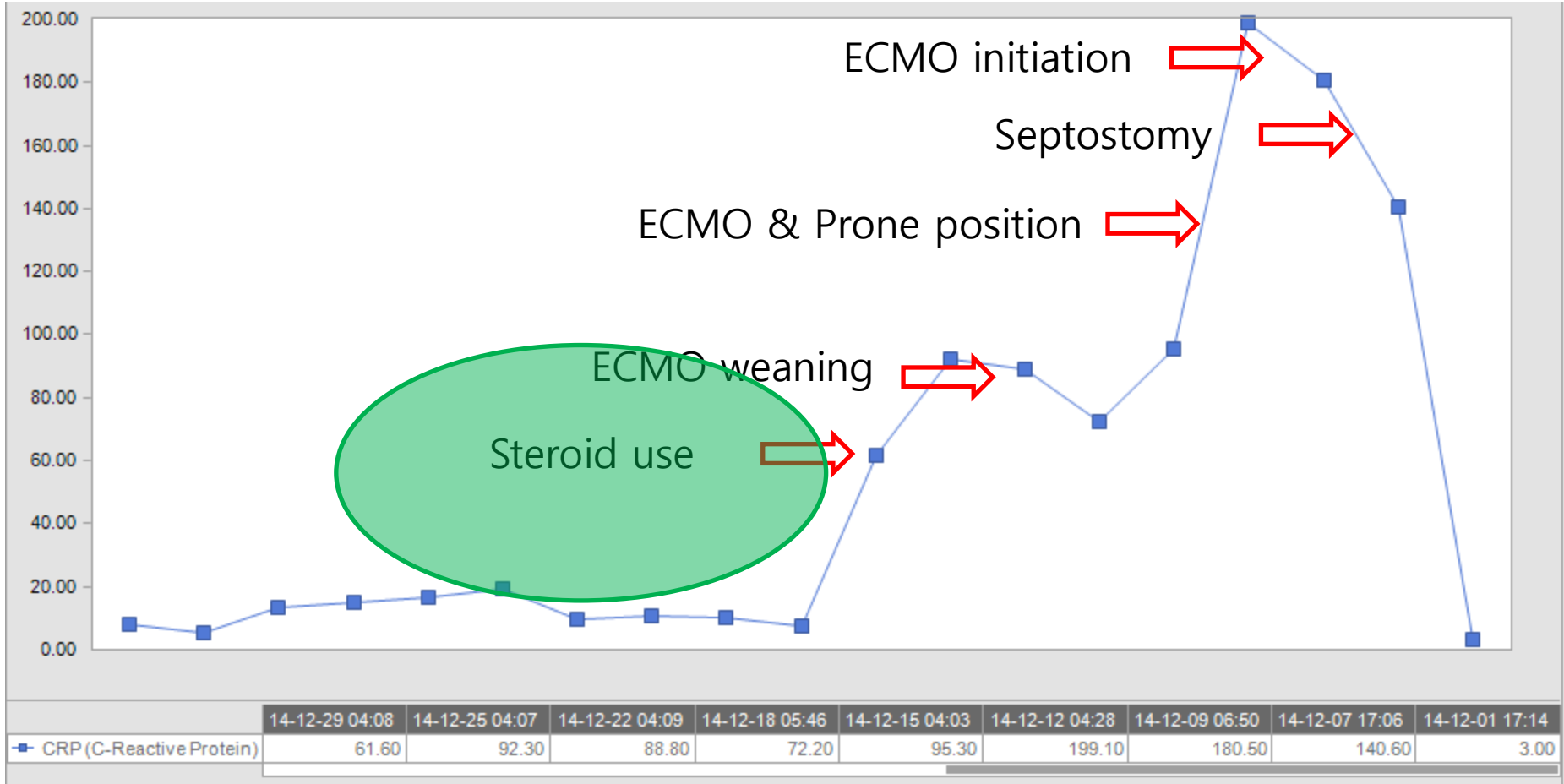
Steroid use (Methylprednisolone 1mg/kg)



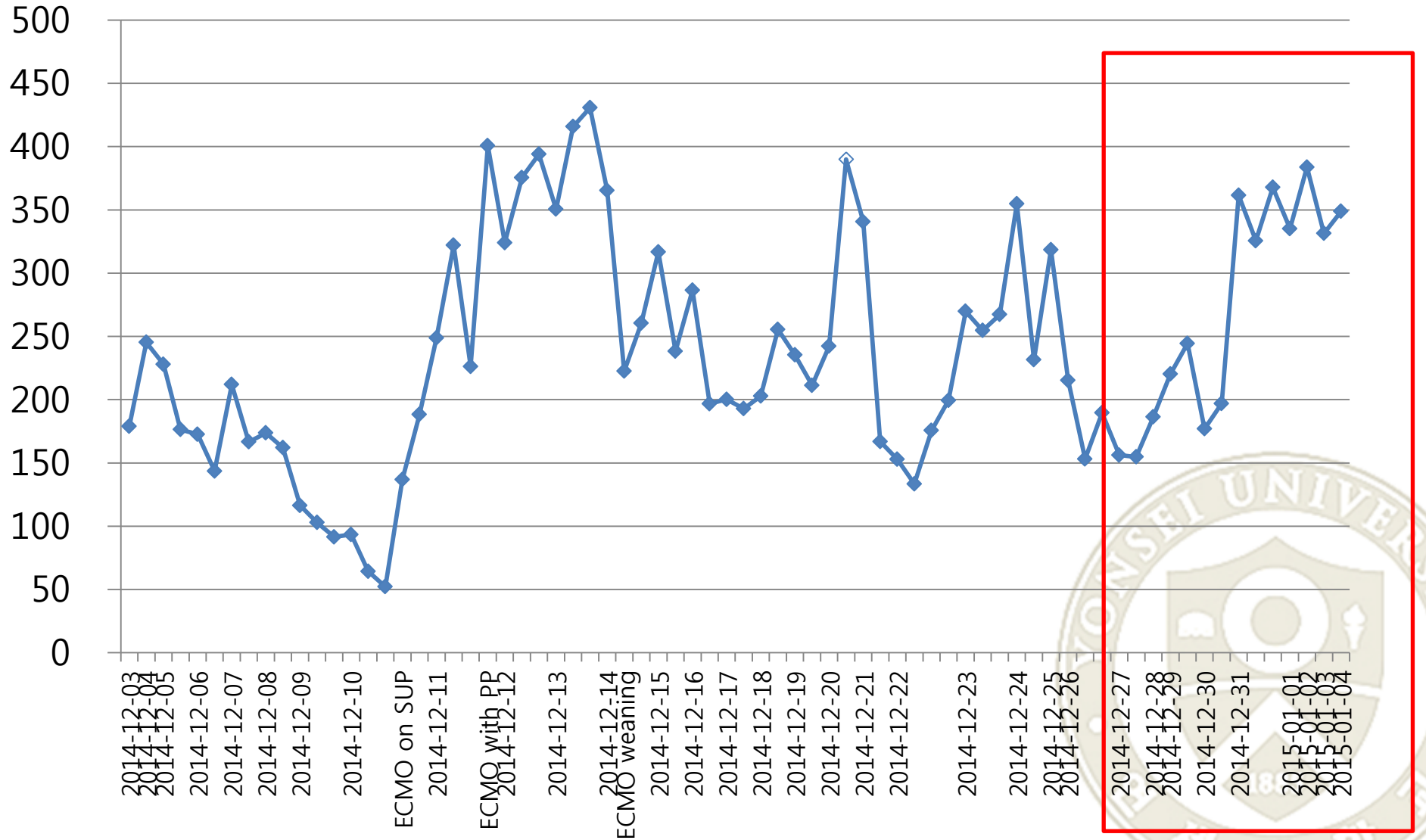
# Procalcitonin



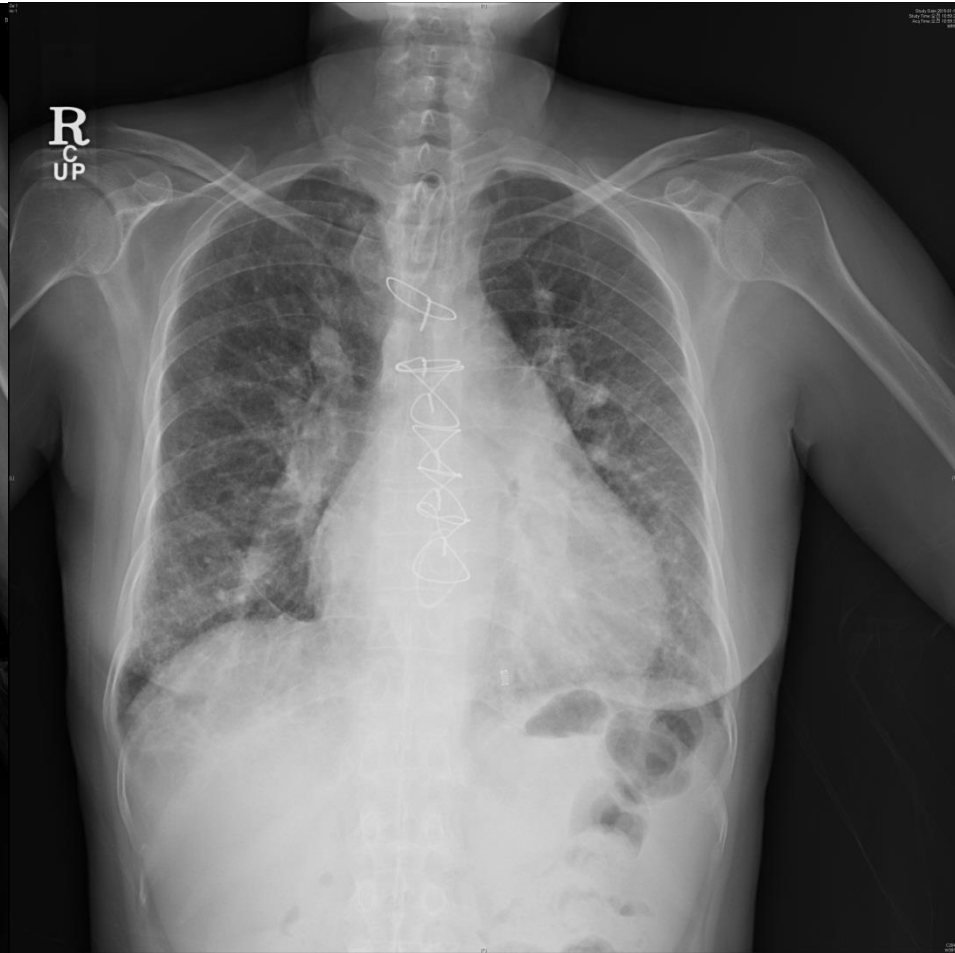
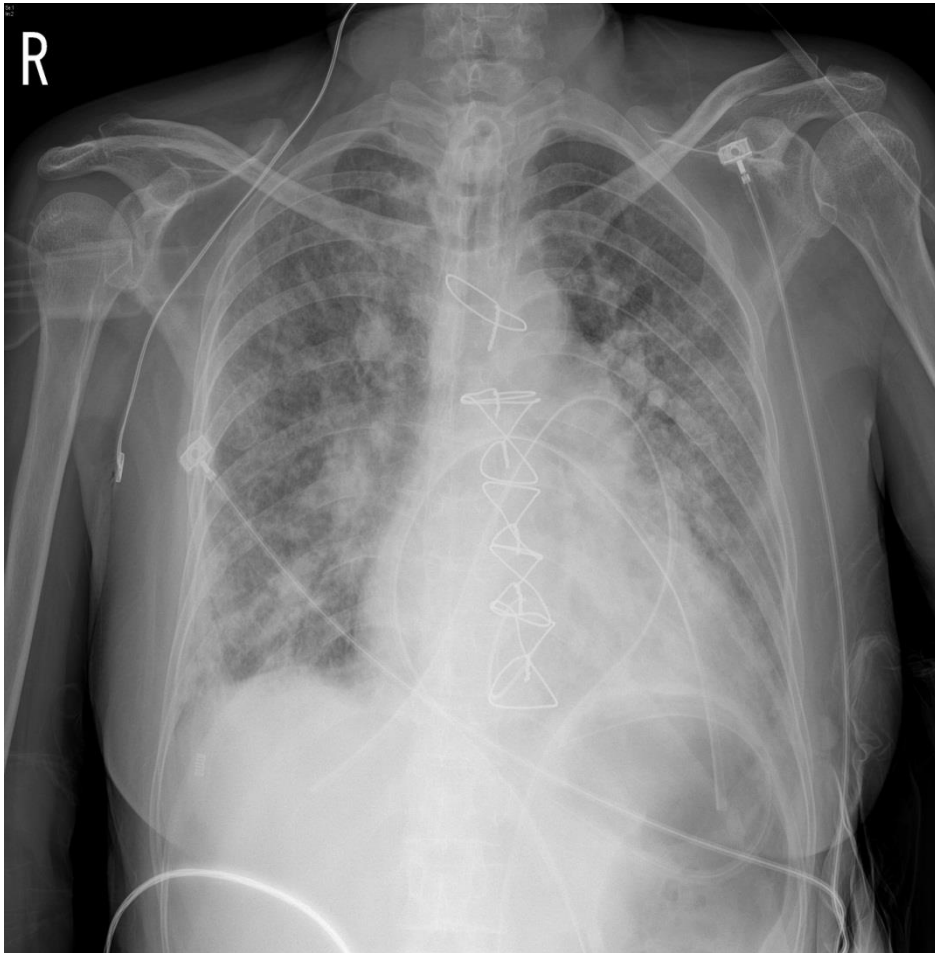
# CRP



# P/F



# 경과 Ventilator weaning ~ 퇴원



# Echocardiography5

- 2015-01-02
- ASD 2'
- s/p ASD patch repair, TAP (2014.12.02)
- s/p ASD creation (2014.12.09)
- No interval change
- patent ASD fenestration (d=10mm, Lt to Rt shunt)
- No TR & TS
- MR (trivial)
- RAE & RVR
- No pericardial effusion
- NL PVR



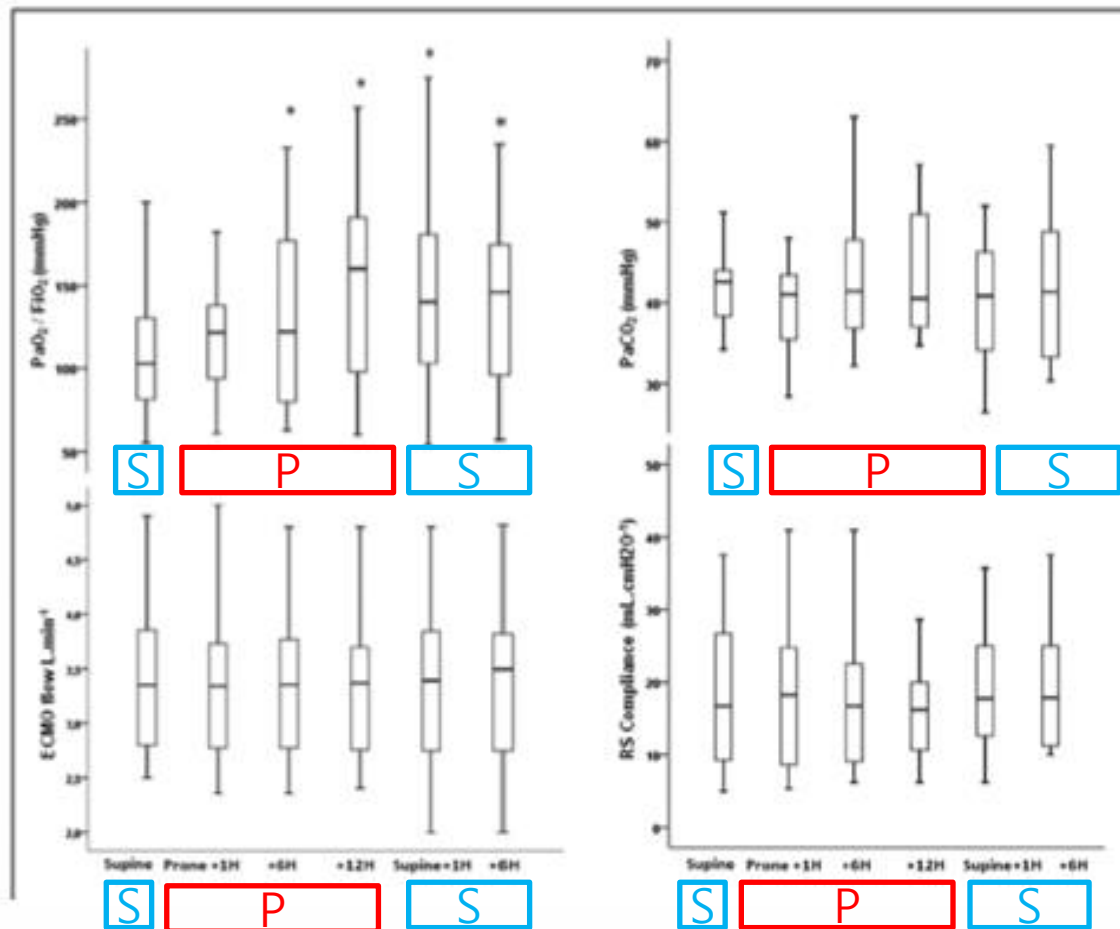
# ECMO and Prone position

- Prone position
  - Patients on vv ECMO are still ARDS patients with predominant posterior condensations
  - Ultraprotective ventilation may induce poorly aerated areas in dependant lung regions
  - Prone position improves survival in severe ARDS and may be considered as an efficient therapy
  - Hypothesis: Prone position may be efficient in severe ARDS treated with ECMO
  - Prone position may recruit the dorsal regions of the lungs
  - Prone position facilitate lung drainage
  - Therefore prone position may improve blood oxygenation and/or hasten ECMO weaning



# Prone positioning during veno-venous extracorporeal membrane oxygenation for severe acute respiratory distress syndrome in adults

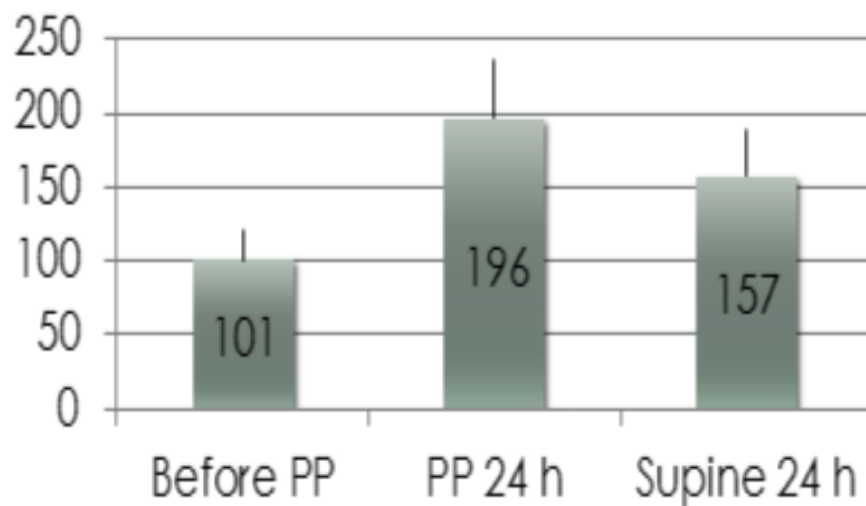
C. GUERVILLY<sup>1</sup>, S. HRAIECH<sup>1</sup>, V. GA RIBOLDI<sup>2</sup>, F. XERIDAT<sup>1</sup>, S. DIZIER<sup>1</sup>, R. TOESCA<sup>3</sup>  
J-M. FOREL<sup>1</sup>, M. ADDA<sup>1</sup>, D. GRISOLI<sup>2</sup>, F. COLLART<sup>2</sup>, A. ROCH<sup>1</sup>, L. PAPAIZIAN<sup>1</sup>



# Prone positioning during veno-venous extracorporeal membrane oxygenation for severe acute respiratory distress syndrome in adults.

Minerva Anesthesiol. 2014 Mar;80(3):307-13. Epub 2013 Nov 21.

- 15 patients, 26 sessions (15 late and 11 early)
- Methods: PP session of 24 hours, no change in ECMO blood flow and ECMO/blood flow ratio, no changes in membrane and ventilator parameters



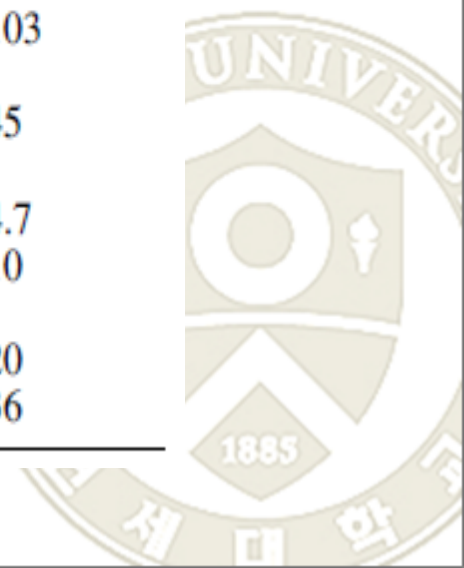
- Improvement in respiratory system compliance
- One membrane thrombosis
- ECMO withdrawal within 48 hours in 9/12 patients

# Prone positioning use to hasten veno-venous ECMO weaning in ARDS

Intensive Care Med (2013) 39:1877–1879

**Table 1** Respiratory parameters before, per and after 24-h session of prone positioning under vvECMO

Respiratory parameters	Before prone position	Per prone position (1 h after)	Supine position (12 h after)
Fraction of inspired oxygen (FiO <sub>2</sub> ) on ventilator (%)	80	80	45
Partial pressure oxygen in arterial blood (PaO <sub>2</sub> ) (mmHg)	67	131	103
FiO <sub>2</sub> on extracorporeal membrane oxygenation (ECMO) (%)	60	60	45
ECMO output (l/min)	5.5	5.5	4.7
Positive end expiratory pressure (PEEP) (cmH <sub>2</sub> O)	10	10	10
Plateau pressure (PP) (cmH <sub>2</sub> O)	28	20	20
Static compliance (SC) (ml/cmH <sub>2</sub> O)	23	32	36



## 결론

- ECMO is useful for the treatment of ARDS after operation
- ECMO with prone position is safe and efficient
  - Timing
    - Early as an ARDS treatment
    - Late to hasten ECMO weaning





**THANK YOU FOR YOUR ATTENTION**

THANK YOU FOR YOUR ATTENTION

