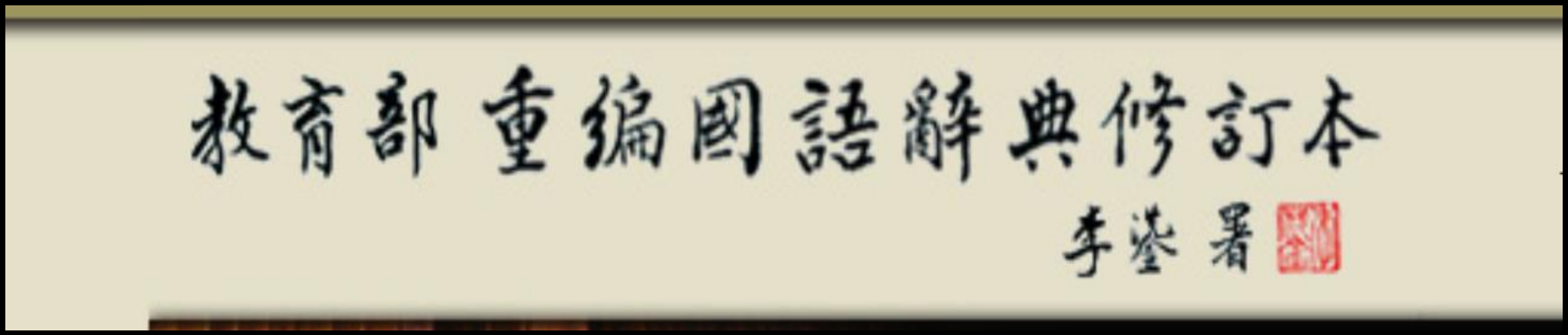
鑑往知來 - 從SARS, H1N1到COVID-19之呼吸照護

郭炳宏

臺大醫院內科部

鑑往知來



- 釋義：觀察過去，就可以推知未來。
- 如：「能夠鑑往知來，就可以避免許多錯誤。

鑑古知今 - 從 SARS, H1N1 到 COVID-19 之呼吸照護與省思

從武漢肺炎想到SARS的慘烈突襲

2020-1-22: 作者 / 前台大醫院院長李源德

https://www.commonhealth.com.tw/article/article.action?nid=80815

SARS

2003 SARS

"I don't think we've seen anything like this before."

- 那一段刻骨銘心的記憶 !!

2003

This is a war.

2003

Almighty God ....

2003 SARS

SARS期間民眾搶購口罩

圖片來源：Shutterstoc

2020

民眾在藥局前排隊等著購買口罩

https://www.peopo.org/news/441491

2003 SARS

2020-2-11

武漢肺炎：正妹飼主替愛貓戴全罩式口罩

https://news.ltn.com.tw/news/world/breakingnews/3063673

2003

From “非典” to SARS

- 2002年11月: 中國大陸於廣東省河源市發生不明原因的肺炎 (非典)
- 2/11: WHO informed from Chinese MOH of an outbreak with 305 cases and 5 deaths (atypical pneumonia).
- 3/10: Chinese MOH asks WHO to provide technical support
- 3/12: 1st WHO global alert
- 3/15: 2nd WHO global alert : a “world wide health threat”
  - Case definition provided; Name: SARS
- 7/5: WHO announced that the last human chain of SARS transmission had been broken
- 30 countries; total 8098 cases; 774 deaths (9.55%).

2003-3-25

2003 ATS

- Seattle (May 2003)

2003 ERS

- Berlin (Sep 2003)

2003-3-30, 臺大醫院101講堂

Severe Acute Respiratory Syndrome (SARS)

嚴重急性呼吸道症候群

Report of 3 cases at NTUH

SARS

臺大醫院內科部

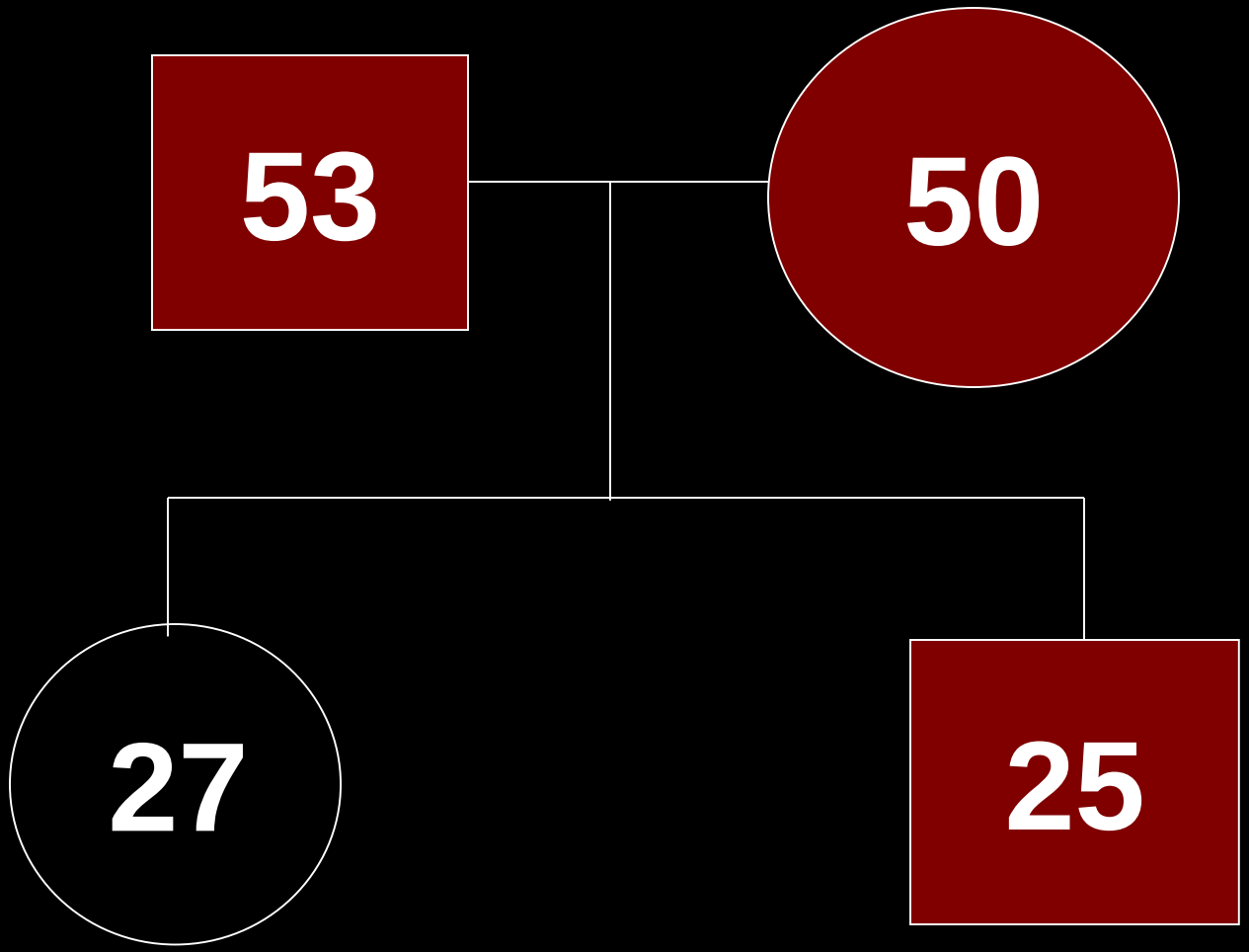
郭炳宏, 陳冠宇, 黃瑞仁

薛博仁, 陳宜君, 張上淳

2003

NTUH

SARS



Case 1

Case 1: 53-year-old man

- Review of symptoms: myalgia (+), fever (+), chills (+), cough (+), diarrhea (+), dyspnea (+),
- Feb 8-21, 2003 : on a business trip to廣州東莞
- 2/21: returned to Taiwan via Hong-Kong
- 2/25 : bilateral lower leg muscle tenderness
- 2/26 : high fever up to 40℃ with chills, dry cough → 公保門診
- 2/28: diarrhea 3 times/day → 仁愛醫院 ER: WBC count normal
- 3/4 : severe dry cough with mild exertional dyspnea
- 3/8 : consulted a local clinic (39℃); WBC : ~ 17000
- 3/8 : NTUH ER

Case 1

53 y/o M

CxR at ER

2003-3-8

Case 1

53 y/o M

SpO_2 88% (NRM)

3/9: intubation → ICU

Cons.: irritable

T/P/R:37.2/114/38;

BP: 214/76 mmHg

2003-3-10

Case 1

53 y/o M

P/F < 80 (FiO2 80%, PEEP 15)

3/13-14: prone positioning

Albumin infusion + Lasix

3/14: visited by Taiwan CDC officials

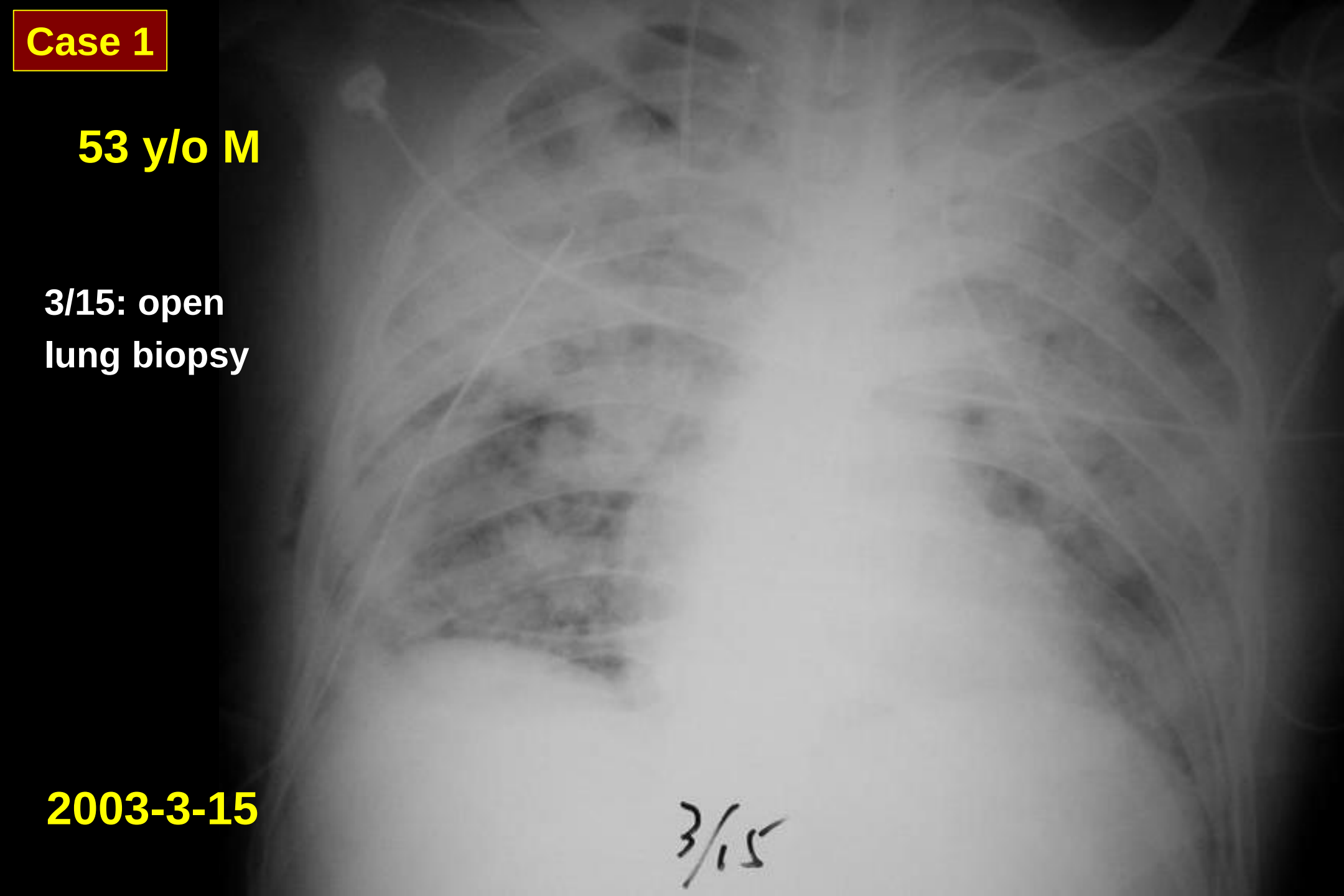
2003-3-12

2003-3-15

台大醫院SARS緊急應變團隊

- 3月15日李源德院長召集五位副院長、部門主任及感染科醫師，成立「SARS緊急應變團隊」，從此每天上、下午定時開會兩次，隨時掌握最新疫情，以便即刻應變。

- 立即啟動P3級感染控制防護措施，病患住的加護隔離病房，空調完全獨立，病人口鼻分泌物也隔離處理；相關醫護人員除使用N95口罩，需穿上兩層手術衣、戴帽子、加上兩層手套並勤洗手。
- 緊急徵調加護病房隔離室，做為收治SARS病患的隔離病房。


Case 1
53 y/o M
3/15: open lung biopsy
2003-3-15
3/15

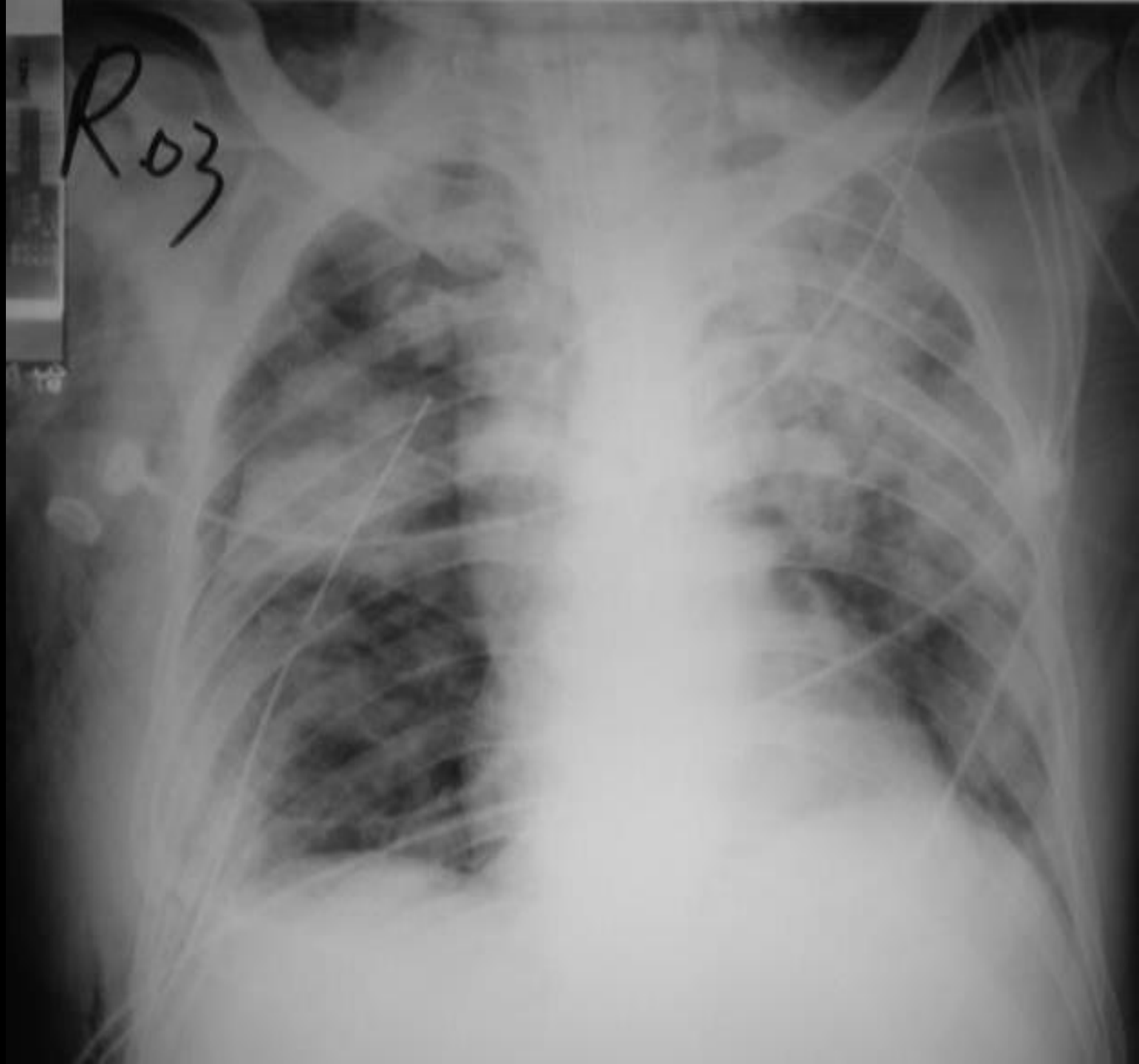
Case 1

53 y/o M

3/20 : fever subsided

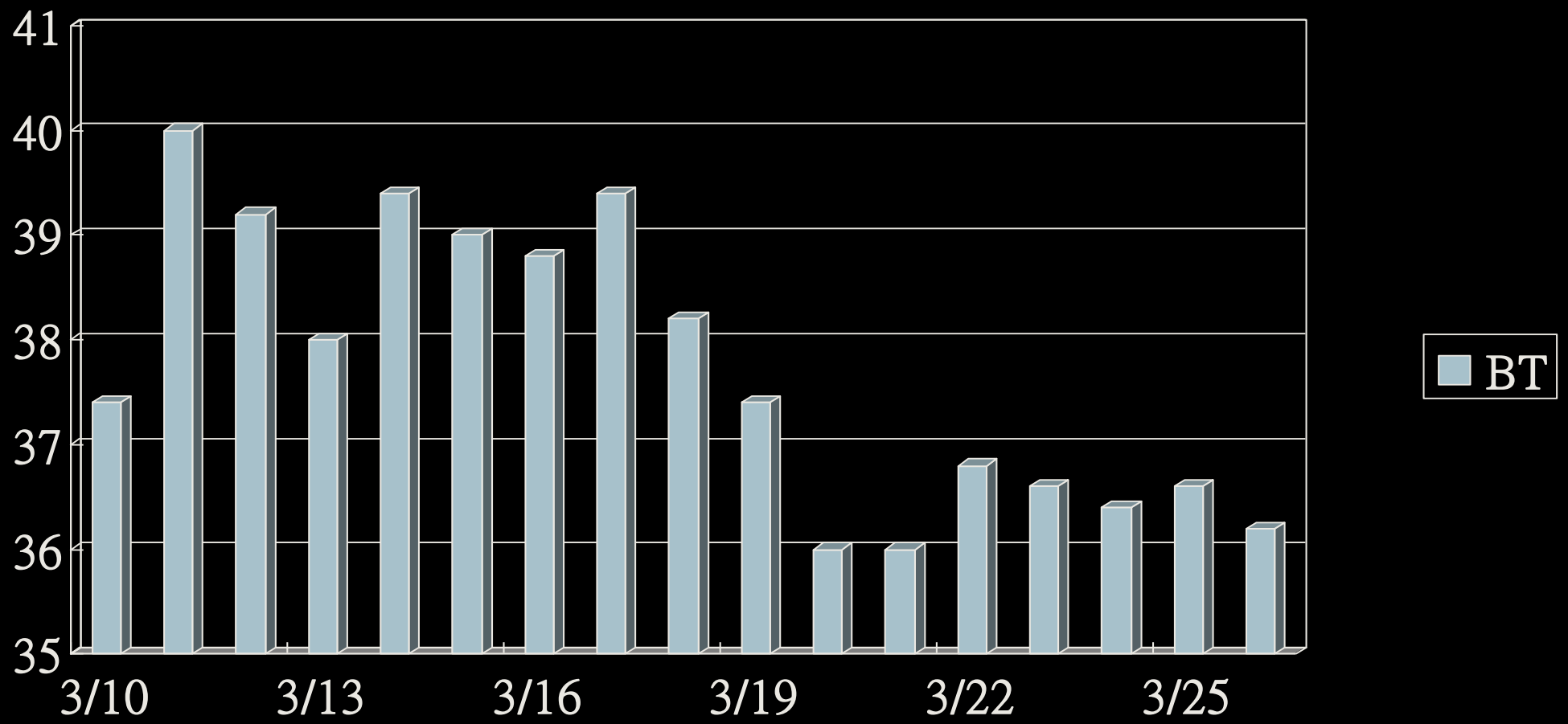
3/21 : extubation

2003-3-20



Case 1

Body Temperature



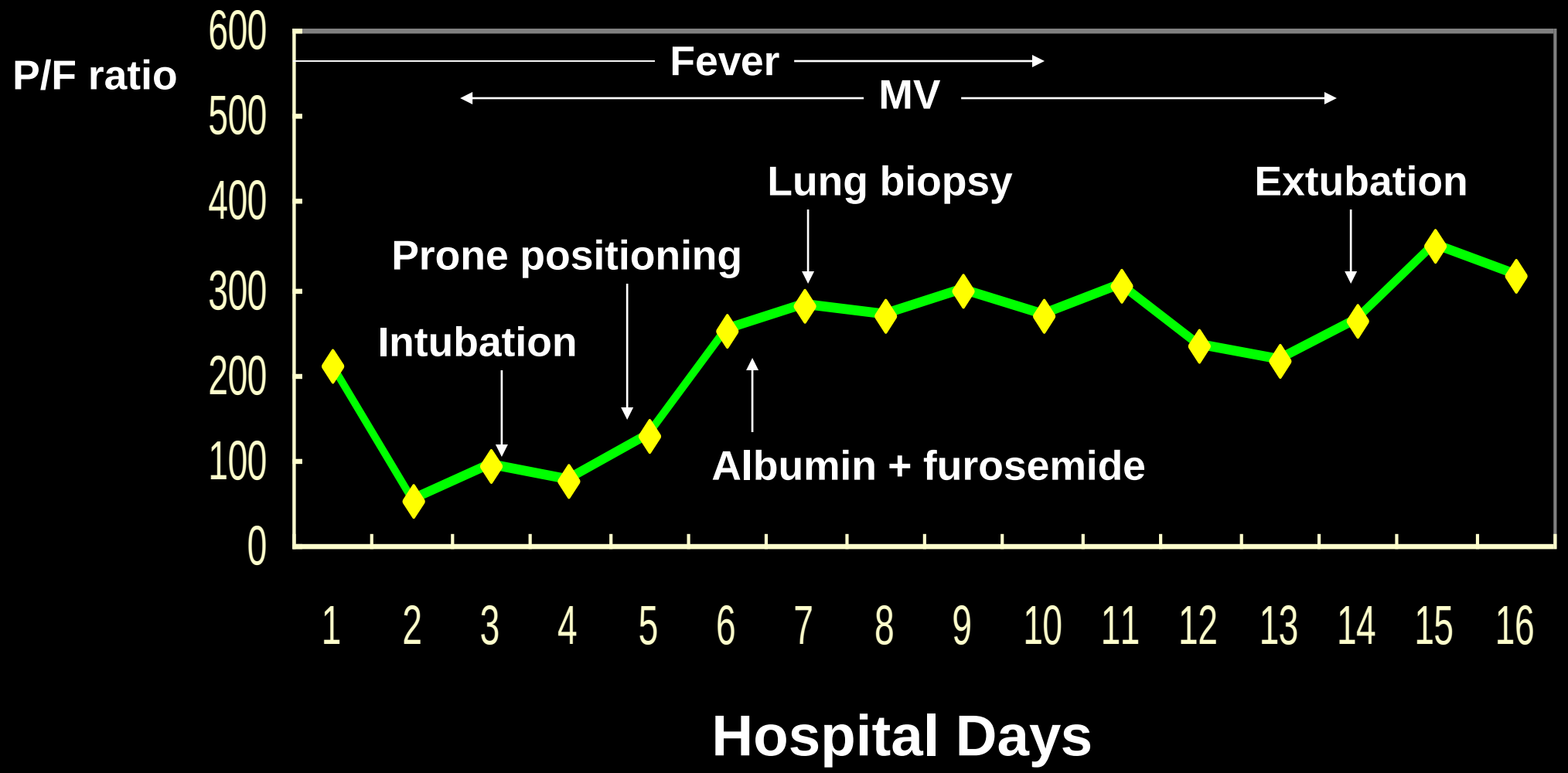
Case 1

Laboratory Data

	Mar 8	Mar 10	Mar 12	Mar 20	Mar 24	Mar 28
WBC	16300	17930	8570	16210	11990	10730
Hb	13.9	12.2	10.8	11.6	12.0	11.4
Plt	177 k	189 k	212 k	233 k	355 k	301 k
Bil		1.17			0.57	
LDH				820	979 (H4+)	1490 (H-)
Cre	0.96	0.90	0.69	0.61	0.7	
CPK		397	38		29	
CRP	> 12		> 12		1.85	

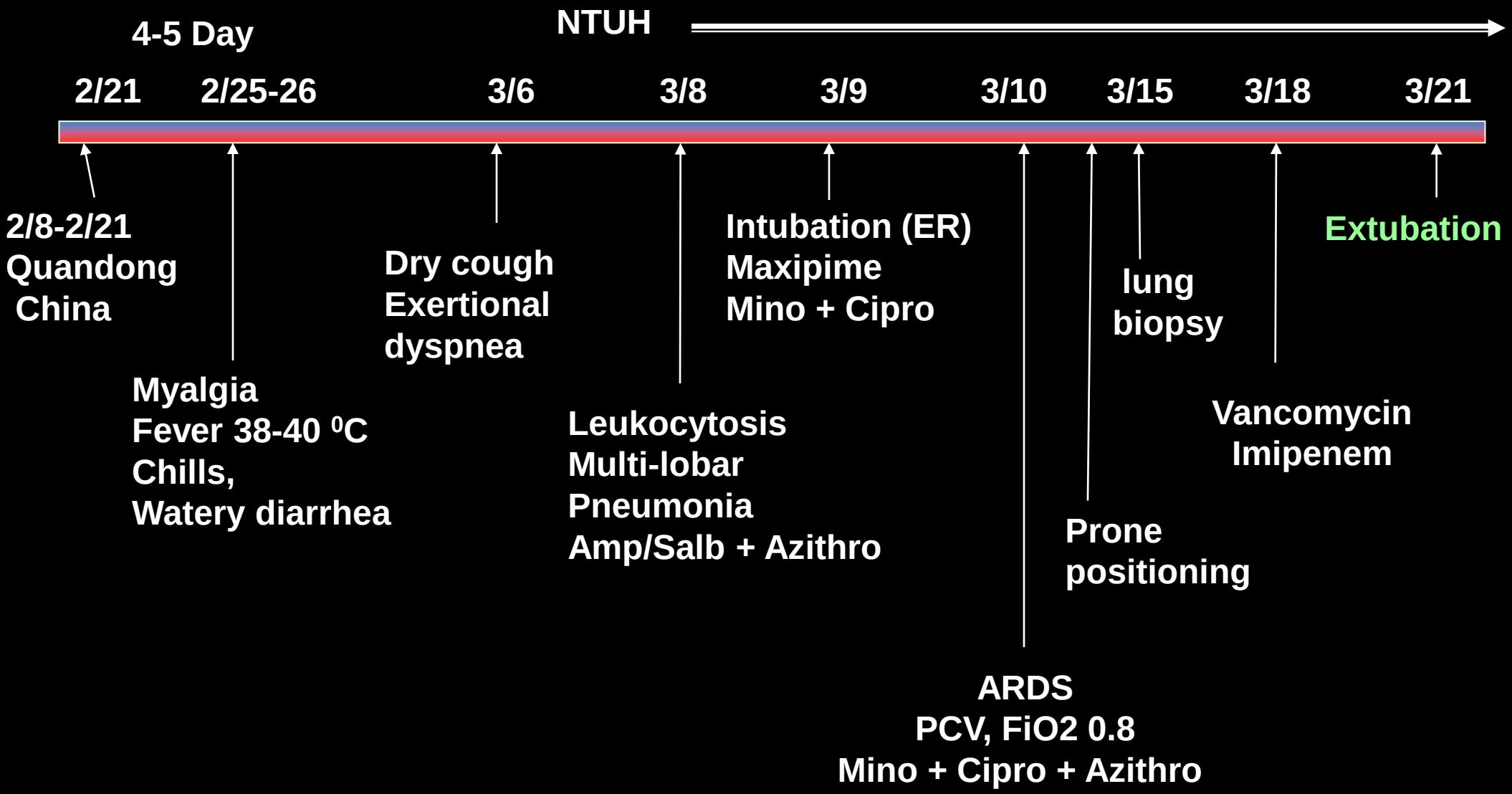
Case 1

PaO_2/FiO_2



Case 1

Summary: 53 y/o M



Case 2

Case 2. 50 y/o woman

- **3/6 : spiking fever with sore throat → LMD → received some medications but fever persisted**
- **3/12 : diarrhea, fever, dry cough**
- **3/14 : NTUH ER of NTUH → WBC 2610; Platelete 140 K**
- **3/15 : CxR RLL + LUL infiltrates**
- **3/16 : transferred to ICU**
- **3/17 - 21 : inhalation of Ribavirin 1200 mg**
- **3/18 : pancytopenia; BM biopsy: VAHS**
- **3/18-19 : IVIG 1 mg/kg/d x 2 d**

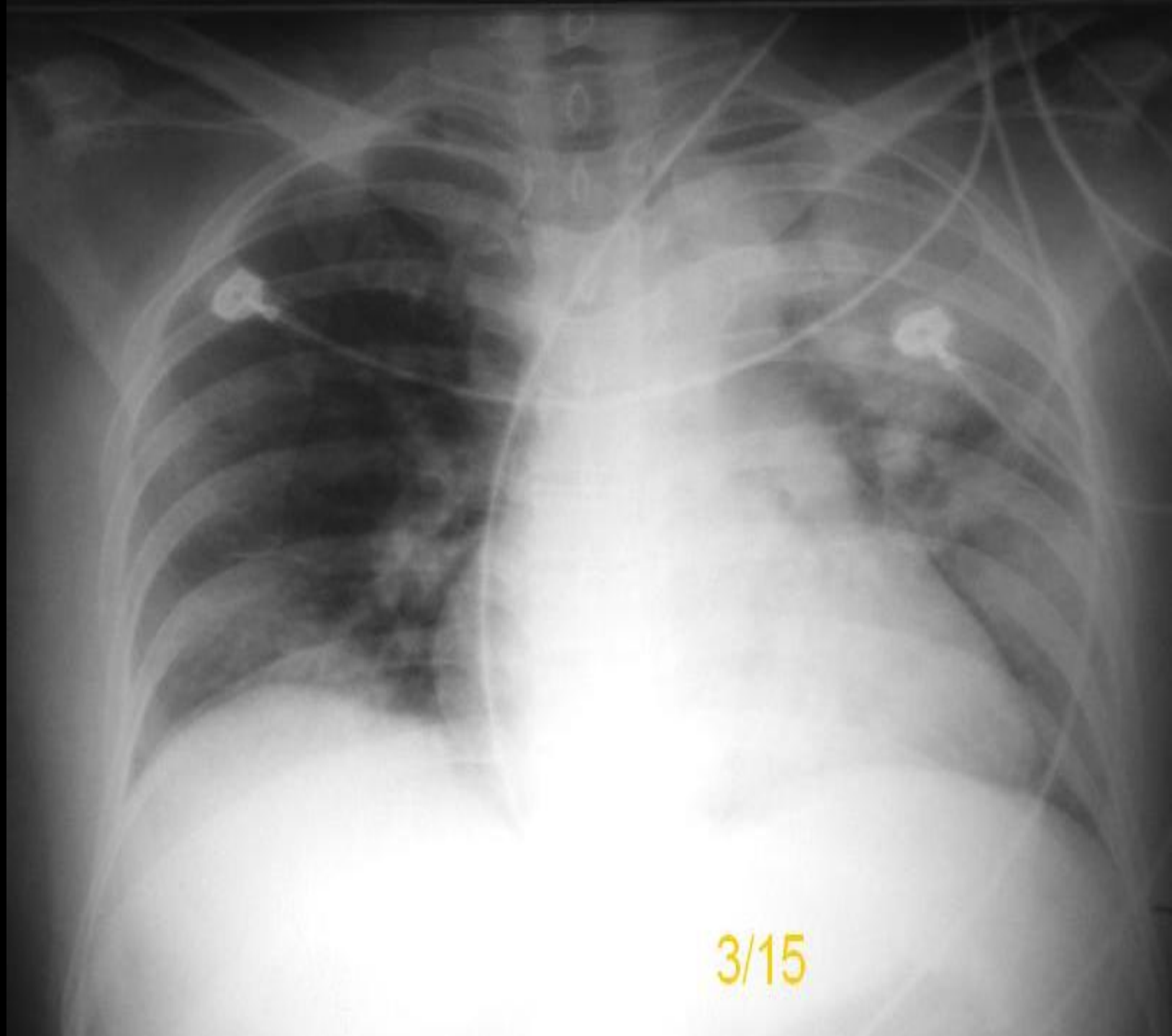
Case 2

50 y/o F

2003-3-14

Case 2

50 y/o F



2003-3-15

Case 2

50 y/o F

3/17 Intubation

台大胸腔科總醫師在緊急插管時不慎感染（台灣首位醫護人員病例）

2003-3-16

Case 2

50 y/o F

Extubation

2003-3-23

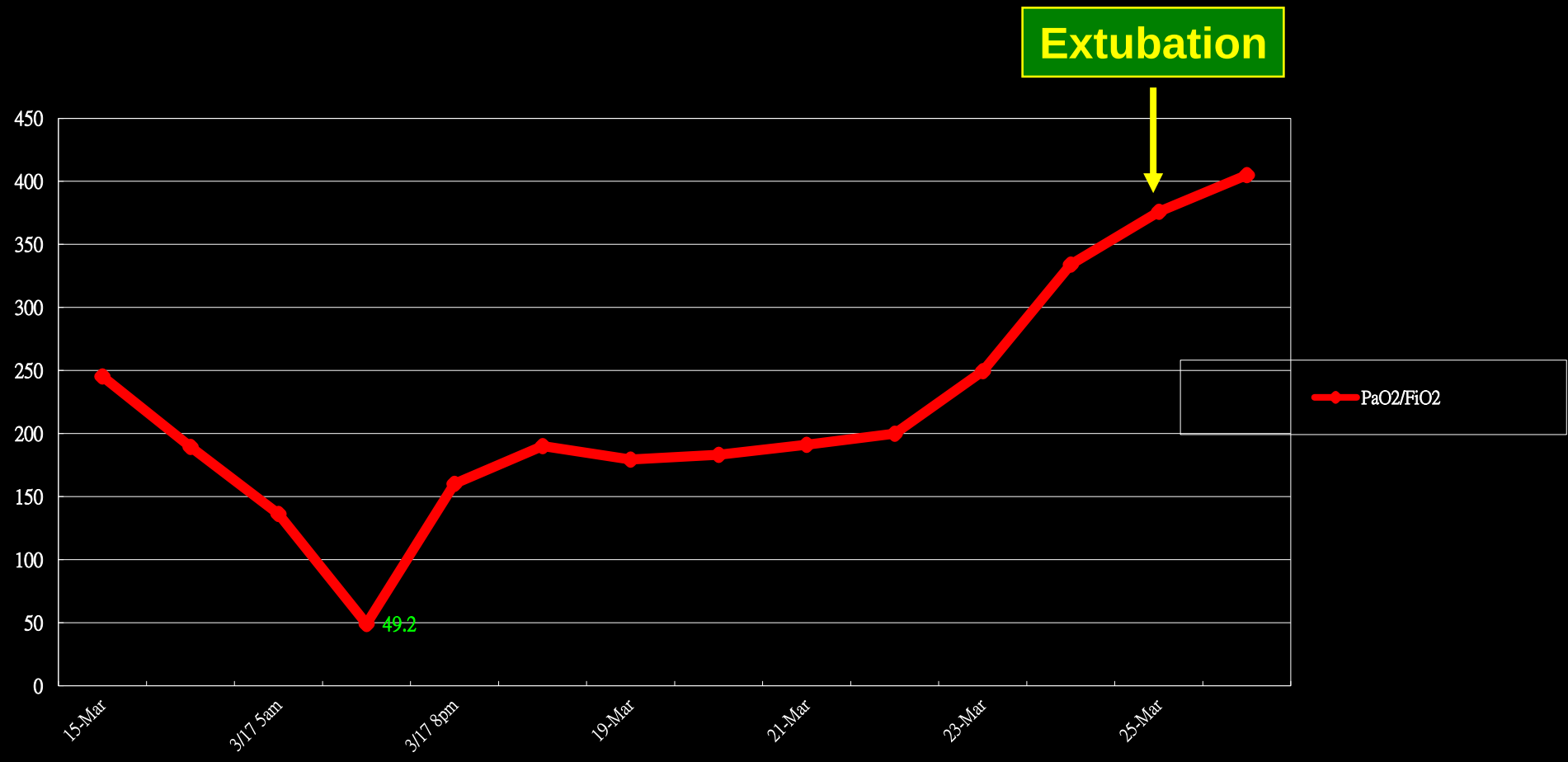
Case 2

Laboratory Findings

	Mar 14	Mar 16	Mar 18	Mar 24	Mar 27
WBC	2610	4180	2700	3750	9840
Hb	10.1	10.4	8.0	11.4	11.5
Plt	140 K	118 K	86 K	157 K	196 K
GPT		16		39	
T-Bil	0.18	0.4			
LDH		444	1252	754	773
Cre	0.65		0.5		0.4
CPK			174		
CRP	> 12		9.37	1.06	0.21

Case 2

PaO_2/FiO_2 ratios



Case 3

Case 3. 25 y/o man

- **3/17 : high fever (~38.5℃), mild dry cough**
- **3/18 : watery diarrhea 2 times; subsided after some medications by LMD**
- **3/20 : fever persisted → visited infection outpatient clinic at NTUH; CxR : RUL/LUL infiltrates**

Case 3

25 y/o M

P:F ratio: 479

Ribavirin 2 g p.o. stat and 600 mg bid p.o.

2003-3-20

Case 3

25 y/o M

P:F ratio: 475

Solumedrol
(40 mg q8h iv)
Vancomycin
Cefepime
Azithromycin

2003-3-21

Case 3

25 y/o M

P:F ratio: 376

2003-3-23

Case 3

25 y/o M

P:F ratio: 73
Dyspnea
Subcutaneous emphysema

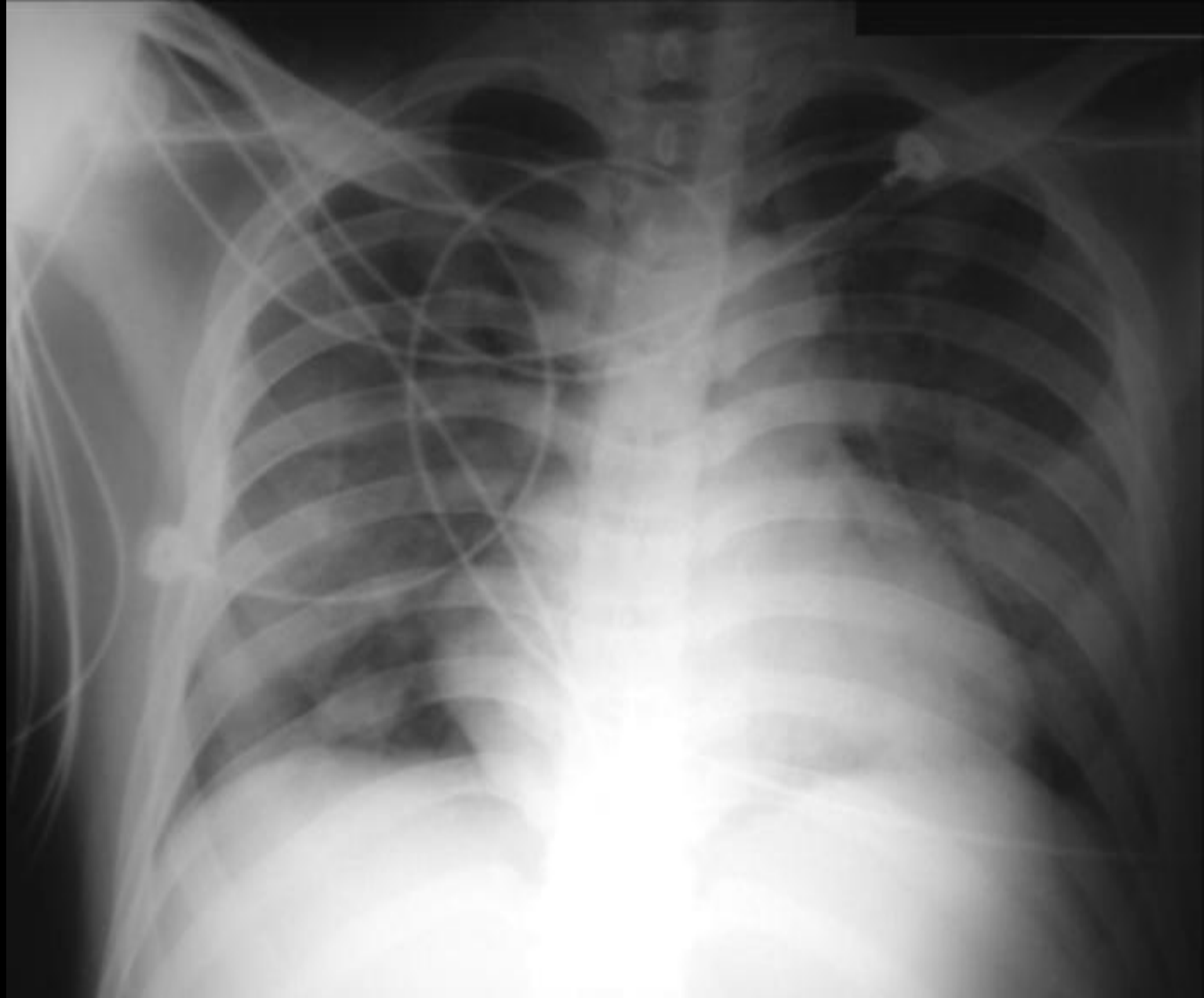
2003-3-24

Case 3

25 y/o M

P:F ratio: 67
→ Intubation

2003-3-26



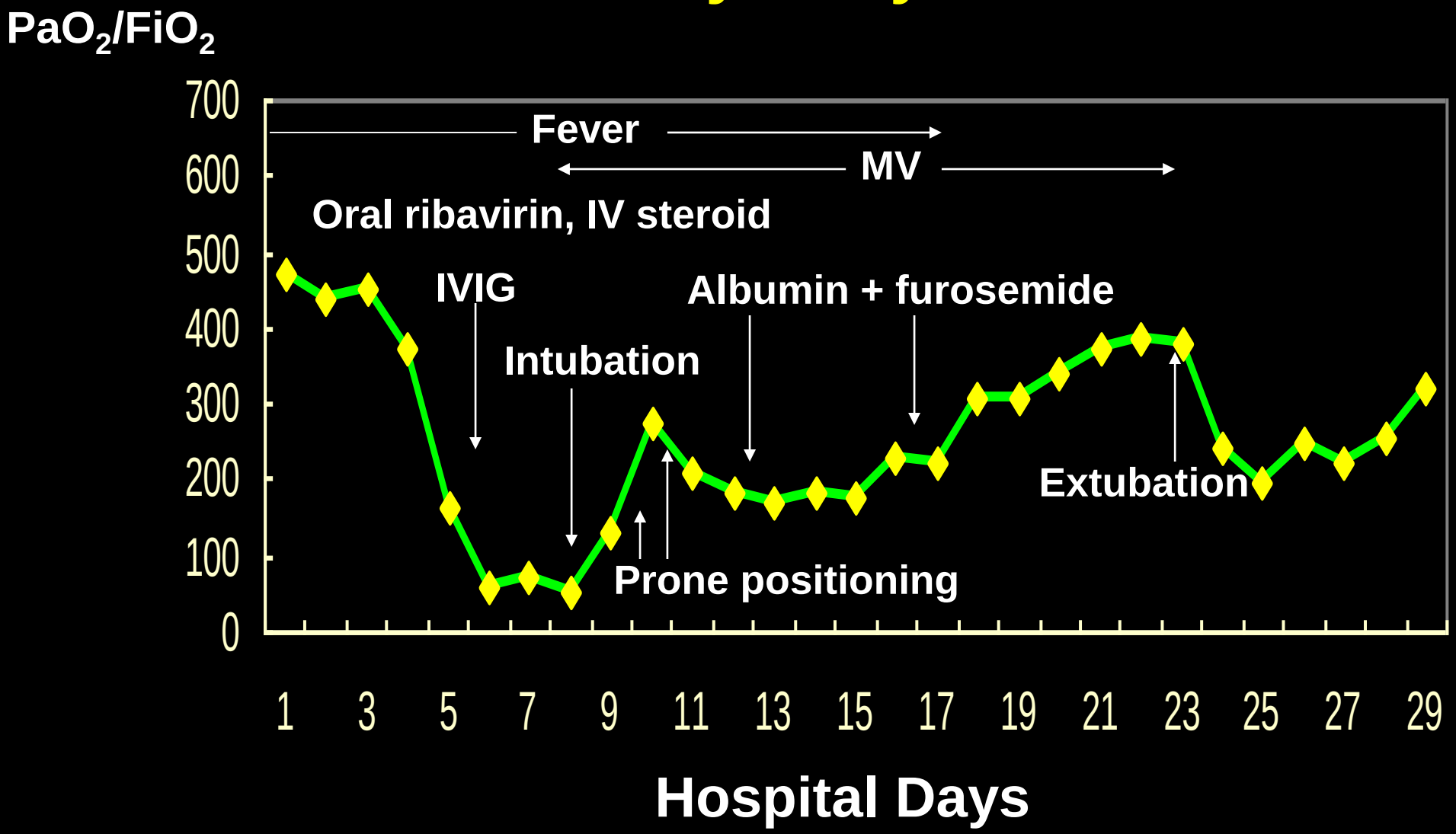
Case 3

Laboratory Findings (1)

	Mar 20	Mar 21	Mar 22	Mar 23	Mar 24	Mar 28
WBC	4410	4380	2830	5300	8700	11900
Hb	15.2	15.3	14.8	14.7	15.1	14.4
Plt	125 K	106 K	101 K	136 K	147 K	260 K
GPT	22					
Bil	0.37		0.25		0.46	
LDH	481	640		511	495	673
Cre	1.12	1.15	0.93	0.8	0.8	0.73
CPK	69		55		22	
CRP						5.1

Case 3

Summary: 25 y/o M



三SARS病例之比較 (1)

	父	母	子
Fever (onset)	+ (2/26)	+ (3/6)	+ (3/17)
Incubation period	4-5 days ?	9 days ?	10 days ?
Dry cough	+	+	+
Diarrhea	+	+	+
Myalgia	+	-	-
Dyspnea	+	+	+
ARDS	+	+	+
VAHS	-	+	-

三SARS病例之比較 (2)

	父	母	子
Initial WBC	17000	2610	4410
Initial Platelet	177 K	98 K	125 K
Peak CPK	397	174	69
Peak GPT	151	39	22
Peak LDH level	820	1280	673
Peak creatinine	0.96	0.64	1.12
Ribavirin Tx	-	Inhaled	Oral
Steroid	-	+	+

2003-3-30, 臺大醫院101講堂

SARS

- SARS virus close to conclusive identification
- **PCR** : good reliability in the early days
- **IFA** : detect infection in convalescent sera at about 3 weeks after infection begins.

--- WHO Mar 28, 2003

革命尚未成功, 同志仍需努力

2003-4-16

WHO Geneva conference:
SARS-CoV as etiologic agent for SARS

2003-9

SARS的臨床表徵

- 九成以上典型的SARS病人幾乎都是在一開始就會出現發燒、咳嗽，伴隨著肌肉酸痛、畏寒
- 許多病人在一開始時會有解稀便、軟便或輕微腹瀉的現象。
- 發燒通常都會持續存在，有時候會昇高至39℃、40℃的程度，且不易退燒，甚至吃了退燒藥也不易退至完全正常的體溫。
- 三、五天後病人可能咳嗽變得比較明顯，部份病人開始覺得呼吸有點喘，呼吸困難；有一些人則有較明顯的腹瀉。
- 病人此時大都會到醫院診治，此時胸部X光片可能是正常的或是輕微的局部性浸潤肺炎變化。接著有些病人保持大致差不多的症狀，包括發燒、咳嗽、輕微呼吸困難、倦怠，有些病人則出現呼吸困難，血氧濃度不足，所謂嚴重急性呼吸衰竭。

2003-9

SARS實驗室檢驗

- 發病初期剛到醫院時白血球正常或是略微偏低，淋巴球數常常是小於1500/cumm以下
- 血小板數目也是偏低，大多數病人可能仍然是10萬以上，但大部份病人為15萬以下，比起其平時之血小板數目偏低的
- 血紅素及紅血球數通常是正常的。
- 隨病情進展，許多病人會出現白血球數目下降至4000/cmm以下，血小板數目也會下降至10萬以下，而紅白球及血色素也略為下降，此時如果施行骨髓檢查，可見有噬血症候群的血液學變化。
- 生化檢查可能見到有肝功能指數AST、ALT之上升，LDH及CK也可能上升，但腎功能指數如BUN及Cre通常是正常的。大部份病人只有上述幾種指數中的一部份出現異常，但隨著病程的進展，上述指數中若原本為正常的，也漸漸會出現不正常。
- 病人的CRP也會昇高，並且隨著病情的進展，持續逐漸上升，直到病情好轉時（約10到14天），CRP才逐漸下降。

2003-9

SARS胸部X光與CT檢查

- 一般在發病後的四、五天之後才開始出現變化
- 有些病人可能發病一週以上才出現變化，典型的變化是局部性浸潤肺炎變化，一小片界限不明之雲霧狀變化
- 若以肺部電腦斷層掃瞄檢查，病灶主要集中在兩側下葉，且靠近邊緣地帶，有些則以局部或大範圍之瀰漫性間質性肺炎為初期變化。
- 大多數是單側單一肺葉出現變化，少部份可雙側、多肺葉的多病灶變化。許多病人除了原發病灶外，會在其他部位出現新的病灶
- 有些病人則快速進展至兩側全面性肺部浸潤而呼吸衰竭。更有些病人一到醫院，胸部X光片已出現兩側瀰漫性嚴重浸潤肺炎變化，所謂急性嚴重呼吸道症候群。
- 出現肺炎後，大部份病人可在一週或10天內肺炎好轉，但少部份病患肺炎須要二、三週以上才會復原，有的病人甚至持續在胸部X光片上留下纖維化之變化。

2003-4

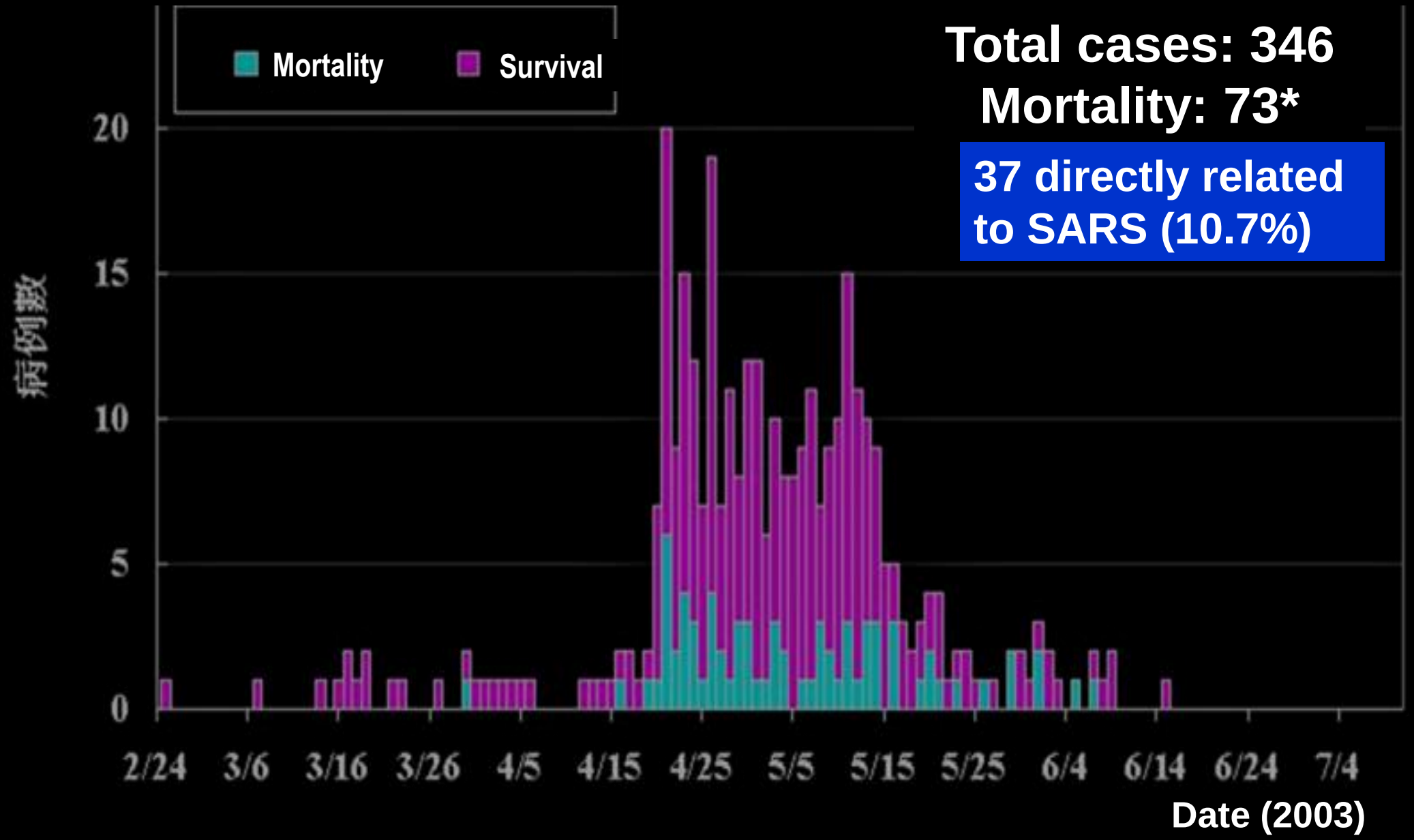
SARS: 世紀災難

- 到4月初，台大共收治11名SARS病患，全部康復出院；照顧的醫護人員達130多人，醫護人員感染率<1%
- 4月22日和平醫院出現集體感染，共有共7人發病。4月29日仁濟醫院封院，中興醫院也爆發疑似感染，發燒病人如潮水湧進台大急診。
- 臺北馬偕、北榮、三總收治多起SARS病例，不時有接觸感染傳聞。高雄長庚、高醫、高雄榮總也陸續爆發群聚感染。
- 4月26日，台中中國醫學院附設醫院出現國內第一起SARS死亡病例。
- 5月1日，和平醫院陳靜秋護理長不幸病逝，成為第一位染煞過世的白衣天使。5月15日住院醫師林重威也因病情惡化轉院國泰醫院殉職

Ref: 前台大醫院院長李源德臉書

2003

SARS in Taiwan



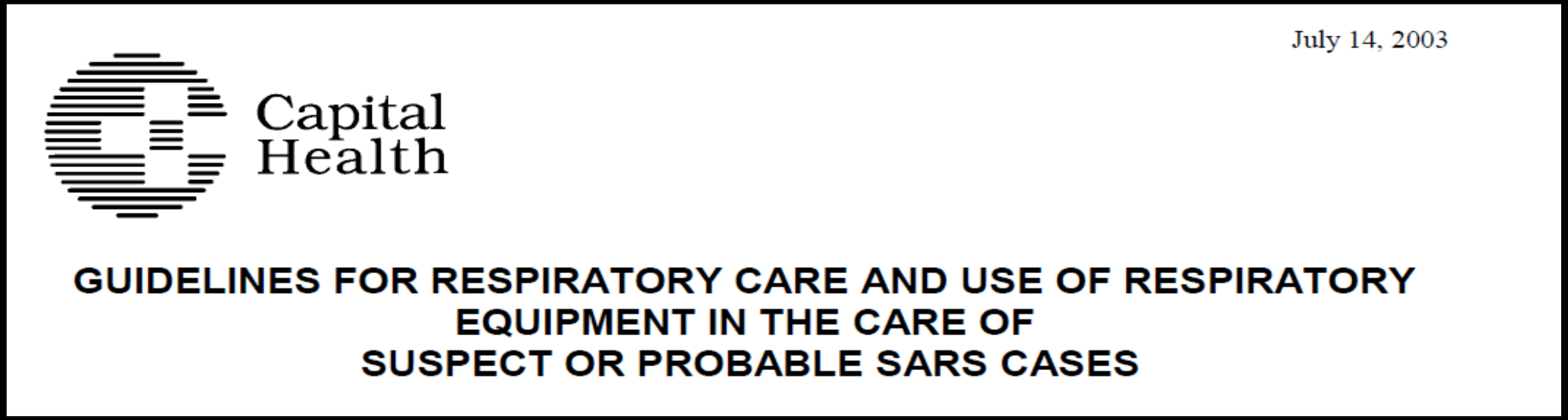
Total cases: 346

Mortality: 73*

37 directly related to SARS (10.7%)

2003

Guidelines for respiratory care and use of respiratory equipment in the care of SARS



- Centers for Disease Control website. Interim domestic infection control precautions for aerosolgenerating procedures on patients with severe acute respiratory syndrome. May 20, 2003.
- Health Canada website. Infection control guidance for respirators (masks) worn by health care workers- frequently asked questions SARS. May 26, 2003
- Health Canada website. Infection control guidance for health care workers in health care facilities and other institutional settings SARS. June 3, 2003.
- Centers for Disease Control website. Interim recommendations for cleaning and disinfection of the SARS patient environment. April 28, 2003.
- Health Canada website. Infection Control Guidance for Respiratory Equipment and Devices for SARS.

2003

NTUH: ICU SARS處置建議

- Indication for intubation:

1. PaO_2 < 80 mm Hg when on non-breathing mask
2. pH < 7.25 because of respiratory acidosis

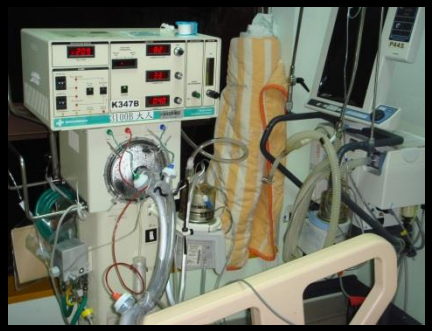
- Not absolutely indicated for young or patients without comorbidities

- # Note: Non-invasive ventilation is NOT recommended for SARS

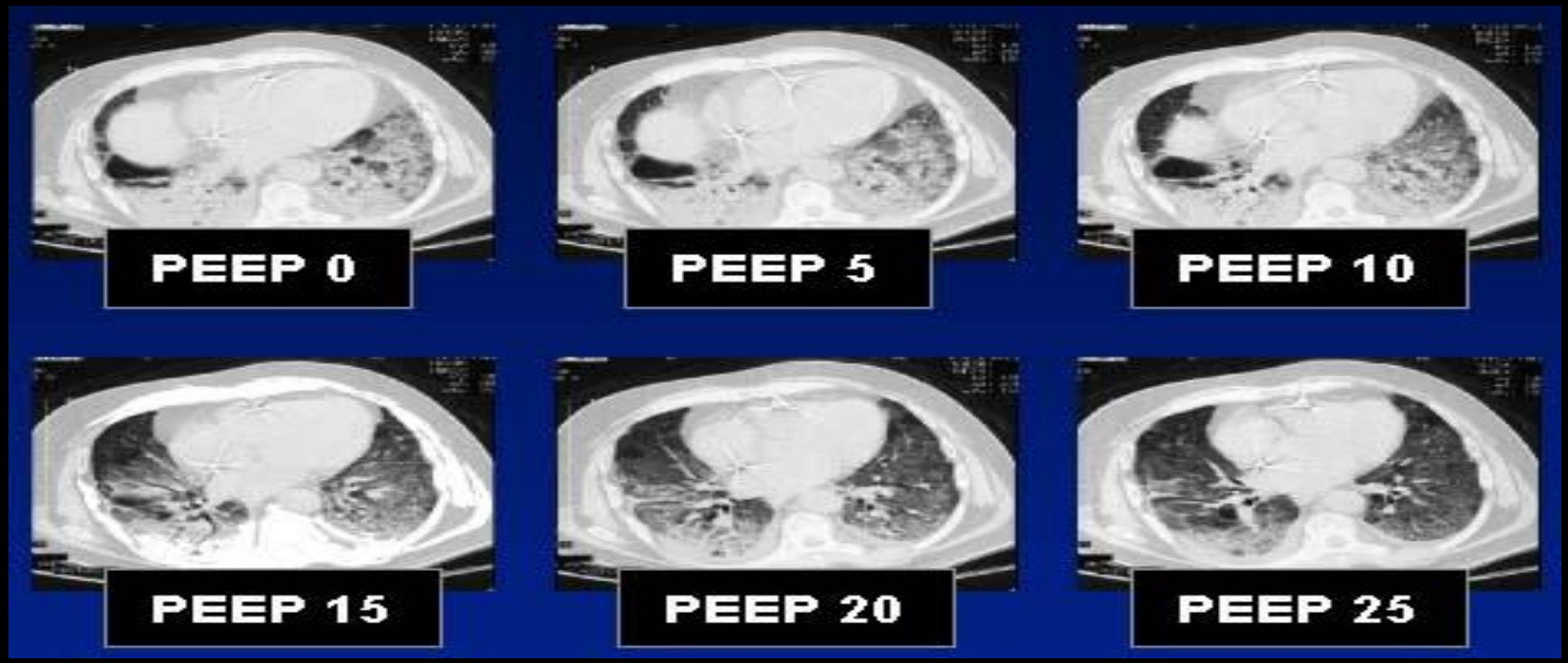
2003

NTUH: Ventilator adjuncts and strategies to improve oxygenation in SARS-ARDS

- Higher PEEP and Recruitment maneuver
- Prone positioning
- ~~APRV/BiLevel~~
- ~~High frequency oscillation (?)~~
- ~~Inhaled nitric oxide~~
- ~~ECMO~~
- Fluid restriction
- Corticosteroids (?)…



PEEP / Recruitment Maneuver in ARDS



Sustained
CPAP 35 cmH_2O

FiO_2 60 mmHg $PaCO_2$ 200 mmHg

PEEP 5 cmH_2O

2003

RM protocol for SARS-ARDS at NTUH

1. ↑ PEEP stepwise to 30 cm H_2O within 30 seconds
2. PCV mode, IP: 20 cm H_2O above PEEP
3. Maintained at this level for 60 seconds
4. PEEP ↓ in 3-5 cm H_2O decrements back to baseline over a period of 60 seconds
5. IP also returned to the baseline level

- This RM was performed twice with two minutes of baseline ventilation in between

Modified from Villagra A. AJRCCM 2002, 165:165-170

Prone position in ARDS

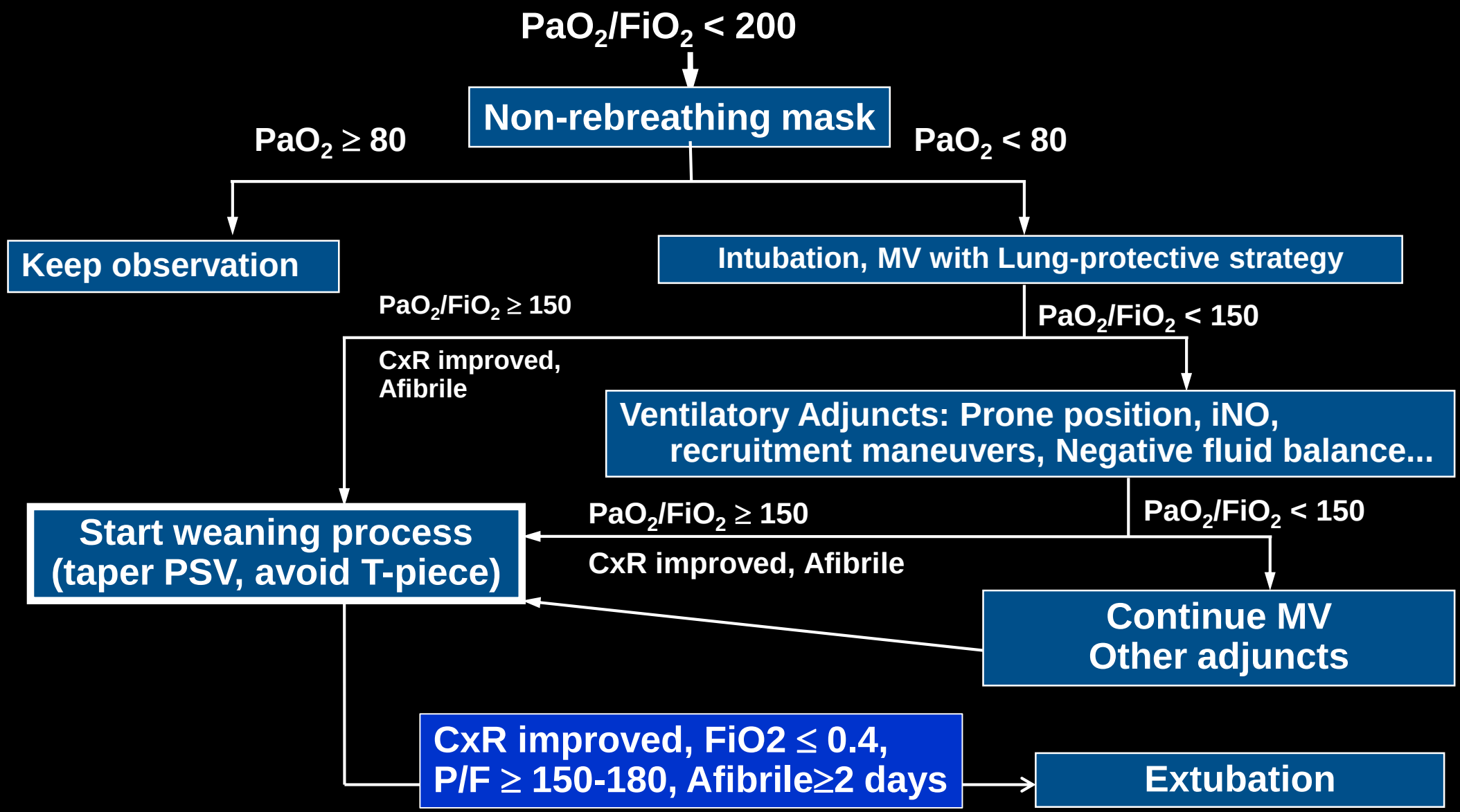
2003

Albumin infusion and negative fluid balance: Protocol

- 50 ml of 25% albumin q8h
- Each course : 3 days.
- Intermittent furosemide infusion to maintain a negative fluid balance
- Avoid systolic BP < 90 mm Hg or CVP < 2 mm Hg

2003

NTUH: Algorithm for SARS-ARDS



Kuo PH, Yu CJ et al 2003

Extubation

拔管步驟：

1. 向病人解釋步驟，並準備器材
2. 抽吸呼吸道與口腔的分泌物
3. 當病人深吸氣後把氣管內管氣囊內空氣排除，把管子拔除，並鼓勵病人咳嗽
4. 給病人氧氣口罩，氣濃度與拔管前一樣
5. 觀察病人至少一天

For SARS-ARDS: Failure is not an option !

2003

SARS-ARDS at NTUH (n = 23)

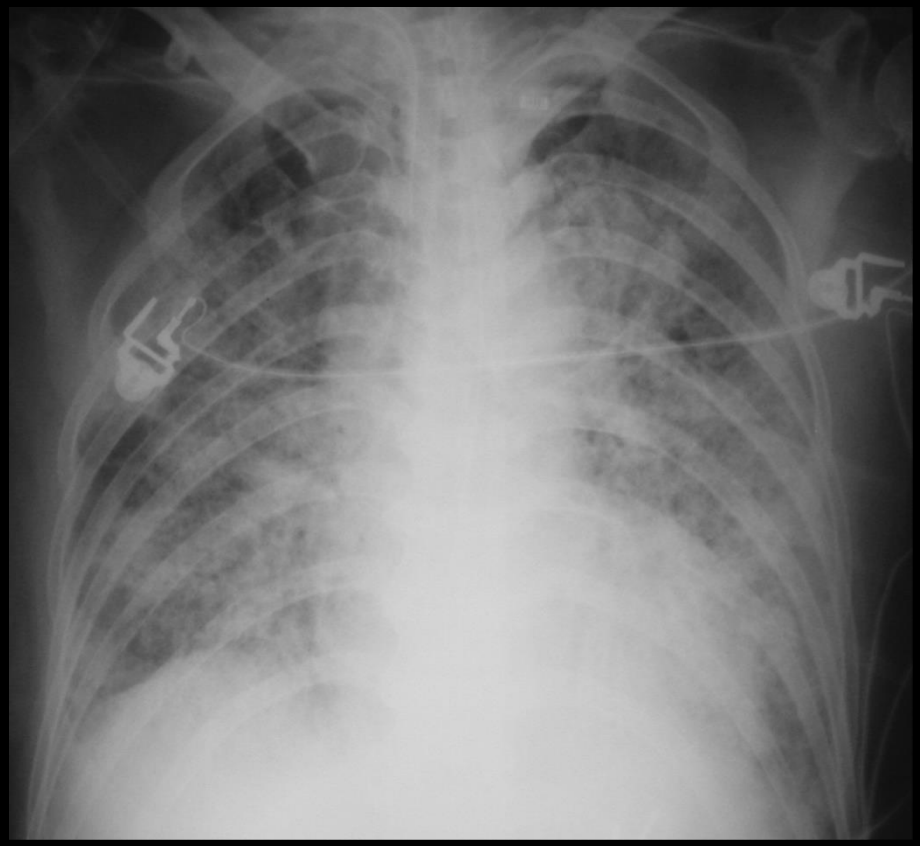
- M 12, F 11, Age; 50.0 ± 16.8 yr (25 - 78).
- Health care workers: 6 patents (none from NTUH)
- Baseline comorbidities : 7 patients (31%)
- Symptoms : fever (100%), cough (100%), dyspnea (100%), myalgia (30%), diarrhea (39%)
- Lab: lymphopenia (87%), thrombocytopenia (70%), elevated LDH (100%), elevated CPK (95.6%)
- Mortality: N = 6 (26%)

Ventilator data	Survivors (N=17)	Nonsurvivors (n= 6)	p
PEEP	11.8 ± 3.6	10.5 ± 2.7	NS
Compliance	22.1 ± 7.2	18.0 ± 5.7	NS
MV days	25.8 ± 27.6	21.8 ± 9.0	NS
Time to intubation (d)	4.3 ± 3.8	1.2 ± 0.9	0.04

2003

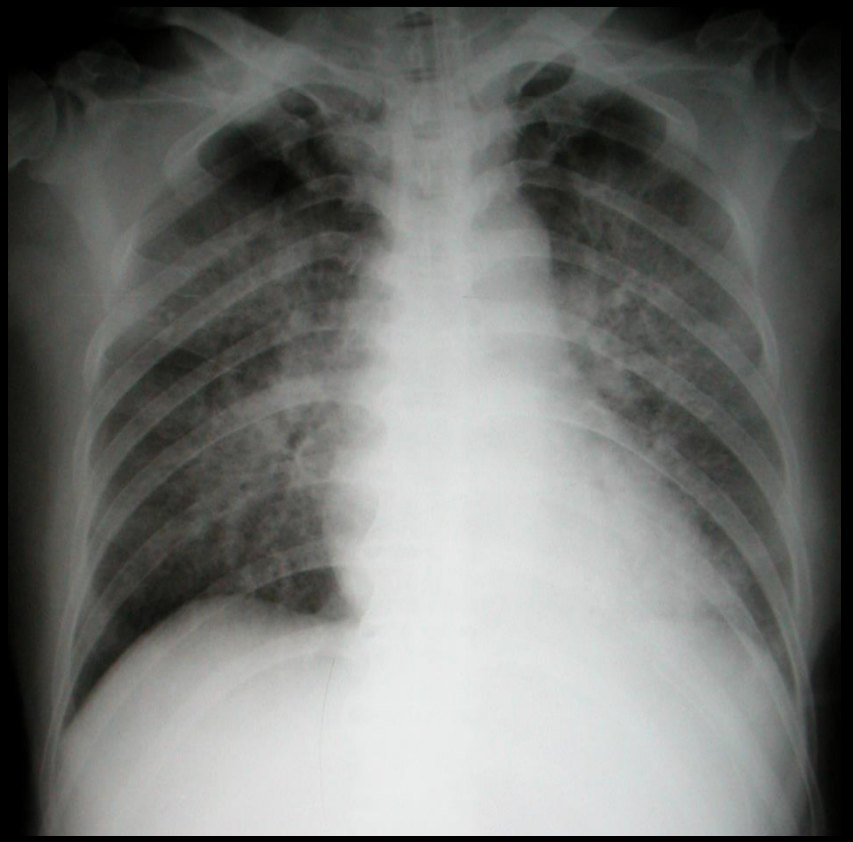
Recruitment maneuver in SARS-ARDS

72 y/o Female



Pre-RM

$PaO_2/FiO_2 = 51$



Post-RM

$PaO_2/FiO_2 = 79$

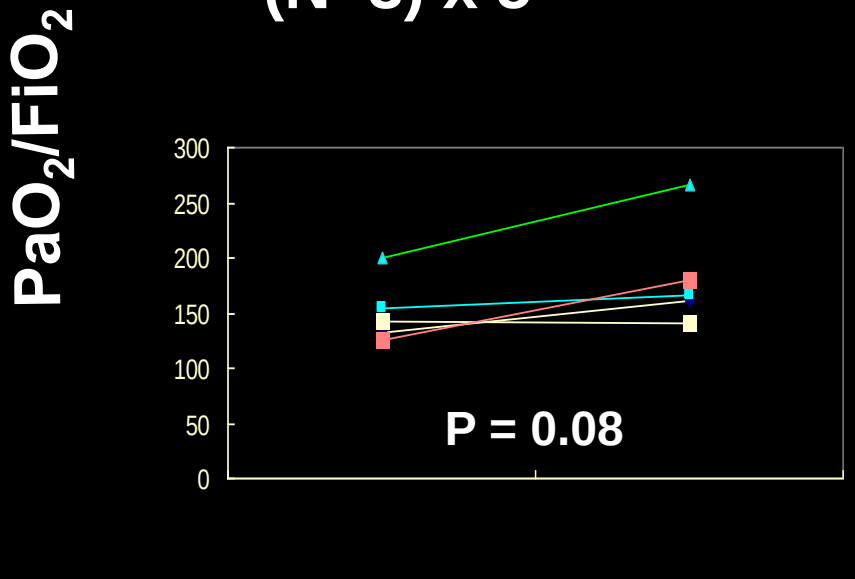
PH Kuo et al. ATS 2004

2003

Management of hypoxemia in SARS-ARDS (NTUH)

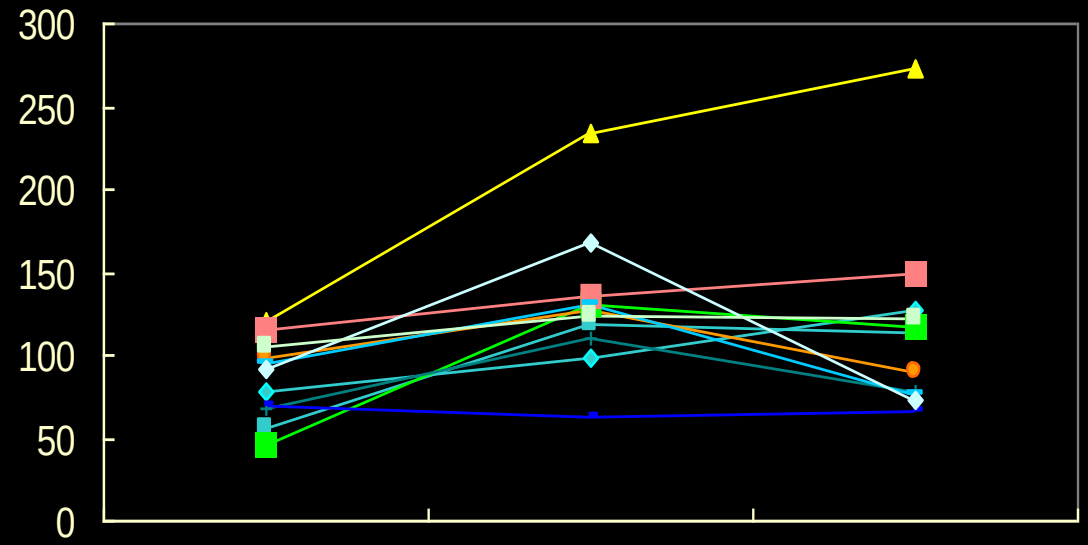
Recruitment maneuver

(N=3) x 5



Prone positioning

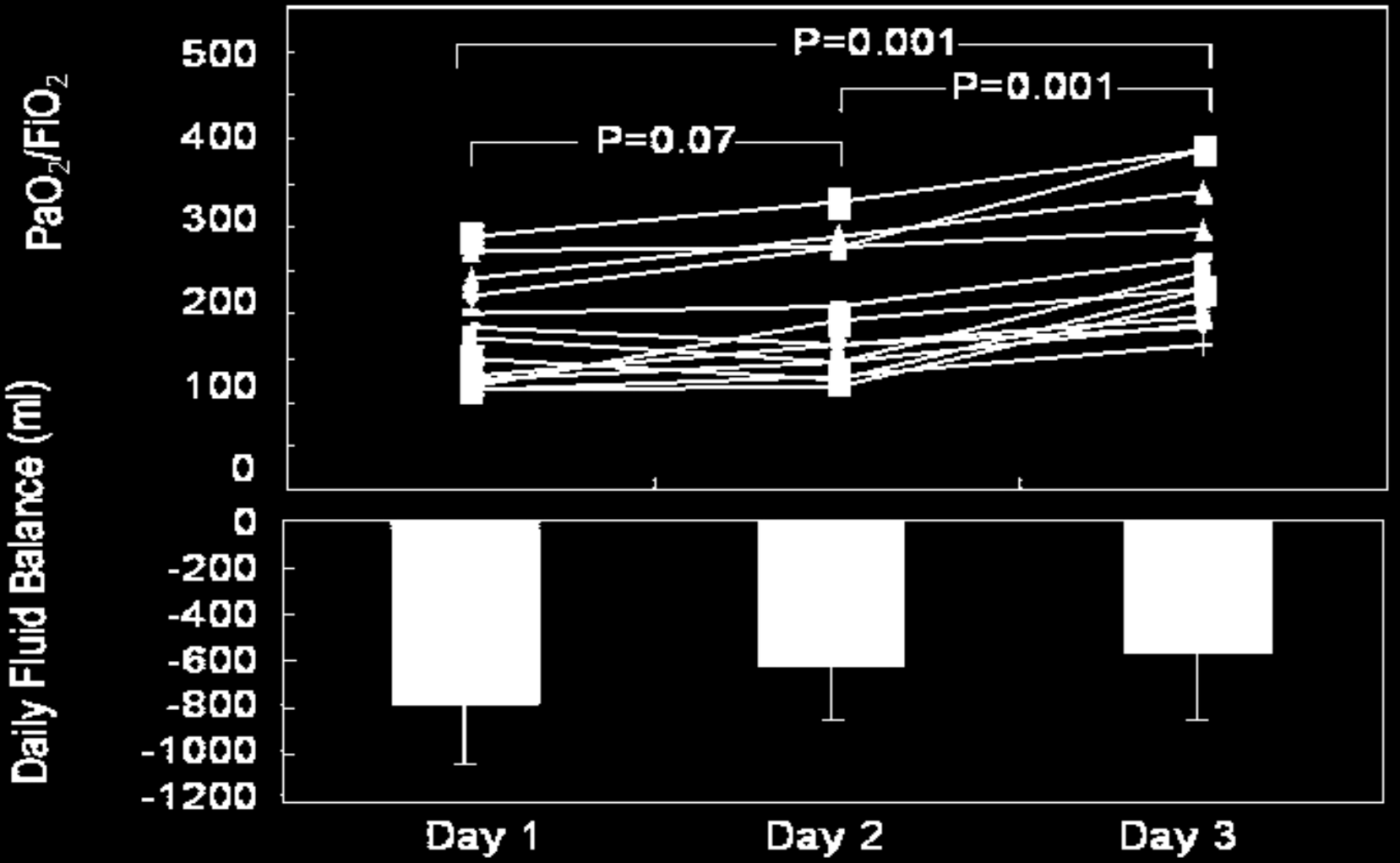
(N=6) x 11



PH Kuo et al. ATS 2004

2003

Changes in PaO_2/FiO_2 and daily fluid balance in 8 patients with SARS-ARDS at NTUH



PH Kuo et al. ATS 2004

2003

SARS-ARDS at NTUH (n = 23)
Associated conditions in ICU

- VAHS : 2 cases (8.6%)
- Severe rhabdomyolysis : 2 cases (8.6%)
- Acute renal failure : 5 cases (21.7%)
- Subcutaneous emphysema: 2 cases (8.6%)
- Pneumothorax: 1 case
- Nosocomial pneumonia: 12 patients (52.1%)
- Septic shock : 9 patients (39%)

PH Kuo et al. ATS 2004

2003

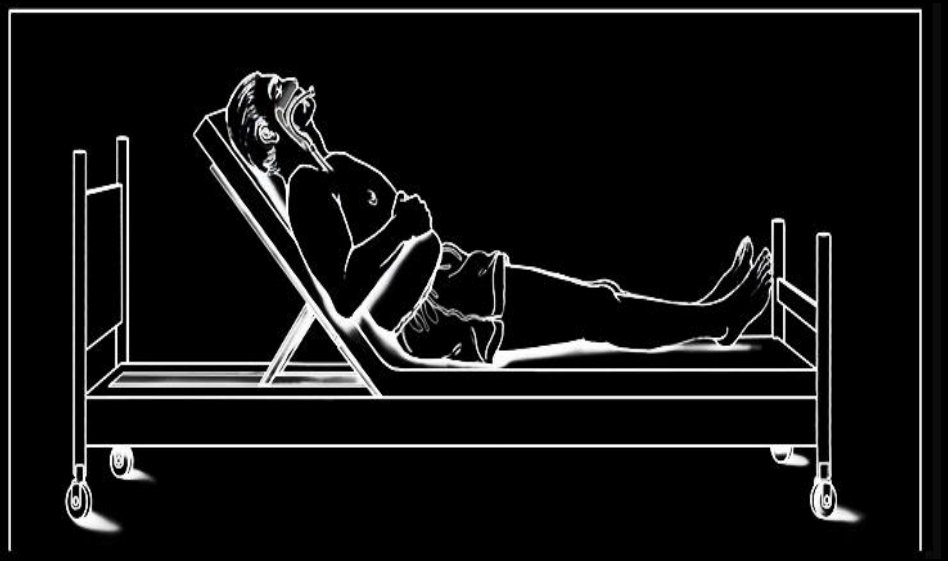
ICU Nosocomial infections in SARS-ARDS (N=12)

Patient	Blood/CVP tip cultures	Sputum culture
1	MRSE	PDRAB, *Steno maltophilia*
2		*P. Aerigenosa*
3	MRSE	MSSA, *K. pneumonia*
4		*K. pneumonia*
5		PDRAB, *K. pneumonia*
6	MRSA	PDRAB
7	MRSA	
8	CNS, *K. pneumonia*	*K. pneumonia*, *H. Influenzae*
9		MRSA
10		*P. Aerigenosa*
11	PDRAB	PDRAB
12		CNS

預防院內感染之重要性!!

"Bundles" for VAP prevention

- Hand-washing
- Head of bead elevation
- Ulcer prophylaxis
- Daily evaluation for sedation



Semi-recumbency

2003

Outcome of 17 survivors of SARS-ARDS at NTUH (as of Oct 11, 2003)

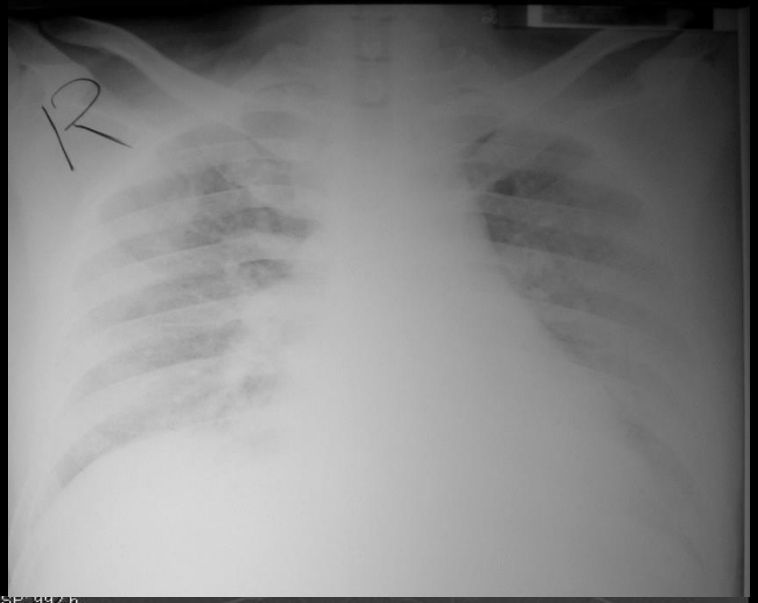
- Severe pulmonary fibrosis: 3 cases (17.7%)
- Tracheostomy: 3 cases (17.7%)
- T-E fistula: 1 case (5.9%)
- Critical ill polymyoneuropathy (CIP) : 4 cases (23.5%)
- Ventilator-dependence : 1 case

70 y/o F, SARS-ARDS

PH Kuo et al. ATS 2004

2003

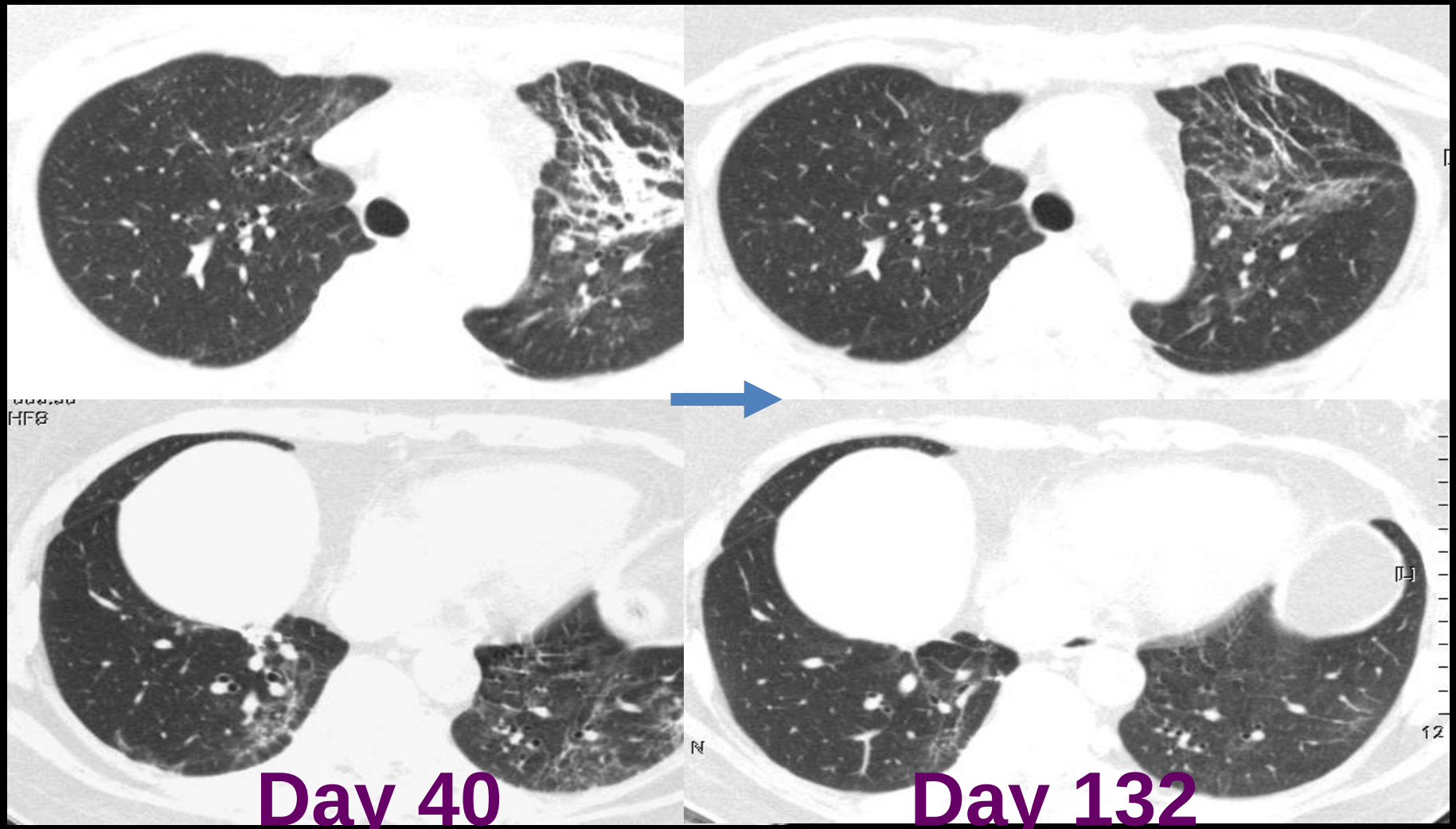
31 y/o male, SARS-ARDS
ICU-acquired weakness



PH Kuo et al. ATS 2004

2003

HRCT changes in SARS



2003-6-25

2003-9-25

Chang YJ et al

2005

HRCT of SARS Patients at NTUH (n=40)

	GGO	Interstitial opacity	Air trapping
ARDS (n=16)	11.12±8.32[a]	7.50±8.66	5.06±3.06
No ARDS (n=24)	4.36±3.89	3.28±3.72	4.44±4.06
Male (n=15)	9.33±8.02	5.87±6.42	5.00±2.67
Female (n=25)	5.62±5.72	4.38±6.43	4.50±4.19
PS (n=11)	13.91±8.20[b]	9.73±9.28	6.64±4.82
No PS (n=29)	4.59±3.98	3.28±3.86	4.07±2.94
IVIG (n=28)	6.79±7.31	4.61±6.42	5.00±4.01
No IVIG (n=12)	8.00±5.69	6.28±6.57	4.25±2.83

[a]: p=0.009, [b]: p=0.001, PS, pulsed steroid therapy; IVIG, intravenous immunoglobulin.

Yeun-Chung Chang, Chong-Jen Yu, Shan-Chwen Chang, Jeffrey R. Galvin, Hon-Man Liu, Cheng-Hsiang Hsiao, Ping-Hong Kou, Kuan-Yu Chen, Teri J. Franks, Kou-Mou Huang, Pan-Chyr Yang

Radiology Sep 1, 2005

2004

台灣醫學 2004 年 8 卷 1 期

特輯　嚴重急性呼吸道症候群（SARS）

SARS 病人之呼吸治療及肺功能變化

郭炳宏　余忠仁

臺大醫院胸腔內科

Kuo PH and Yu CJ, 2004

2004

PFT in 37 SARS survivors

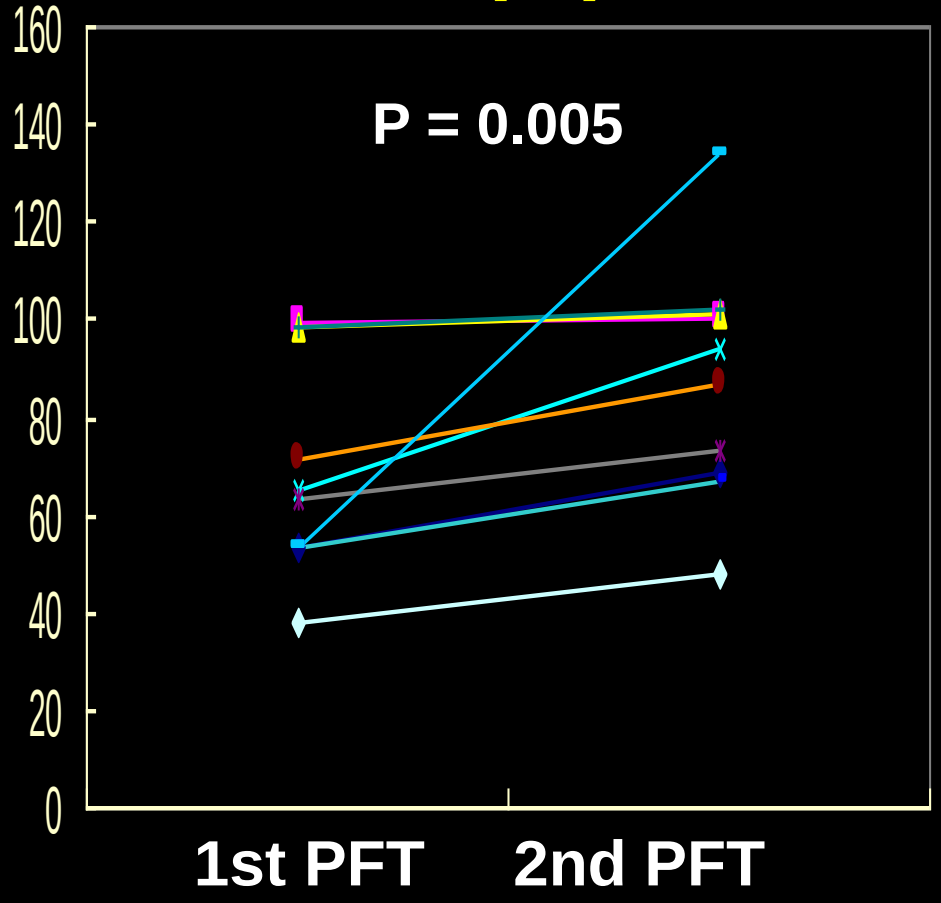
Timing (after discharge)	1st month (N=37)	3rd month (N=22)	p
FVC (%)	71.3 ± 23.4	98.1 ± 19.6	0.004
FEV_1 (%)	73.9 ± 21.0	96.5 ± 17.9	0.005
FEV_1/FVC (%)	91.0 ± 6.8	85.8 ± 8.0	0.16
FEF_{25-75} (%)	91.4 ± 23.7	87.4 ± 30.5	0.65
FRC (%)	95.6 ± 30.7	117.5 ± 30.2	0.04
TLC (%)	86.4 ± 20.3	104.0 ± 14.1	0.03
DLco (%)	88.8 ± 25.7	102.6 ± 16.8	0.19
MVV (%)	80.7 ± 18.9	95.9 ± 14.7	0.03

Kuo PH and Yu CJ, 2004

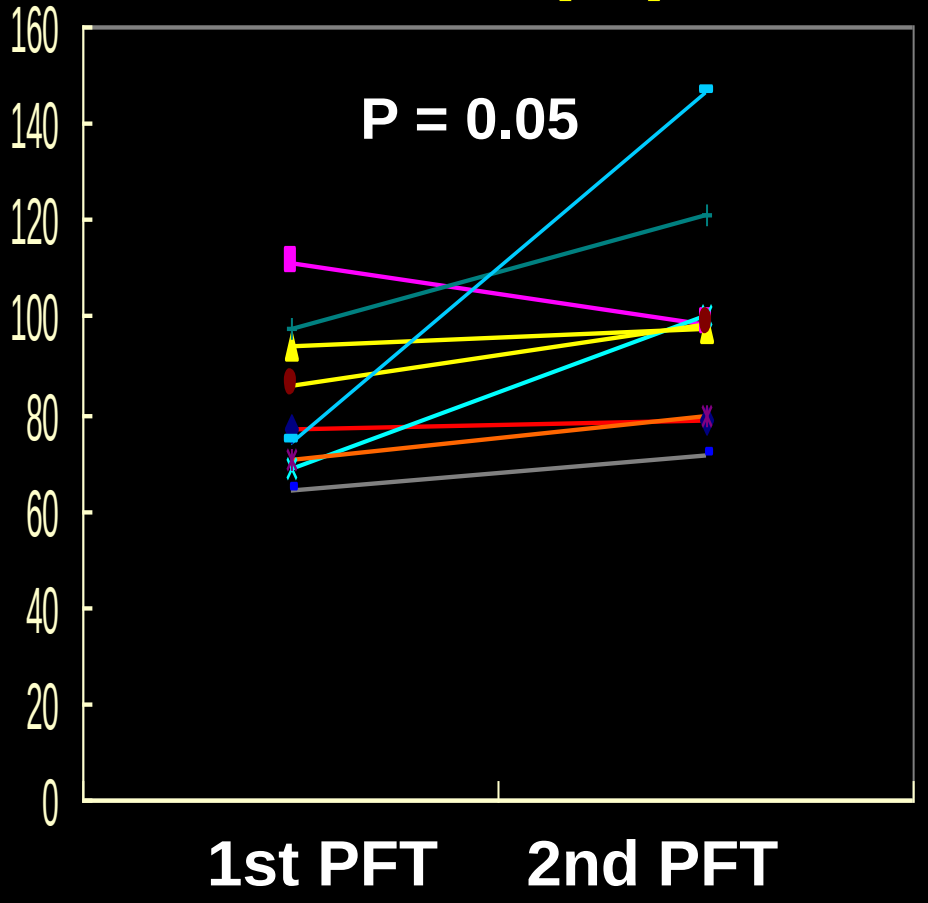
2004

SARS-ARDS (N = 11)

FVC (%)



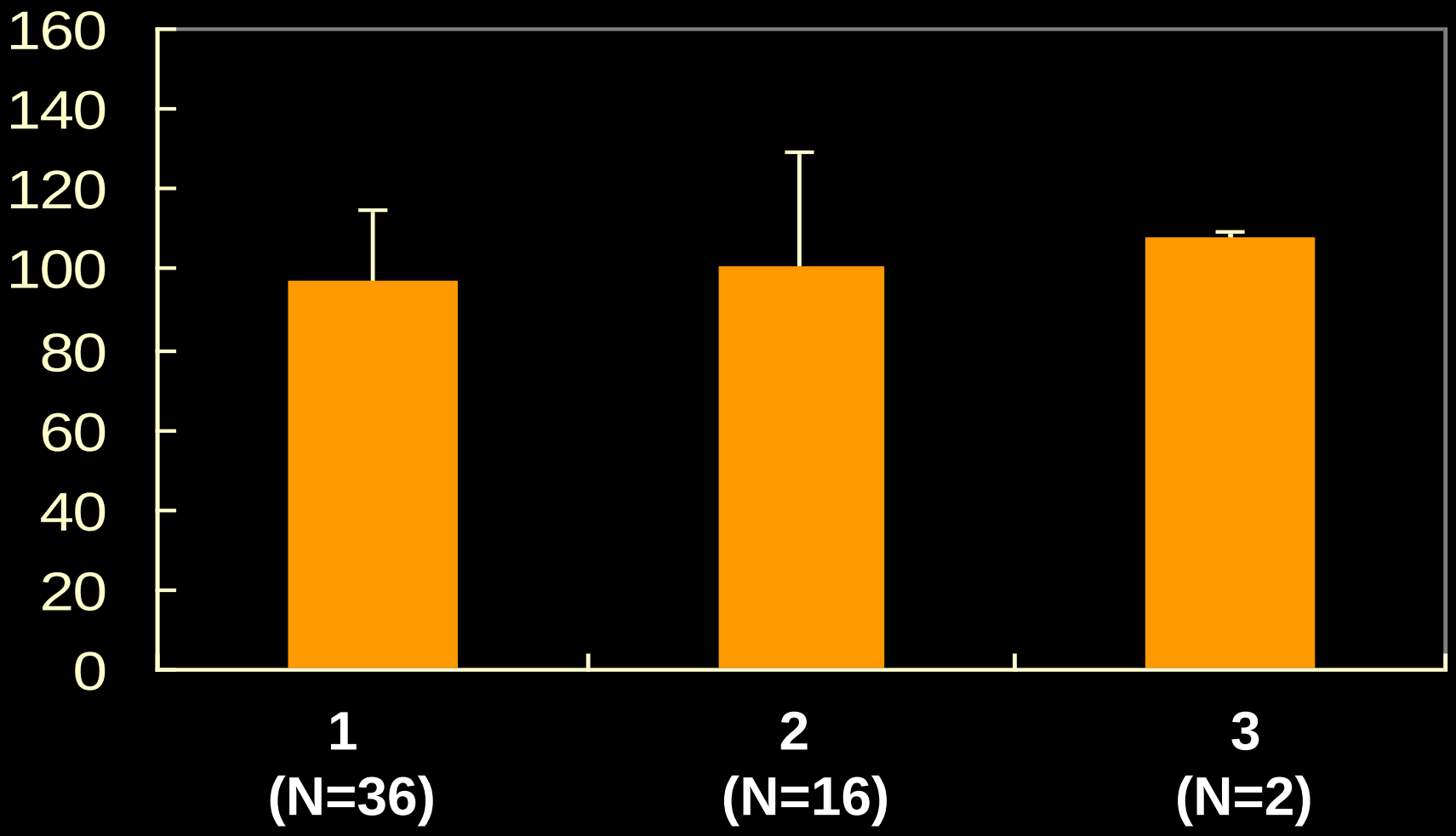
TLC (%)



PH Kuo and CJ Yu, 2004

2004

DLco (% of SARS patients at NTUH



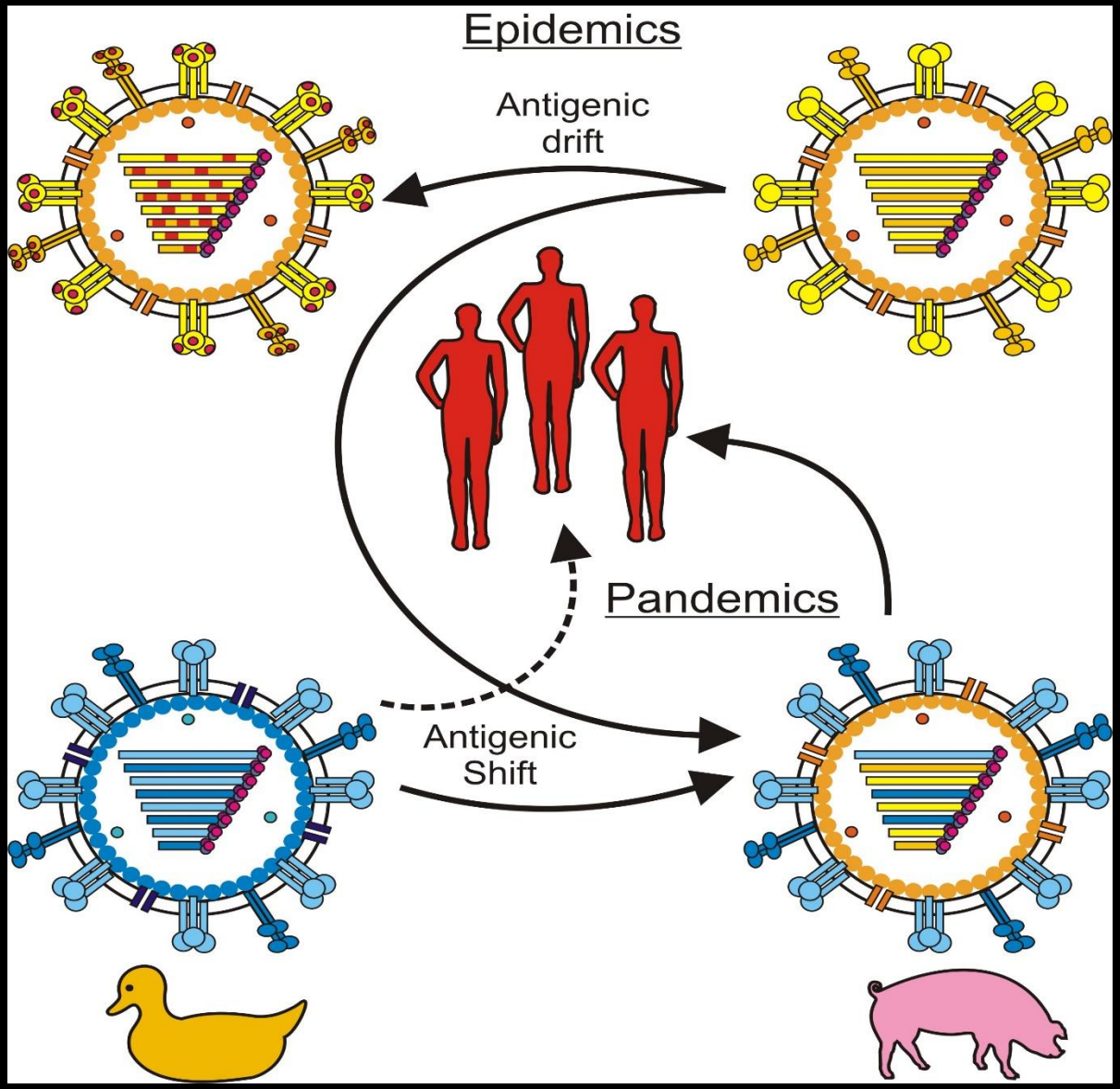
2003

Lessons learned from SARS-ARDS at NTUH

1. Often deteriorate despite medical therapies.
2. May not respond to conventional MV using lung-protective ventilatory strategy.
3. Ventilatory adjuncts (prone position, RM and fluid restriction) may improve oxygenation
4. ICU nosocomial infections are common
5. Optimal supportive care is the key to survival
6. Recovery in survivors is generally good

PH Kuo et al. ATS 2004

Seasonal epidemics and pandemics



Seasonal epidemics
- A(H3N2)
- A(H1N1)/A(H1N1)pdm09
- Influenza B

Pandemics
- H1N1 (1918)
- H2N2 (1957)
- H3N2 (1968)
- H1N1pdm09 (2009)

van de Sandt et al, 2012, Viruses, 4, 1438-1476

2009年H1N1流感大流行台灣情況

4/21	於美國加州發現
5/20	台灣首例境外移入H1N1新型流感病例。一名52歲外籍人士投與克流感治療。[7]
5/24	首例因境外移入病例傳染其密切接觸者之個案。個案是一名40歲台灣女性
6/7-6/11	首宗台灣旅行團境外移入H1N1群聚事件。
7/2	首度發現兩個來自社區的檢體驗出H1N1新型流感病毒。
7/17	首例H1N1住院病例。個案是一名34歲男性
7/30	台灣首例H1N1往生病例。一名39歲的男子，有肝癌、肝硬化與洗腎病史，7月14日發病化，7月30日不治死亡。
8/15	首例孕婦感染H1N1新型流感併發重症病例。
10/20	國內首例對克流感產生抗藥性的H1N1新流感病毒株，台灣為全球第十個發現抗藥性病毒株之國家。

https://zh.wikipedia.org/wiki/2009年H1N1流感大流行台灣情況

2009

重症2009 H1N1各國報告之比較

	病例數	入住 ICU%	P/F ratio	插管率	MV days	死亡率
加拿大	168	100 %	147	81 %	12 days	17.3 % (90 day)
澳洲和紐西蘭	722	28.7 %		64.6 %	7 days	14.3 %
新加坡	12*	100 %	87.9	83 %		50 %

* with severe hypoxemia

N Engl J Med 2009;361:1935-44
JAMA, 2009, 302: 1872-1879
Singapore Med J. 2010 Jun;51(6):490-5.

2009

加拿大重症H1N1

2009年4月16日至7月13日，168例入住加拿大38個成人和兒科ICU重症H1N1患者

Characteristic -- no./total no. (%)	Value
Pregnant	13/168 (7.7)
BMI >30	56/168 (33.3)
Asthma or chronic pulmonary disease	69/168 (41.1)
Diabetes	35/168 (20.8)
Hypertension	41/168(24.4)
Ever smoker	38/168 (22.6)

Lung rescue therapie	%
Neuromuscular blockade	28.0 %
Inhaled nitric oxide	13.7 %
High-frequency oscillatory ventilation	11.9 %
Extracorporeal membrane oxygenation	4.2 %
Prone positioning ventilation	3.0 %

JAMA, 2009, 302: 1872-1879

2009

衛生署疾病管制局

醫療機構照護H1N1新型流感病人之感控措施建議

會引發飛沫微粒(aerosol)產生的醫療處置包括：

- 氣管內插管或拔管
- 氣霧或噴霧治療
- 誘發痰液的採檢
- 支氣管鏡檢查
- 呼吸道抽吸(aspiration)
  (含:鼻咽抽吸及支氣管抽吸)
- 氣管造口護理
- 胸腔物理治療
- 使用正壓呼吸器面罩(例如：BiPAP、CPAP)
- 高頻震盪式呼吸器
- 心肺復甦術
- 屍體解剖等醫療行為

2009年8月疾病管制局H1N1新型流感臨床治療指引

2012

啟用呼吸器輔助呼吸時機

- 絕對適應症：PaO2/FiO2 < 100，或使用Non-rebreathing mask後PaO2 < 80mmHg
- 相對適應症： PaO2/FiO2 < 200，PaCO2 > 50 mmHg或是PH < 7.25及血流動力狀態不穩定
- 建議不要使用非侵襲性呼吸器
- 在治療人員有適當的防護措施下，若病患病情一旦惡化，建議提早插管

1.2009年8月疾病管制局H1N1新型流感臨床治療指引
2.台灣大學麻醉部2003年5月製，SARS病患執行插管操作手冊

2003 SARS後

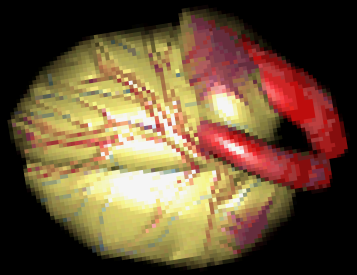
使用呼吸器時應注意事項

- 呼吸器使用拋棄式管路
- 潮溼裝置：優先使用具細菌過濾人工鼻，每兩天或必要時更換一次
- 吐氣端出口加裝細菌過濾器
- 使用密閉式抽痰管路系統，每兩天或必要時更換一次
- 若需使用甦醒球須加裝高效能過濾之人工鼻或細菌過濾器
- 非必要應減少鬆開管路的機會
- 不建議使用噴霧治療，盡量以口服及注射給藥

1.2009年8月疾病管制局H1N1新型流感臨床治療指引
2.台大麻醉部2003年5月:，SARS病患執行插管操作手冊

2012

疫災ARDS重症病患呼吸器之運用



- 使用呼吸器是用來支持病患心肺功能
- 呼吸器運用之終極目標: 讓病患有意義之存活！
- 嚴密觀察和監測是判斷病情變化的關鍵
- 不同病患呼吸器策略應有不同考量
- 應全力保護肺部，避免呼吸器併發症

- 處變不驚 “Don’t panic !”
- 不要氧氣稍有下降就“凍未條”
- 淡定！ 淡定！
- 嚴密監控病情

Kuo PH, 07, Oct, 2012

NIV for viral pandemic ?

2009

NIV and influenza A H1N1 pneumonia

- 34 patients: helmet
- 6 patients: full face mask
- 6 patients: total face mask
- 1 patient: nasal mask

- 31 received PSV
- 11 received PCV
- 5 received CPAP

- Predictors for NIV failure:

  1. Low PaO_2/FiO_2 (< 95) 2. High SAPS II score (> 33)

> 150 hospital staff members: none tested positive for H1N1

Nicolini, et al. ERS, Sep 2012

2020-1-25

Interim guidance for management of COVID-19
(11 pages, 57 refs)

Management of COVID-19

Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected

Interim guidance
28 January 2020

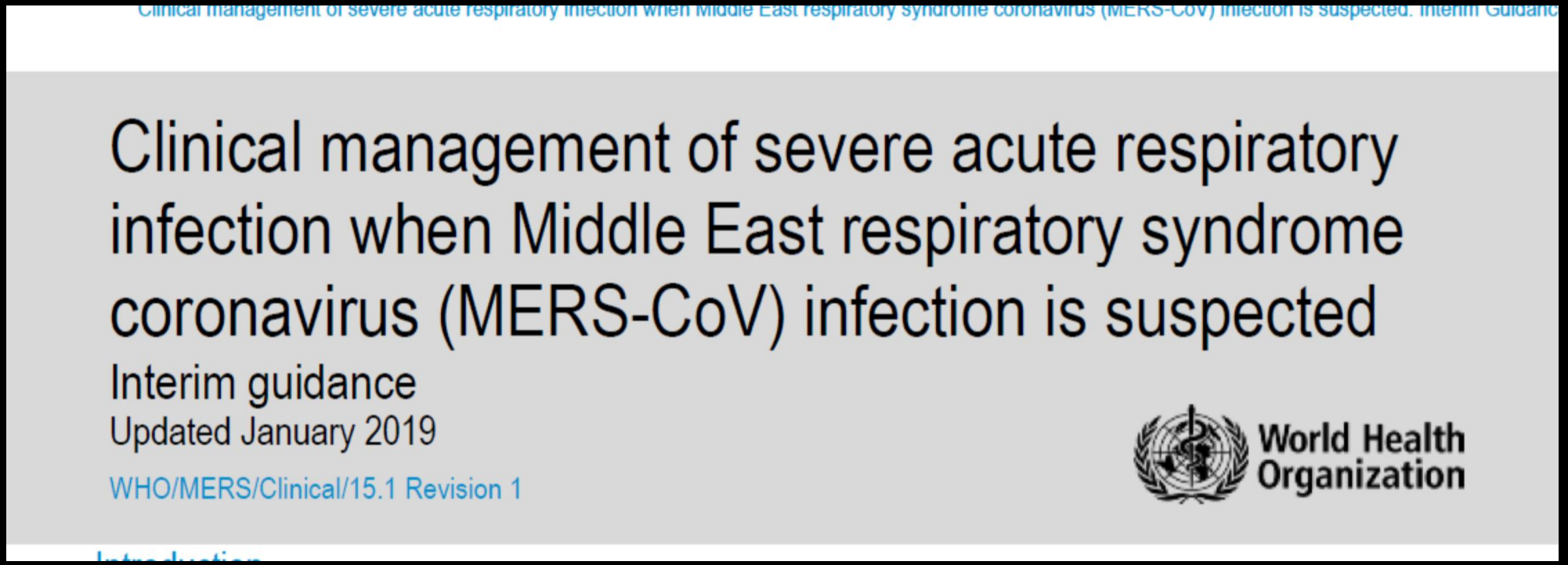
World Health Organization

5. Management of hypoxemic respiratory failure and ARDS

2019-1

Interim guidance for management of MERS
(12 pages, 78 Refs)

Management of MERS


Clinical management of severe acute respiratory infection when Middle East respiratory syndrome coronavirus (MERS-CoV) infection is suspected. Interim Guidanc

Clinical management of severe acute respiratory infection when Middle East respiratory syndrome coronavirus (MERS-CoV) infection is suspected

Interim guidance
Updated January 2019

WHO/MERS/Clinical/15.1 Revision 1

World Health Organization

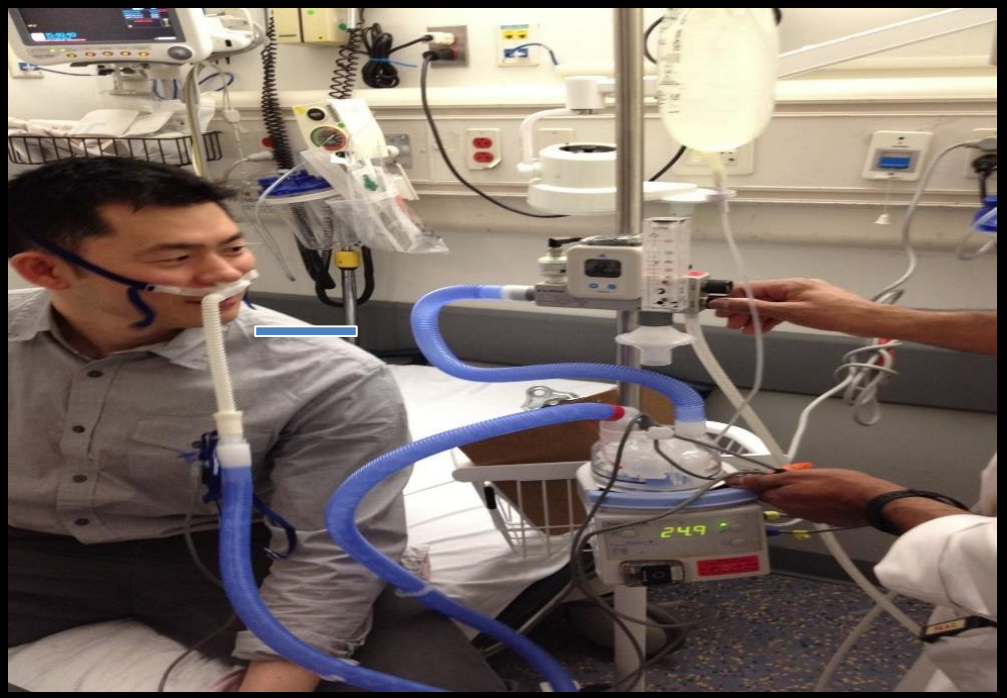
Introduction

5. Management of hypoxemic respiratory failure and ARDS

file:///C:/Users/Ping-Hung%20Kuo/Desktop/MERS%20Mx%20WHO.pdf

High Flow Nasal Cannula (HFNC) for viral pandemic ?

- Delivery of up to 100% FiO_2
- More warmed + humidified gas
- Overcomes inspiratory resistance
- Positive distending pressure for lung recruitment (up to 5-6 cmH_2O- depending on mouth open and leak)



HFNO or NIV

- Should only be used in selected patients with hypoxemic respiratory failure and closely monitored (risk of NIV failure is high in MERS)
- Patients with hypercapnia (exacerbation of obstructive lung disease, cardiogenic pulmonary edema), hemodynamic instability, multi-organ failure, or abnormal mental status should generally NOT receive HFNO,
- Should be cared for by experienced personnel capable of ET intubation in case the patient deteriorates or doe not improve after a short trial (1 hour).
- Risks: delayed intubation, large VT, and injurious transpulmonary pressure.
- Patients with hemodynamic instability, multiorgan failure, or abnormal mental status should not receive NIV.
- Newer HFNO/NIV systems with good interface fitting do not create widespread dispersion of exhaled air: low risk of airborne transmission

Rochwerg B. Eur Respir J 2017;50. Arabi YM. Ann Intern Med 2014;160:389-97.
Leung CCH, J Hosp Infect 2019;101:84-7. Hui DS. Eur Respir J 2019;53. Hui DS. Chest 2015;147:1336-43

Endotracheal intubation

- Should be performed by a trained and experienced provider using airborne precautions.
- Patients with ARDS, especially young children or those who are obese or pregnant, may desaturate quickly during intubation.
- Pre-oxygenate with 100% FiO2 for 5 minutes, via a face mask with reservoir bag, bag-valve mask, HFNC, or NIV.
- Rapid sequence intubation is appropriate after an airway assessment that identifies no signs of difficult intubation

Detsky ME, et al. JAMA 2019;321:493-503

Mechanically ventilated patients with ARDS

- Lower tidal volumes (4–8 ml/kg predicted BW)
- Lower inspiratory pressures (Pplateau < 30 cmH2O).
- Sepsis-induced respiratory failure which does not meet ARDS criteria: initial tidal volume 6 ml/kg; up to 8 ml/kg is allowed if undesirable side effects occur (e.g. dyssynchrony, pH <7.15).
- Hypercapnia is permitted (if pH 7.30-7.45).
- Sedation may be required to control respiratory drive and V_T
- Driving pressure (Pplateau−PEEP) may more accurately predict mortality
- Severe ARDS: prone ventilation for >12 hours/day is recommended.
- Conservative fluid strategy for patients without tissue hypoperfusion.

Rhodes A. Intensive Care Med 2017;43:304-77, ARDS Network Tools. 2014.
Fan E. Am J Respir Crit Care Med 2017;195:1253-63. Amato MB. N Engl J Med 2015;372:747-55

PEEP

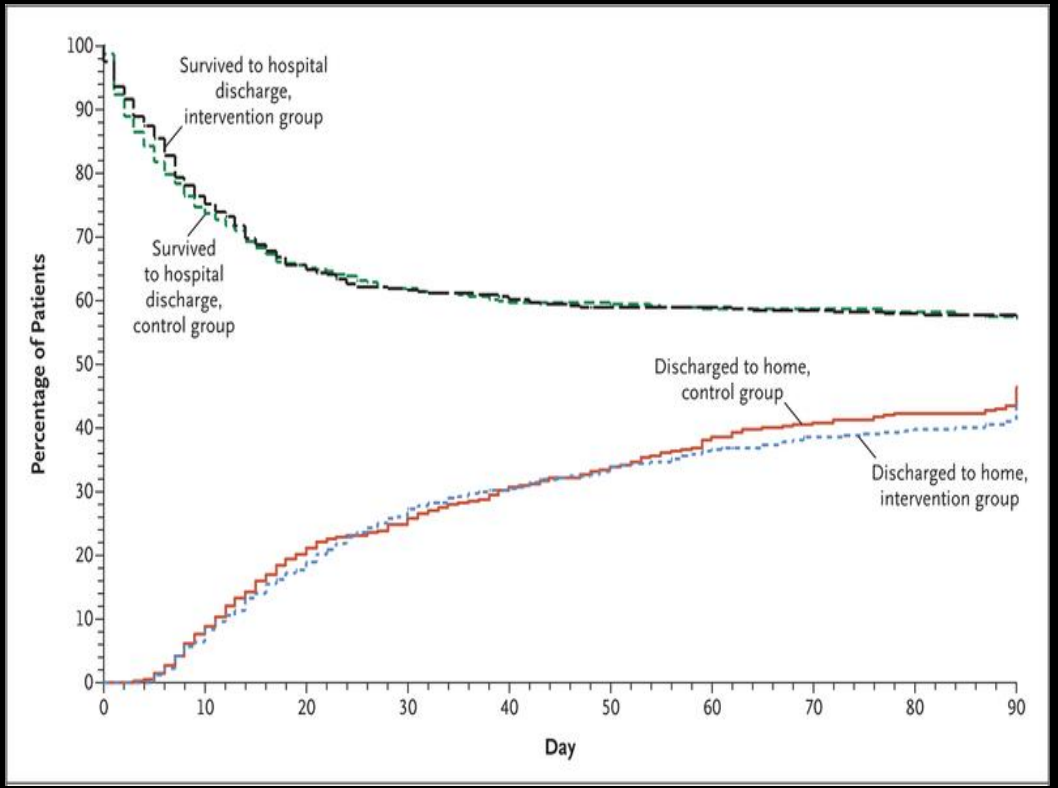
- Moderate or severe ARDS: higher PEEP is suggested.
- PEEP titration: benefits (alveolar recruitment) vs. risks (overdistension and higher PVR)
- Recruitment maneuvers (RMs) is delivered as episodic periods of high CPAP [30–40 cm H2O], progressive incremental increases in PEEP with constant driving pressure, or high driving pressure
- Monitoring of patients to identify those who respond to the initial application of higher PEEP or a RM, and stopping these interventions in non-responders, is suggested

Fan E. Am J Respir Crit Care Med 2017;195:1253-63. Goligher EC. Am J Respir Crit Care Med 2014;190:70-6

Neuromuscular blockade

- Moderate to severe ARDS (P/F < 150): NM blockade by continuous infusion should NOT be routinely used.

- This strategy improved survival in severe ARDS *(NEJM 2010),*
- A recent trial: NM blockage with high PEEP strategy was not associated with 90-day survival benefit *(NEJM 2019)*



- NM blockade may still be considered in : ventilator dyssnchony despite sedation, such that tidal volume limitation cannot be reliably achieved; or refractory hypoxemia or hypercapnia.

Papazian L,acouin A, et al. N Engl J Med 2010;363:1107-16.
NHLBI PCTN, et al. N Engl J Med 2019;380:1997-200

Extracorporeal life support (ECLS),

- Recent guideline: no recommendation about ECLS in ARDS
- An RCT stopped early : no benefits in 60-day mortality
- ECLS should only be offered in expert centres and that can apply the IPC measures required for 2019-nCoV patients

Combes A. N Engl J Med 2018;378:1965-75. Goligher EC, JAMA 2018;320:2251-9.
Combes A, et al. Am J Respir Crit Care Med 2014;190:488-96. 2018;8:3.

2014 to 2015 in Saudi Arabia	ECMO (*n* = 17)	Control (*n* = 18)	*P* value
In-hospital mortality *n* (%)	11 (64.7%)	18 (100%)	0.020
ICU length of stay (days)[a]	22.5 [12.5–28.3]	7 [4.3–11.5]	0.001
Hospital length of stay (days)	25 [6.3–56.5]	47 [5–76.5]	0.421
Time to death (days)	32 [1–68]	47 [1-93]	0.422
Cause of death *n* (%)			
Septic shock/infection	7 (41.2%)	4 (22.2%)	0.401
Refractory hypoxemia	3 (17.6%)	2 (11.1%)	0.975
Others (undetermined)	1 (5.9%)	12 (66.7%)	0.042

. Alshahrani MS. Ann Intensive Care 2018;8:3

Prevention of complications

Reduce days of invasive mechanical ventilation

- Use weaning protocols that include daily assessment
- Minimize continuous or intermittent sedation, targeting specific titration endpoints (light sedation unless contraindicated) or with daily interruption of continuous sedative infusions

Reduce incidence of ventilator- associated pneumonia

- Keep patient in semi-recumbent position (head of bed elevation 30-45º)
- Use closed suctioning system; periodically drain and discard condensate in tubing
- Use a new ventilator circuit for each patient; once patient is ventilated, change circuit if it is soiled or damaged but not routinely
- Change heat moisture exchanger when it malfunctions, when soiled, or every 5–7 days
- Turn patient every two hours
- Give early enteral nutrition (within 24–48 hours of admission)
- Administer H2 blockers or PPI in patients with risk factors for GI bleeding.

呼吸衰竭之處置
(Management of Respiratory Failure)

If nothing else, Do No Harm !!

2020-2-4, V2

臺大醫院疑似或確診高傳染性新興肺炎插管流程 (成人版) (1)

1. 當有氧合或生命徵象不穩定等造成呼吸衰竭徵象，先以N/C 15 L/min加外科口罩或NRM 15 L/min將病人轉至加護病房負壓隔離室，至加護病房負壓隔離室即刻進行插管處置 (Elective intubation)(若高度懷疑或確診個案請插管前通知麻醉科備援，盡量於下午6點前完成)。
2. 應完成個人完整防護措施下執行氣管內管插管，禁止穿著不完整之防護裝備執行氣管內管插管，即使需緊急插管(Emergent intubation)。
3. 進行插管的場域務必在加護病房負壓隔離室進行。
4. 插管前施打Glycopyrrolate 0.2 mg抑制口水分泌
5. 若病人有自主呼吸，用NRM 15 L/min (or nasal cannula 15 L/min)進行5分鐘插管前給氧 (pre-oxygenation) 禁止使用Ambu-bagging。

2020-2-4, V2

臺大醫院疑似或確診高傳染性新興肺炎插管流程 (成人版) (1)

6. 插管前，以楊克式硬式抽吸管(yankauer suction)清除口腔分泌物。

7. 快速順序插管(rapid sequence intubation; RSI) : sedation + muscle relaxation (共60秒)

A. Sedation (擇一)

a. Etomidate 0.3-0.4mg/kg (TBW) (ex: 1 amp 20mg for 50kg patient) or

b. Ketamine 1.5-2 mg/kg (IBW) (ex: 100mg for 50-70kg patient)

B. Muscle relaxation (擇一)

a. Rocuronium 0.6-1.2mg/kg (IBW) (1 amp 50mg for 50-70kg patient) or
Antidote: Sugammadex: 16mg/kg (4 amp for 50-70kg patient)

b. Succinylcholine 1.5-2 mg/kg (IBW) (ex: 100mg for 50-70kg patient)

8. Video-assisted laryngoscopy: McGrath + 3/4# blade (4# for >180cm)。

9. 若插管失敗，以NRM 15 L/min (or nasal cannula 15 L/min)進行呼吸暫停通氣(Apnea ventilation)(不要Ambu-bagging)，嘗試第二次插管，並通知麻醉科支援。

10. 若插管持續失敗，放置supraglottic airway (如LMA)，此時可考慮暫時先接上Ventilator (Keep PIP<20 cmH2O建議IP=15 cmH2O，PEEP=5 cmH2O，ICU現有機型PB840或R860)，如無ventilator可考慮甦醒球(Ambu)加HMEF filter(備註一)單手壓(請小力壓，不要造成太大壓力)，等待麻醉科支援。

11. 插管完成後以拋棄式EtCO2確認氣管內管位置。

12. 氣管內管位置確認正確後接上呼吸器，使用closed system suction，以楊克式硬式抽吸管(yankauer suction)清除口腔分泌物。

13. 若病人在非加護病房完成插管，運送前請務必先抽好痰及口水，運送過程不可使用portable suction。運送過程以甦醒球(Ambu)加HMEF filter進行Ambu-bagging，不使用portable ventilator。請先叫好電梯等候，確定好運送動線再出發，盡快抵達加護病房。

14. 院內轉送路線要事先規劃好，運送前確認氧氣鋼瓶是否滿桶足夠運送時使用，運送過程中要確保管線的安全，不要耽擱。)加HMEF filter

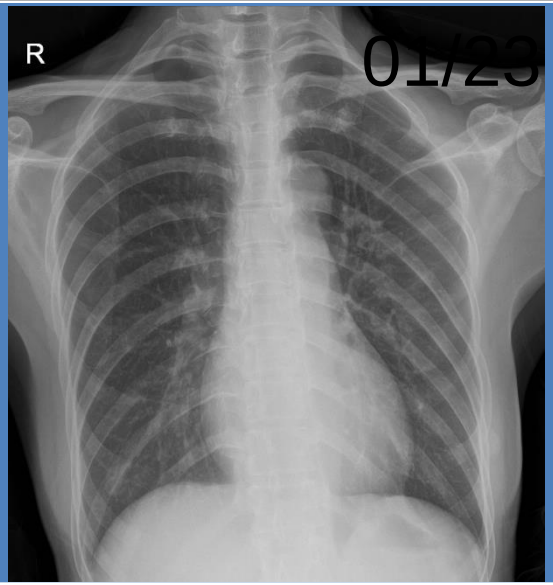
2020

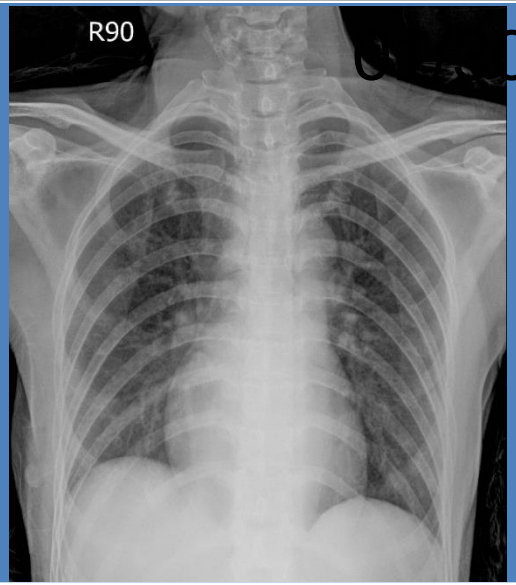
目前台大內科正進行R3-R5及ICU胸腔科VS模擬插管訓練與進開刀房實戰演練

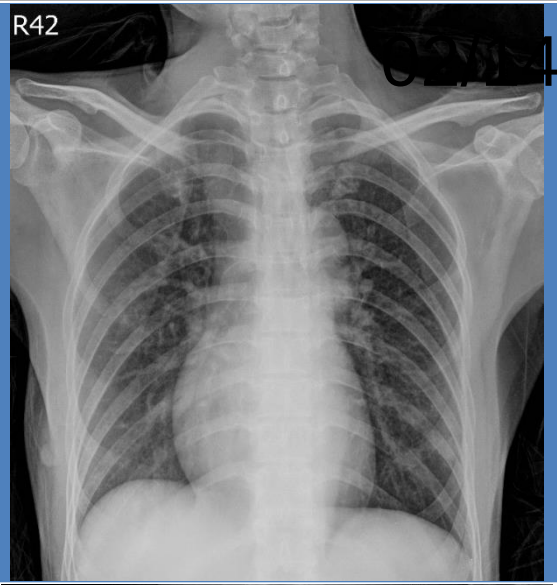
2020

COVID-19 patients at NTUH

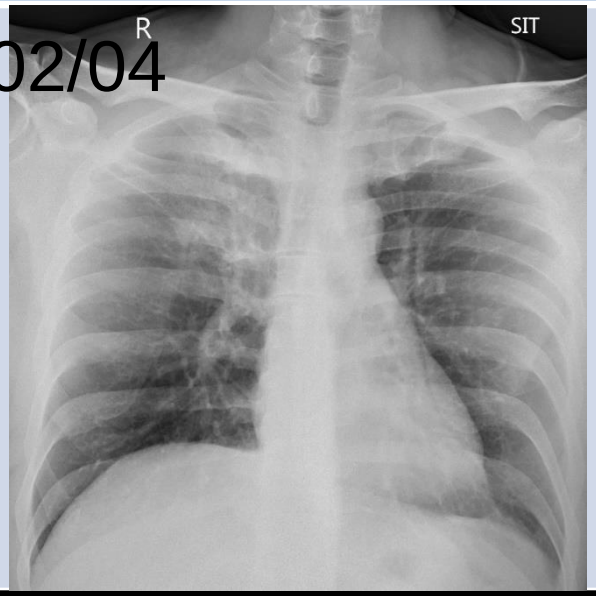
50 F

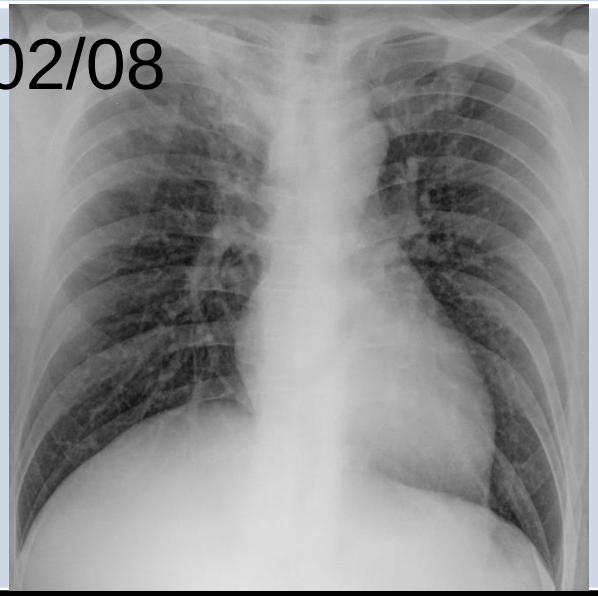


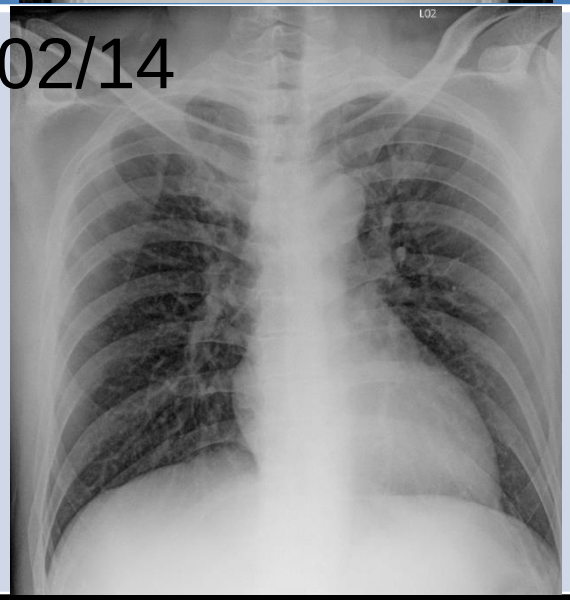




45 M



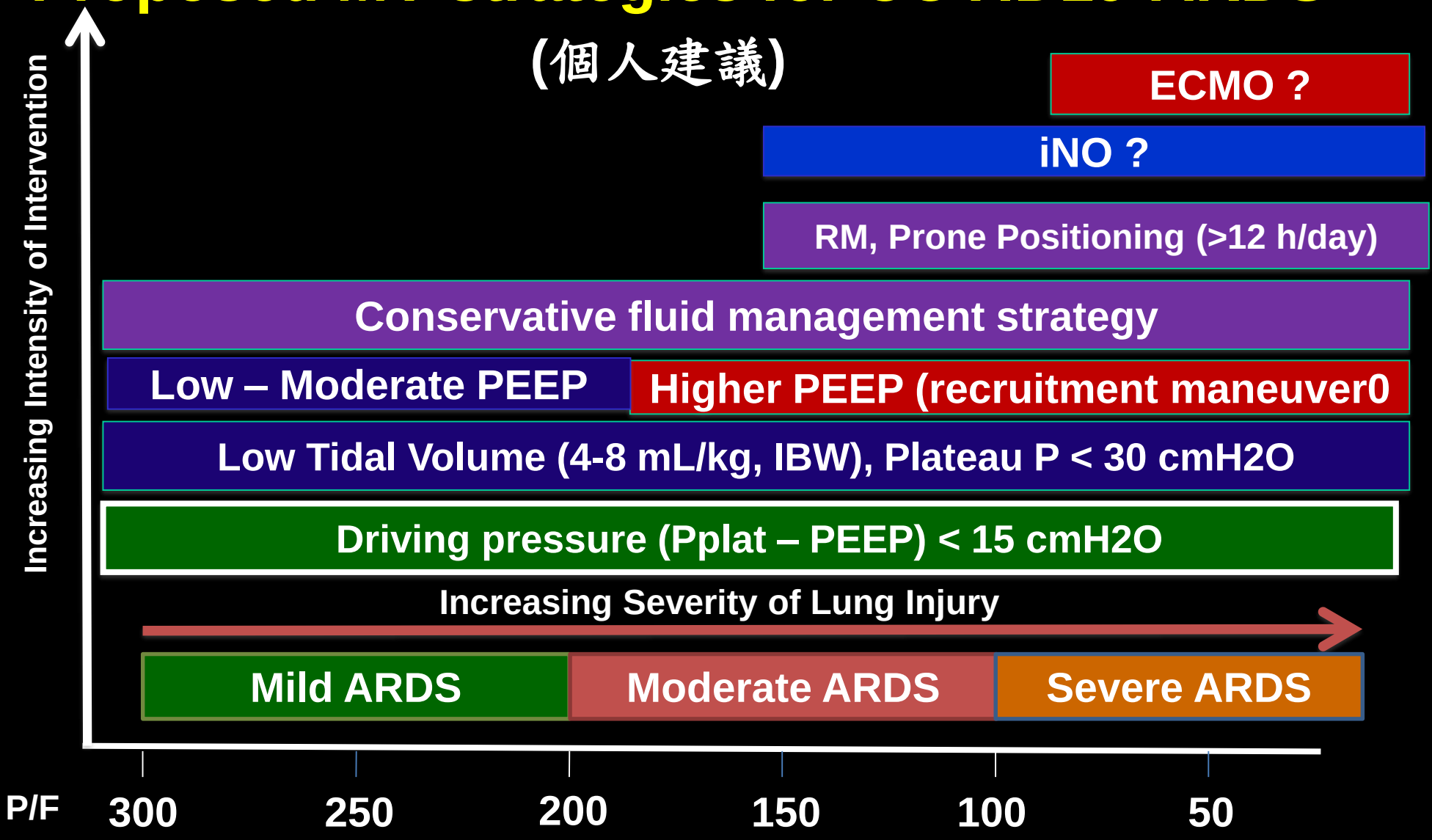




2020

Proposed MV strategies for COVID19-ARDS

(個人建議)



2020

Extubation criteria for COVID19-ARDS
(個人建議)

- Consciousness clear
- Vital signs and hemodynamics stable
- P/F ratio ≥ 180-200
- CxR improvied
- No fevr for ≥ 2-3 days
- SBT using PSV 5-8 cmH_2O successful
- CRP decreased (?)
- ~~RT-PCR for 2019 nCoV negative~~ (???)

中华重症医学电子杂志 2020 年 2 月 第 6 卷 第 1 期 Chin J Crit Care Intensive Care Med, February 2020, Vol

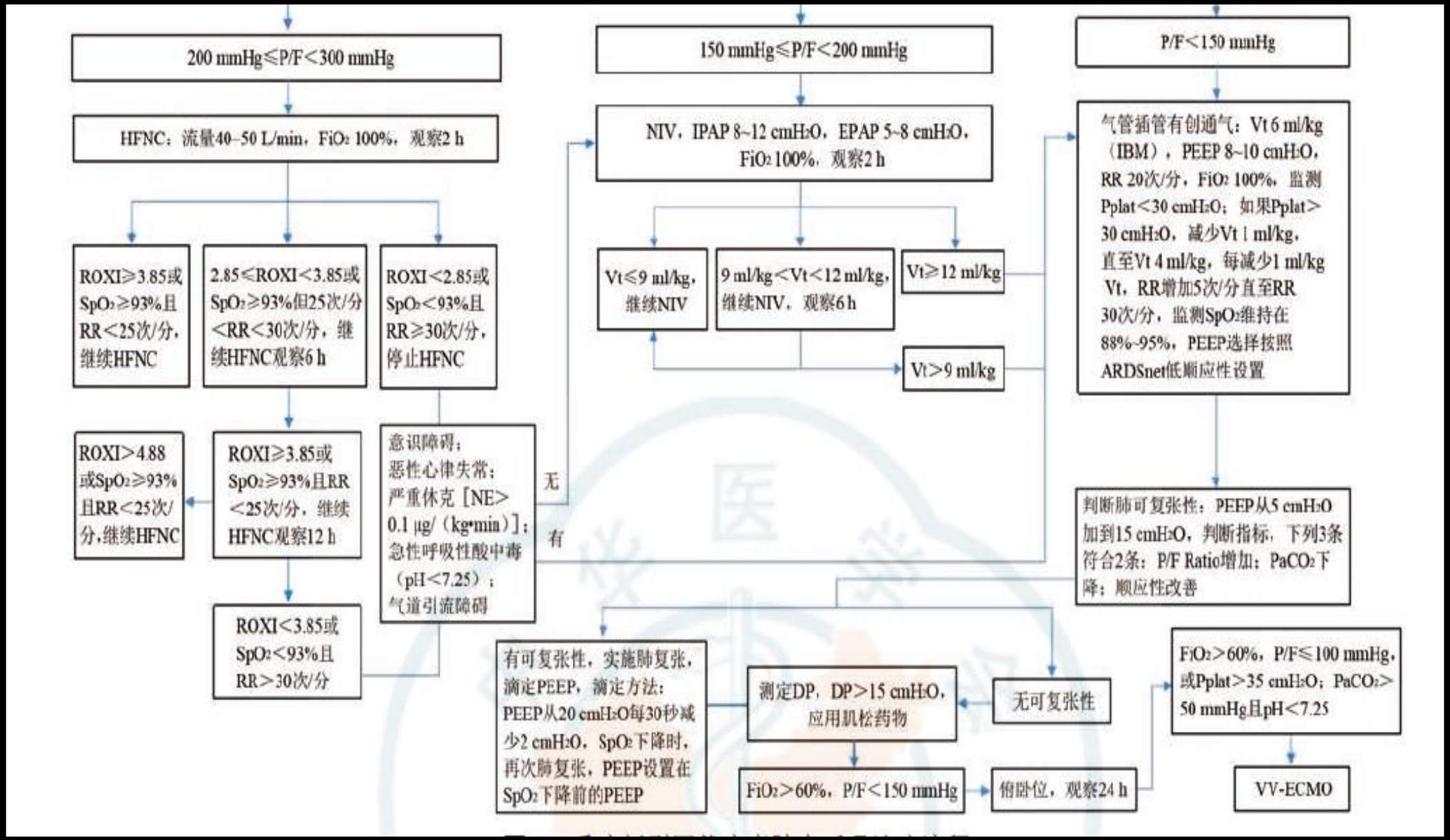
新型冠状病毒肺炎重症患者的管理

奚晶晶 马朋林

中國大陸COVID-19重症患者接受之治療

- 機械通氣: 90%
- 循環支持治療: 10%~ 30%
- 體外膜肺氧合治療(ECMO): 5%~11%
- 連續性腎臟替代之治療（CFRT): 5%~10%

重症新型冠状病毒肺炎呼吸治疗流程



郑瑞强 et al. 中华重症医学电子杂志 Chin J Crit Care Intensive Care Med, February 2020, Vol.6, No.1

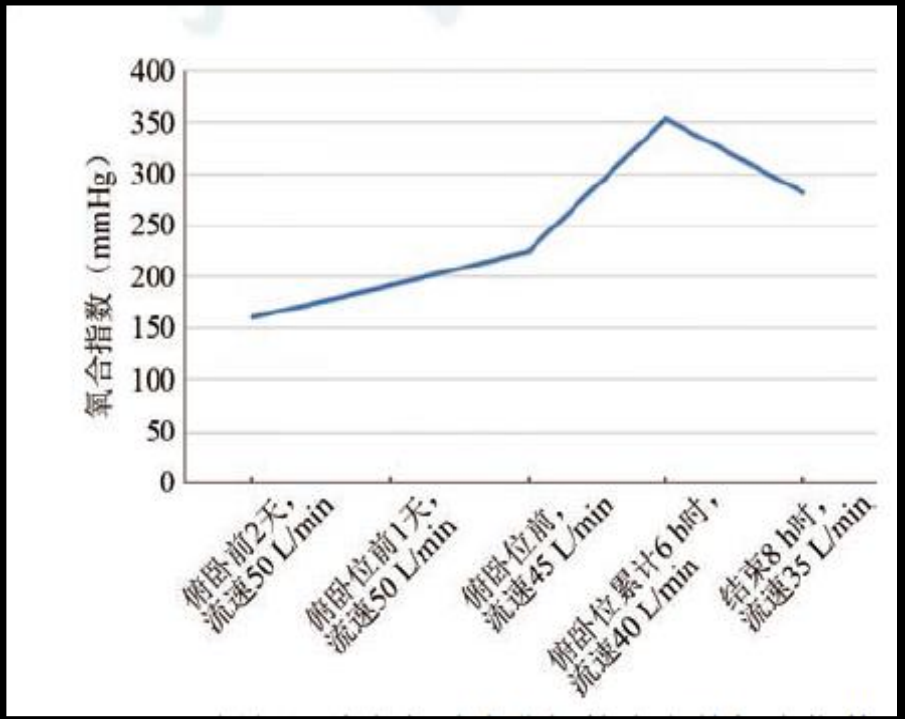
中华重症医学电子杂志 2020 年 2 月 第 6 卷 第 1 期 Chin J Crit Care Intensive Care Med, February 2020, Vol.6, No.1

· 诊治经验

新型冠状病毒肺炎危重症患者救治中优化管理与呼吸治疗的探索

靳欣[1*] 方毅敏[2*] 黄绍华[3] 罗林[4] 秦运检[3] 吴慧[4] 杨明施[1] 艾宇航[5] 彭玥[1]

- 在湖南省常德地區重症患者氣管插管後進行俯臥位通氣效果好，氧合指數能很快改善，從100 左右上升至250 mmHg 以上，影像學也較前好轉。
- 我們對新冠有創機械通氣患者會優先考慮在插管後直接進行俯臥位治療，而非按照ARDS 六步法在插管後先進行肺開放，從而避免了肺開放可能導致的氣壓傷。根據目前實踐的情況來看，該方案是有效的。

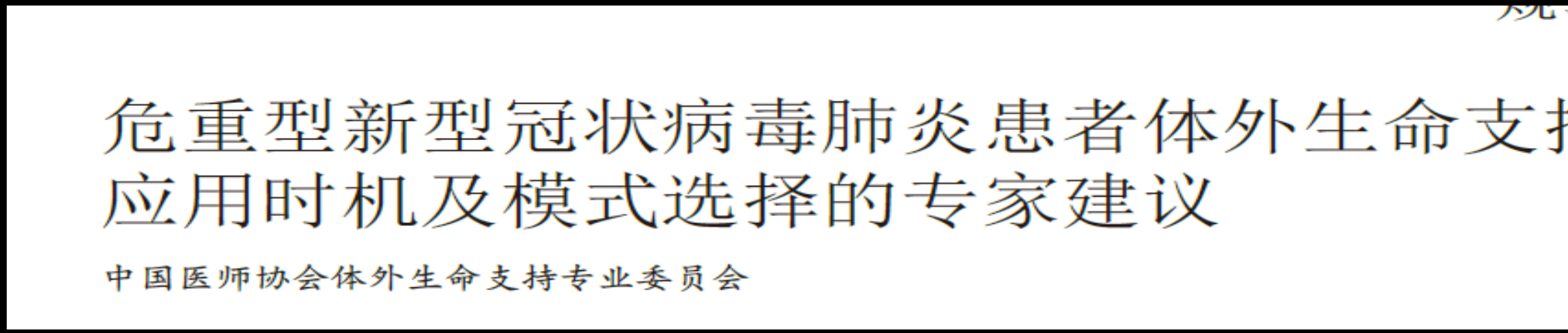


靳欣 et al. 中华重症医学电子杂志 Chin J Crit Care Intensive Care Med, February 2020, Vol.6, No.1

湖南省常德地區新冠肺炎危重症患者呼吸治療流程

靳欣 et al. 中华重症医学电子杂志 Chin J Crit Care Intensive Care Med, February 2020, Vol.6, No.1

危重型新型冠狀病毒肺炎患者體外生命支持應用時機及模式選擇的專家建議(中國醫師協會體外生命支持專業委員會)


危重型新型冠状病毒肺炎患者体外生命支
应用时机及模式选择的专家建议

中国医师协会体外生命支持专业委员会

- ECMO 啓動時機: 在最優的通氣條件下（FiO2 ≥ 80%，潮氣量爲6 ml/kg，PEEP ≥ 10 cmH2O），如果無禁忌證， 且滿足以下條件之一即可啓動ECMO：

1. PaO2/FiO2 ＜ 50 mmHg 超過3 h
2. PaO2/ FiO2 ＜ 80 mmHg 超過6 h
3. FiO2=100%， PaO2/FiO2 ＜ 100 mmHg；
4. pH 值＜ 7.25 且PaCO2 ＞ 60 mmHg 超過6 h， 且呼吸頻率＞ 35 次/min
5. 呼吸頻率＞ 35 次/min 時， 血pH 值＜ 7.2 且平臺壓>30 cmH2O
6. 嚴重漏氣綜合征
7. 合幷心源性休克或者心臟驟停。

中國醫師協會體外生命支持專業委員會. 中華重症醫學電子雜志 February 2020, Vol.6, No.1

2020-2-5

中研院 何美鄉教授

新冠病毒肺炎死亡率:

- 武漢 4.9%
- 湖北 3.1%
- 全球平均 2.1%
- 大陸境外 0.2%

→ 差別就在醫療體系崩潰的程度。

https://news.ltn.com.tw/news/politics/breakingnews/3058382

2003

和平醫院在SARS期間爆發集體感染導致封院

- 4月24日下午1時，和平醫院封院。透過媒體現場直播，我們不斷看到和平院內失控的場景，醫護人員不甘被遺棄，有人抗命不從，拚命想往外逃，有人隔著玻璃窗拉布條哭訴：「我們為什麼要照護SARS病人？」

Ref: 前台大醫院院長李源德臉書

2003

SARS考驗了當時台灣醫療體系、防疫制度，更如照妖鏡般反映人心。

- 台大以不到全國3%的醫護人力，承擔40%的SARS病人，且多是他院不敢收治的嚴重病人
- 這期間無人擅離職守，推託卸責

Ref: 前台大醫院院長李源德臉書

高雄長庚紀念醫院胸腔內科網頁

科史沿革

- 民國92年SARS期間林孟志副教授由林口長庚南下接掌內科部兼胸腔內科主任，專責肩負起領導抗煞的重責大任。在後SARS期間，林部長陪伴大家走出陰霾。

https://www1.cgmh.org.tw/intr/intr4/c8130/intro.asp

2003

COVID-19 對未來台灣呼吸照護人力之影響？

鑑古知今　鑑往知來

- 在網路時代任何資料只要上網查詢即隨手可得之下，更重要的是學習用什麼樣的史觀看待過去與現在。
- 當我們反思歷史時，就等於學習傾聽各種不同的觀點。也能用較高的視角，觀察一件事情長期發展的結果與影響。
- 歷史從來就沒有定論！

東吳大學歷史系林慈淑教授

Acknowledgement

- 感謝每一位曾經照護以及現在正在照護嚴重傳染性病毒肺炎的醫護人員以及呼吸治療師 ！

2020-2-16

同舟共濟，心手相連

革命尚未成功，同志仍需努力

Thank You !