



Severe cases of COVID-19

Medical team in Hubei
Zhongshan Hospital, Fudan University
East Branch, Rennin Hospital of Wuhan University

Zheyong huang,Jiatian Cao
Shanghai Institute of Cardiovascular Diseases
Dept. of Cardiology, Zhongshan Hospital

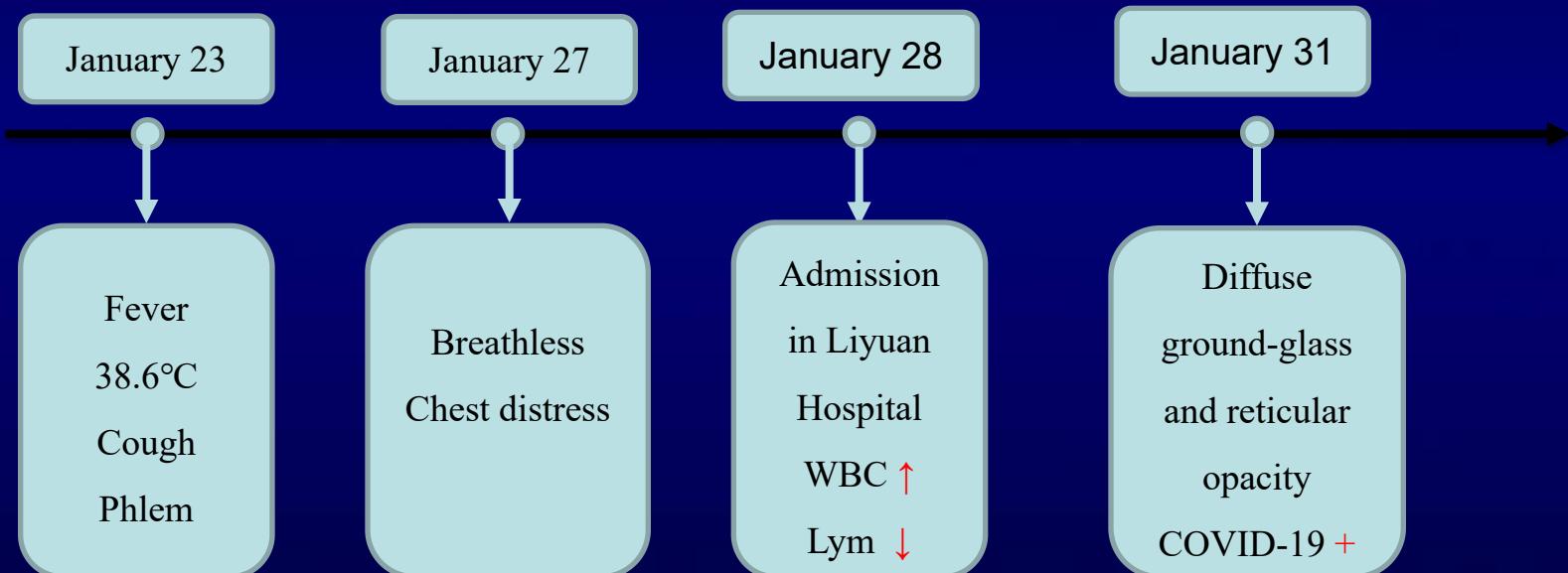


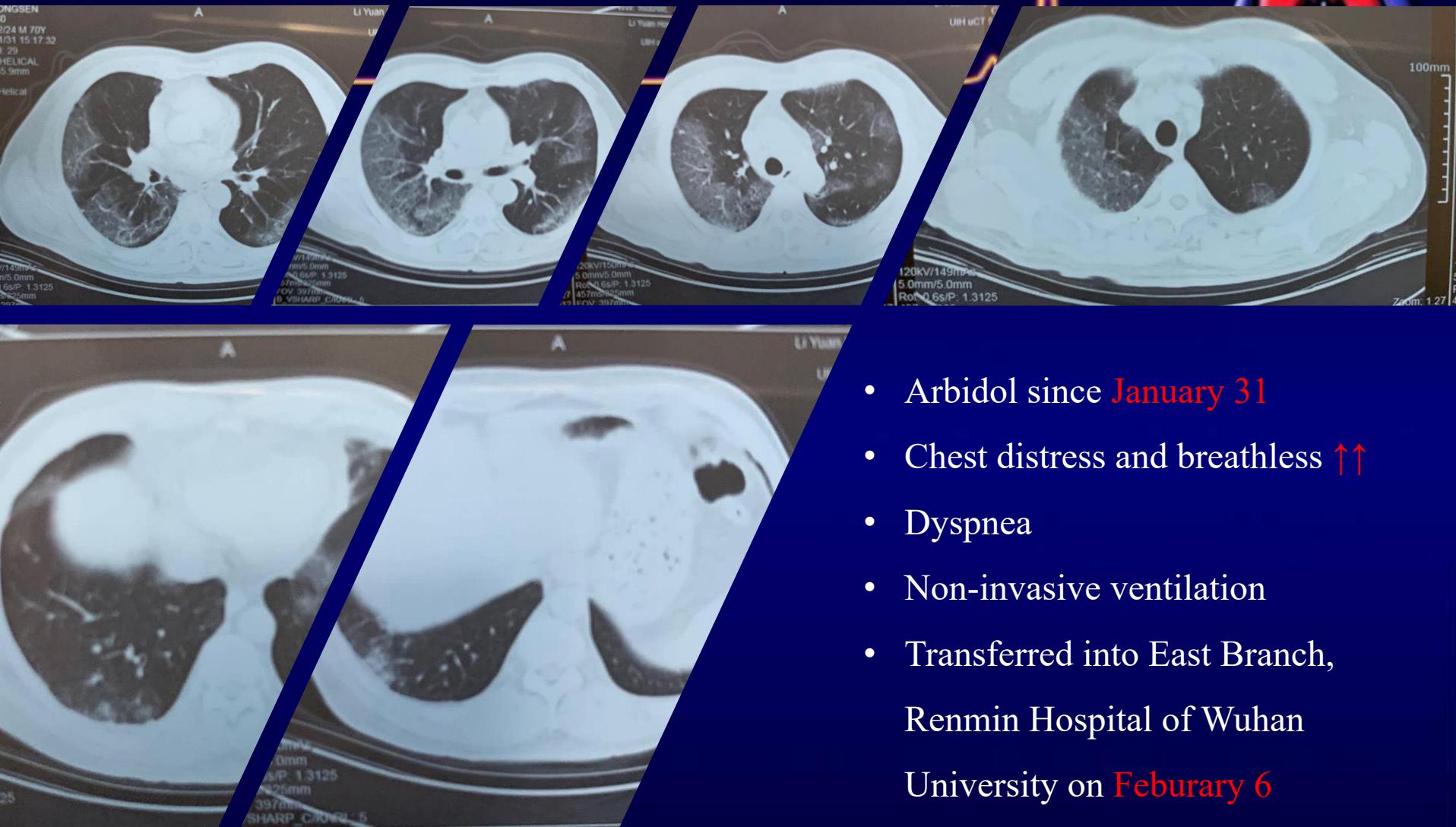
One critical patient with COVID-19

History



- Male, 70 yld, ethnic Han, Wuhan, Hubei Province
- [Chief complain] Fever accompanied with cough and chest distress for 1 week





- Arbidol since **January 31**
- Chest distress and breathless ↑↑
- Dyspnea
- Non-invasive ventilation
- Transferred into East Branch, Renmin Hospital of Wuhan University on **Feburary 6**

History

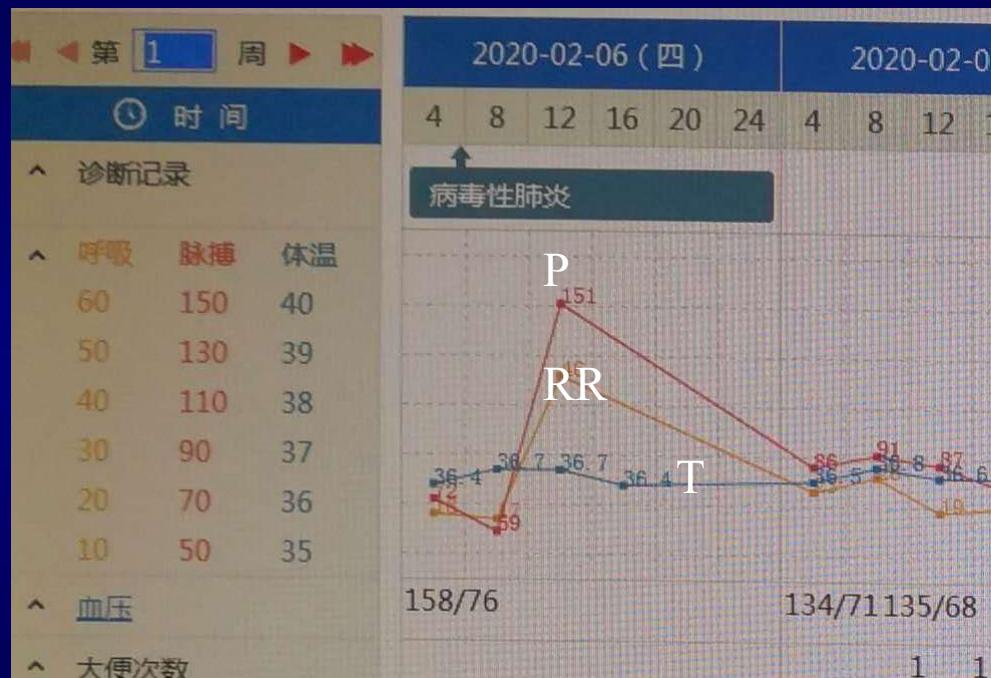


- **[Medical history]** Hypertension, Diabetic mellitus, COPD
- **[History of infectious diseases]** Living in Wuhan, COVID-19 in family members, exposure to COVID-19
- **[History of operation or trauma]** None.
- **[Drug and poison contact]** Arbidol and Lianhua Qingwen capsule
- **[Allergy]** None.
- **[Personal history]** Born and living Wuhan, Hubei; no history of cigarettes or alcohol
- **[Marital history]** Married.
- **[Family history]** Denied.



History

- Signs on admission:
- T: 38.3°C
- P: 72 beats per min
- R: 18 breaths per min
- BP: 158/76mmHg
- Non-invasive ventilated with 60% of oxygen concentration
- H: 175cm
- BW: 80kg





History

Laboratory tests on admission

WBC	LYN	NEU	HB	PLT	CRP	PCT	CD4	CD8	IL6
7.62	0.47	6.82	127	183	16.6	0.051	193	10.98	107.25

ProBNP	cTNI	MYO	CK-MB	ALT	AST	TB	Scr	LDH	K	Na	D-dimer
319.5	0.006	178.43	1.36	29	38	23.6	68	562	4.14	138	63.86

lipase	amylase	TC	TB	BG	urine alkone	urine glucose	GFR
(-)	(-)	7.31	8.83	11.41	-	++	91.98

PH	PCO2	PO2	SaO2	HCO3-	BE	lac
7.46	42	80	96	29.9	5.5	2.2

Diagnosis



- Critical COVID-19
 - Acute respiratory failure ($\text{PO}_2/\text{FiO}_2=130$)
- Type 2 diabetes mellitus
- Hypertension, Grade 3, High risk



Treatment

- ① Lianhua Qingwen capsule:
3 capsules tid
- ② Arbidol: 200mg tid
- ③ Human IgG: 20g qd
- ④ Methylprednisolone: 40mg bid
- ⑤ Ambroxol Injection: 6ml
- ⑥ Meropenem : 1g q8h
started Feb. 9

连花清瘟胶囊 3粒 TID
[盐酸氨溴索注射液 6ml, 0.9%氯化钠注射液 100ml] QD
[维生素C 3g, 0.9%氯化钠注射液 100ml] QD
[0.9%氯化钠注射液 100ml, 痰热清注射液 20ml] QD
[血必净注射液 100ml, 0.9%氯化钠注射液 100ml] BID
盐酸阿比多尔颗粒 200mg TID
人血丙种球蛋白注射液 20g QD
0.9%氯化钠注射液 100ml QD
[注射用甲泼尼龙琥珀酸钠 40mg, 0.9%氯化钠注射液 20ml] BID
[注射用甲泼尼龙琥珀酸钠 40mg]

Treatment



- Chest distress, breathless and dyspnea worsen gradually
- Oxygen concentration increased up to 90% on Feb. 12

	Feb. 7	Feb. 8	Feb. 9	Feb. 11	Feb. 12
FiO ₂	60%	70%	70%	80%	90%
PH	7.46	7.47	7.43	7.42	7.43
PaO ₂	69	53	44	44	51
PaCO ₂	38	39	42	41	39
SaO ₂	96	90	82	85	87
HCO ₃ ⁻	27.8	28.4	27.9	26.6	25.9
BE	5.0	4.4	3.2	1.9	1.50
Lac	2.0	1.7	2.10	2.4	2.5



Laboratory test

	Feb. 7	Feb. 9	Feb. 11	Feb. 12 am	Feb. 12 pm
WBC	7.62	10.51	10.58	12.84	13.51
N	6.82	9.50	9.44	11.65	12.52
L	0.47	0.52	0.46	0.49	0.32
Hb	127	132	125	128	121
Hct	0.350	0.355	0.345	0.357	0.338
Plt	183	143	123	117	93
CRP	16.6	101.3	167.7		136.8
PCT	0.051		0.095		0.467
IL-6	89.3	107.25			
ALT/AST	29/38				17/62
LDH	562				854
BUN	7.08				6
Scr	68				66
GFR	91.98				93.11

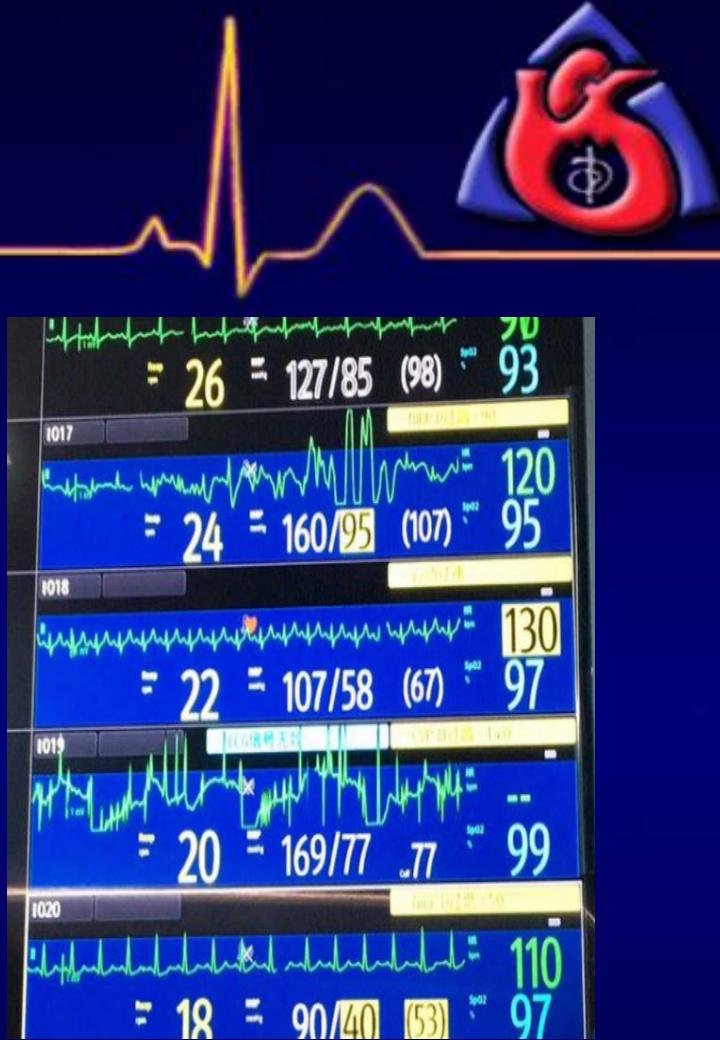
Treatment

- Transferred into ICU at 19:00 Feb. 12, 2020, non-invasive ventilation with FiO₂ from 90% up to 100%, SpO₂: 88-90%
- 8:00 Feb. 13, invasive mechanical ventilation, sedative anesthesia and muscle relaxant
VCV mode, RR: 15, Vt: 420, PEEP: 16, FiO₂: 100%, SaO₂: 94%, low tidal volumes, lung protective ventilation with drive pressure

Peak: 35 Pplat: 31 PEEPt: 18 Cstat: 18 R: 13

ABG: PH: 7.148, PaCO₂: 75.9, PaO₂: 81, HCO₃: 26.3, SaO₂: 91%, BE: -4, lac: 3

- Oliguria, COVID-19 +++, lab+++
- Feb. 13: imipenem



Treatment



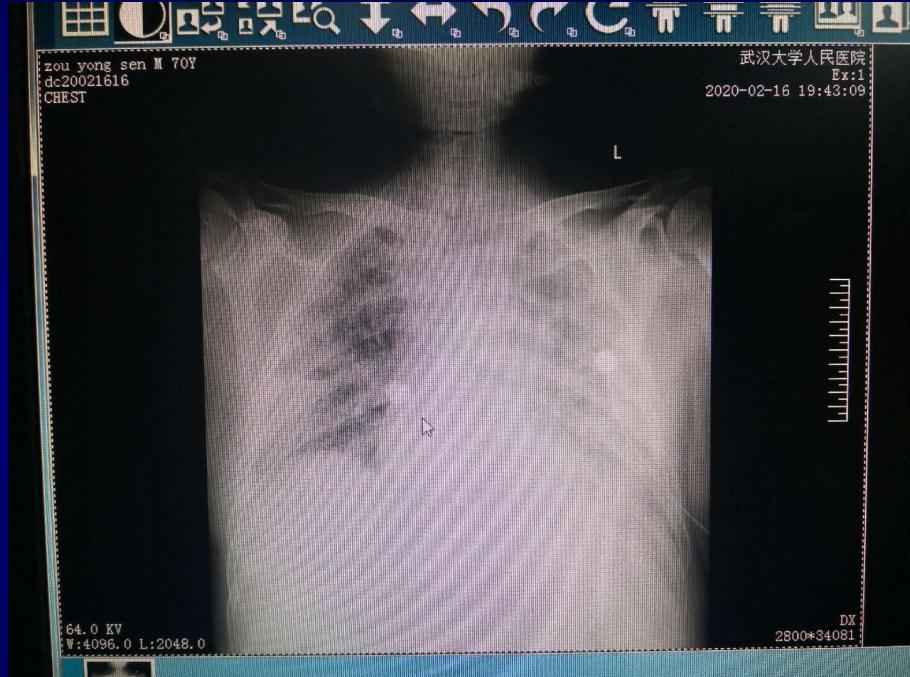
VCV mode, low tidal volumes, lung protective ventilation with drive pressure

	Feb. 13am	Feb. 13pm	Feb. 14am	Feb. 14pm	Feb. 15
FiO ₂	85%	85%	80%	75%	70%
PH	7.23	7.08	7.12	7.31	7.43
PaO ₂	65	158	147	106	121
PaCO ₂	74	90	102	65	63
SaO ₂	88	99	98	98	87
HCO ₃ ⁻	27.0	28.4	23.7	32.7	41.8
BE	-3.4	-4.8	-1.6	1.9	15.9
Lac	2.2	1.2	1.2	1.2	2.1
Treatment	Vt 460, RR20 PEEP14, Pplat 31,RM	RR30	anuria, CRRT artificial liver Vt 420, RR30	MDT Qiu Haibo Kang Yan	artificial liver CRRT LWMH

Treatment



Feb. 14, 2020



Feb. 16, 2020

	Feb. 13	Feb. 14	Feb. 15	Feb. 16	Feb. 17
WBC	9.49	18.09	9.95	5.18	6.31
N count	8.89	16.39	8.57	4.03	5.15
L count	0.34	9.73	0.79	0.81	0.71
Hb	131	108	88	85	96
Hct	0.371	0.332	0.268	0.256	0.283
Plt	114	143	100	88	110
CRP	136.5	91	40.3	14.8	8.8
PCT		1.46	0.705	0.423	0.294
IL-6	64.35	22.75	4.7	10.05	189.57
ALT/AST	20/62	15/28	9/20	7/19	11/33
LDH	1002	641	391	290	376
BUN	7.25	15.67	12.55	12.5	18.1
Scr	73	209	179	126	130
GFR	89.34	26.83	32.35	49.36	47.63
NT-proBNP		2543	1184	418.7	215.8
TNI		0.151	0.086	0.017	0.017
myo		85	93.62	75.63	145.6
D-dimmer	148.6	102.91	21.23	8.06	11.95

Treatment



- ① Invasive mechanical ventilation, sedative anesthesia and muscle relaxant:
sufentanil, atracurium, diprivan, midazolam
- ② Feb. 14, 15 and 16: artificial liver + CRRT
- ③ Feb. 17: hyperpyrexia, tachycardia, tachypnea
automatic respiratory rhythm caused respirator confrontation
urinalysis: WBC++++, antibiotics continued
- ④ Feb. 18: SpO₂ ↓, poor RM, oxygen concentration ↑



Treatment

VCV mode, low tidal volumes, lung protective ventilation with drive pressure

	Feb. 18	Feb. 19	Feb. 20	Feb. 21	Feb. 22
FiO ₂	80%	70%	70%	75%	70%
PH	7.42	7.40	7.22	7.24	7.43
PaO ₂	64	123	107	80	121
PaCO ₂	61	69	65	76.7	63
SaO ₂	92	99	97	93	87
HCO ₃ ⁻	35.1	28.4	26.6	32.7	41.8
BE	15.1	-4.8	-1.1	1.9	15.9
Lac	1.2	1.1	0.8		2.1
	Vt 420, RR30 PEEP10, Pplat 27 CRRT	CRRT airway resistance: 10	CRRT, artificial liver, Vt 420, RR30, airway resistance: 20 Chloroquine sulfate	CRRT, artificial liver, Vt 420, RR30, airway resistance: 30	CRRT tracheotomy

Treatment

- Tracheotomy, resistance:
30 decreased to 5
- Decreased sedatives and
stopped muscle relaxant
- Feb. 20: Chloroquine
sulfate
- Mechanical ventilation
- Feb. 23: COVID-19 +++



	Feb. 14	Feb. 19	Feb. 20	Feb. 22	Feb. 23
WBC	6.73	5.23	6.13	5.75	6.98
N count	5.26	3.83	4.57	3.76	6.10
L count	0.75	0.84	0.89	1.04	0.32
Hb	104	88	88	90	105
Hct	0.297	0.332	0.268	0.256	0.283
Plt	137	169	100	88	328
CRP	46.4	74.8	40.3	14.8	68.6
PCT	0.138		0.133	0.557	0.177
IL-6	101.82	114.6	4.7	110.77	15.5
ALT/AST	26/54		26/55	7/19	11/33
LDH	480		391	412	376
BUN	17.54		8.4	8	18.1
Scr	124		74	93	130
GFR	50.43		88.84	71.4	73.73
NT-proBNP	246.9		122.7	418.7	1055
TNI			0.008	0.017	0.017
myo			77.59	75.63	105.21
D-dimmer	148.6		19.09	8.06	7.61

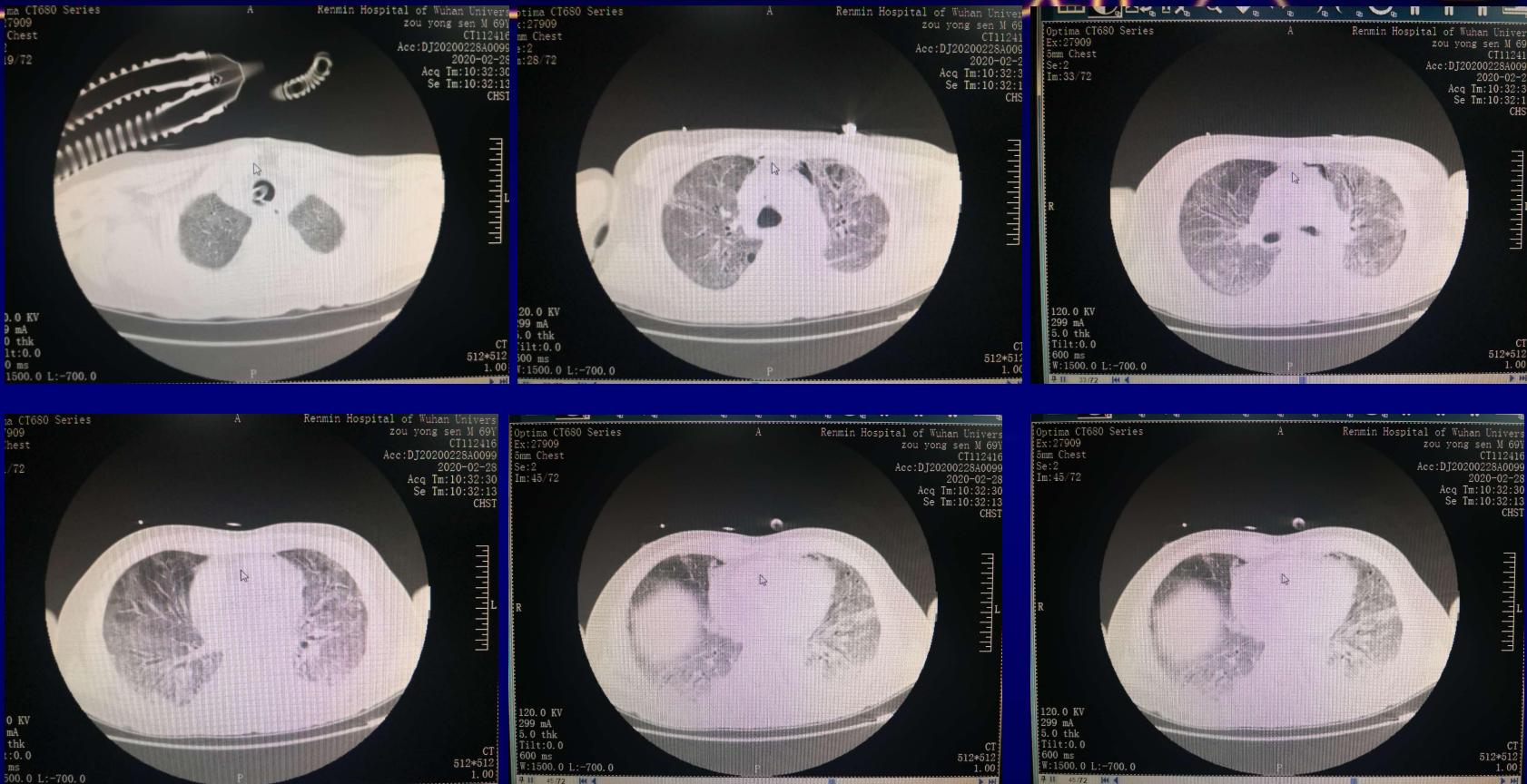
	Feb. 24	Feb. 26	Feb. 29	Mar. 2	Mar. 4
WBC	9.22	9.5	10.79	9.93	
N count	8.01	8.55	9.69	8.71	
L count	0.54	0.63	0.67	0.81	
Hb	97	91	85	84	
Hct	0.297	0.279	0.309	0.256	
Plt	392	418	318	302	
CRP	30.7	10.7	48.6	58.7	
PCT	0.093	0.090	0.144	0.122	
IL-6	23.83	7.82	27.5	110.77	
ALT/AST	26/46	24/35	26/55	7/19	
LDH	480	417	377	430	
BUN	13	15.65	9.75	6.9	
Scr	96	192	71	71	
GFR	68.71	60.27	90.36	90.36	
NT-proBNP	464	429.1	310.7	364.3	
TNI		0.026	0.008	0.008	
myo		112	77.59	70.6	
D-dimmer	6.68	10.99	6.48	9.73	



Treatment

VCV mode, low tidal volumes, lung protective ventilation with drive pressure

	Feb. 24	Feb. 26	Feb. 28	Mar. 2	Mar. 4
FiO ₂	50%	45%	40%	35%, RR40	40%
PH	7.37	7.40	7.50	7.47	7.46
PaO ₂	114	123	112	98	142
PaCO ₂	52	49	45	35	44
SaO ₂	98	99	99	98	99
HCO ₃ ⁻	47.4	28.4	35.1	25.5	31.3
BE	18.8	-4.8	-1.1	1.9	15.5
Lac	3.7	1.1	0.8		1.4
	PSV mode, PEEP 6, CRRT	PSV mode, PEEP 5, Vt 450-460	PSV mode, Vt 450-460	PSV mode, High-flow oxygen, On 2 off 3	PSV mode, High-flow oxygen, On 3 off 3



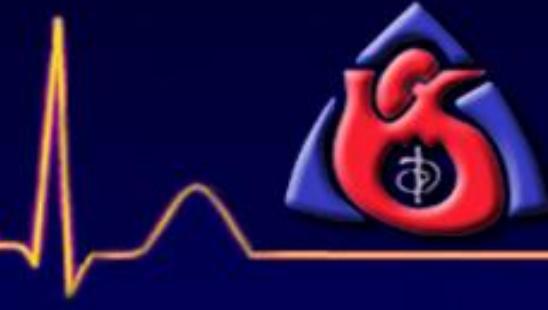
2020-2-28

Treatment



- Tracheotomy with sedatives and muscle relaxant
sedatives increased due to agitation and withdrew on Mar. 2
- Feb. 24: Tazocin instead of imipenem till now
- COPD: Aerosol inhalation, aminophylline and methylprednisolone
- Feb. 28: Bilateral pulmonary significant interstitial changes, drainage ↑↑
- Respirator: change to PSV mode, lower condition, ventilator weaning process

Experiences



- ① MDT improved diagnosis and treatment.
- ② Artificial liver cleared away inflammatory mediator effectively.
- ③ Benefit from early CRRT + negative balance.
- ④ Low tidal volumes and lung protective ventilation with drive pressure of proper PEEP to improve prognosis.
- ⑤ Aggressive antibiotics therapy when infected: The condition critically worsened by bacterial infection, which occurred twice in the patient.
- ⑥ Targeted blood pressure guaranteeing peripheral tissue perfusion.
- ⑦ Intermittently weaning reduced respiratory muscle fatigue
- ⑧ Crucial role of airway management.

Problems and puzzles?



- PCO₂ reduced significantly, but increased occasionally. How to resolve it?
- The mechanism of transient elevation of NT-proBNP?
- D-dimmer increased early and changed with patient's condition. Its impact of prognosis needs further investigation.
- Large doses of analgesics and sedatives used in early stage. How to optimize the time, duration and doses?



One COVID-19 case with multiple system damage

Jiatian Cao
Shanghai Institute of Cardiovascular Diseases
Dept. of Cardiology
Zhongshan Hospital, Fudan University



History

- Zhu XX, Male, 31-year-old
- [Chief complain] Intermittent fever for 3 weeks
- [Present history] Since January 24, 2020, the patient developed fever with a little cough, so he went to Wuhan Wuchang Hospital on January 26. Laboratory test showed: WBC $2.73 \times 10^9/L$, L: $1.15 \times 10^9/L$, Plt: $99 \times 10^9/L$ and CRP: 40mg/L. Chest CT: Multiple patchy opacity, some of them ground-glass.



History

- Oropharyngeal swabs: COVID-19 +
- Oral abidol use for 6 days Lianhua ,Qingwen capsule: 5 days
“Pneumonia 1st” prescription: 5 days in shelter hospital
- Fever worsened for 3 days, Tmax 38.5°C with sweating and liver dysfunction. Transferred into our department.
- Normal sanity, diet, feces and urine were normal

Physical examinations

- Conscious, slightly faster breath
- Signs on admission:
- T: 38.5°C
- P: 152 beats per min
- R: 24 breaths per min
- BP: 134/107mmHg
- SpO2: 95% (no oxygen)
- Height: 177cm, weight: 88kg
- Soft abdomen, no tenderness or rebound pain
- No obvious filling of jugular vein and no swelling of lower limbs



History

[Medical history] Diabetic 10 years, untreated and hyperlipidemia 5 years, untreated

[History of infectious diseases] Living in Wuhan, probable exposure to COVID-19

[History of operation or trauma] Appendectomy.

[Drug and poison contact] Arbidol 6 days.

[Allergy] None.

[Personal history] Born and living Wuhan, Hubei; no history of cigarettes or alcohol

[Marital history] Married.

[Family history] Denied.



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Laboratory test (2020-2-29)

- Blood glucose: 31mmol/L
- Arterial Blood Gas Analysis (intranasal oxygen inhalation 7L/min):
PH 7.4, PCO₂ 24mmol/L, PO₂ 290 mmol/L , BE -8.3mmol/L



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ECG (2020-2-29 1:20)





Laboratory test (2020-2-29)

WBC	LYN	NEU	Hb	PLT	CRP	PCT	CD4	CD8	IL6
2.6	0.41	1.98	124	55	>200	3.37	38	32	146

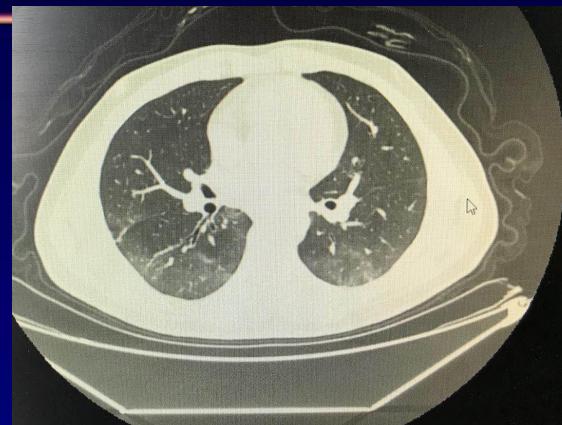
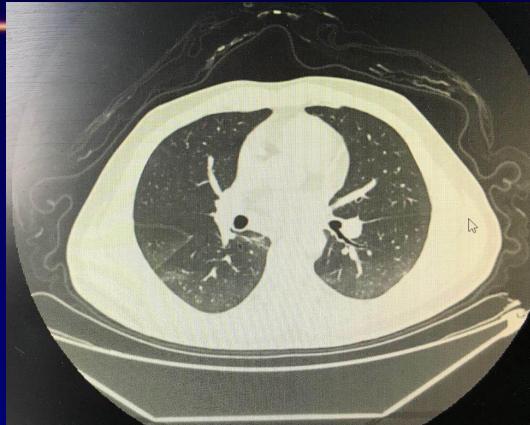
BNP	cTNI	MYO	CK-MB	ALT	AST	Scr	LDH	K	Na	D-dimer
1651	0.15	33	0.6	189	110	55	380	3.9	126	0.96

lipase	amylase	TC	TB	urine alkone	urine glucose	
(-)	(-)	7.31	8.83	+++	++++	



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Chest CT (2020-2-29)





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Diagnosis

- Critical COVID-19
- Type 2 diabetes mellitus, ketoacidosis?
- Heart failure, tachycardia, myocardial injury?
- Sepsis?
- Liver dysfunction



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Treatment

- Antiviral therapy (Arbidol, completed)
- Anti inflammatory and immunomodulatory therapy
 - ① Enhance immunity (human immunoglobulin + thymalfasin)
 - ② Anti inflammatory (Methylprednisolone: 20mg q12h)
 - ③ Antibiotics (Meropenem + Tigecycline)
- Oxygen therapy
- Treatment of complications and comorbidity

Treatment of complications and comorbidity



- Blood glucose and Ketosis
 - ① Insulin (insulin pump + Lantus)
 - ② Replenish blood volume (Lactate Ringer's solution + physiological saline+ albumin)
- Thrombocytopenia: Recombinant human thrombopoietin injection
- Liver dysfunction: Glutathione + Magnesium Isoglycyrrhizinate Injection



3-1 21:47 acute heart failure

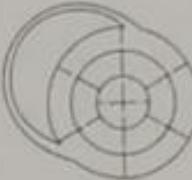
- Furosemide
- Isosorbide
- Morphine
- BIBAP



Treatment

- Torasemide 10mg bid, reduced to 10mg qd on Mar. 2
- Spironolactone 20mg qd

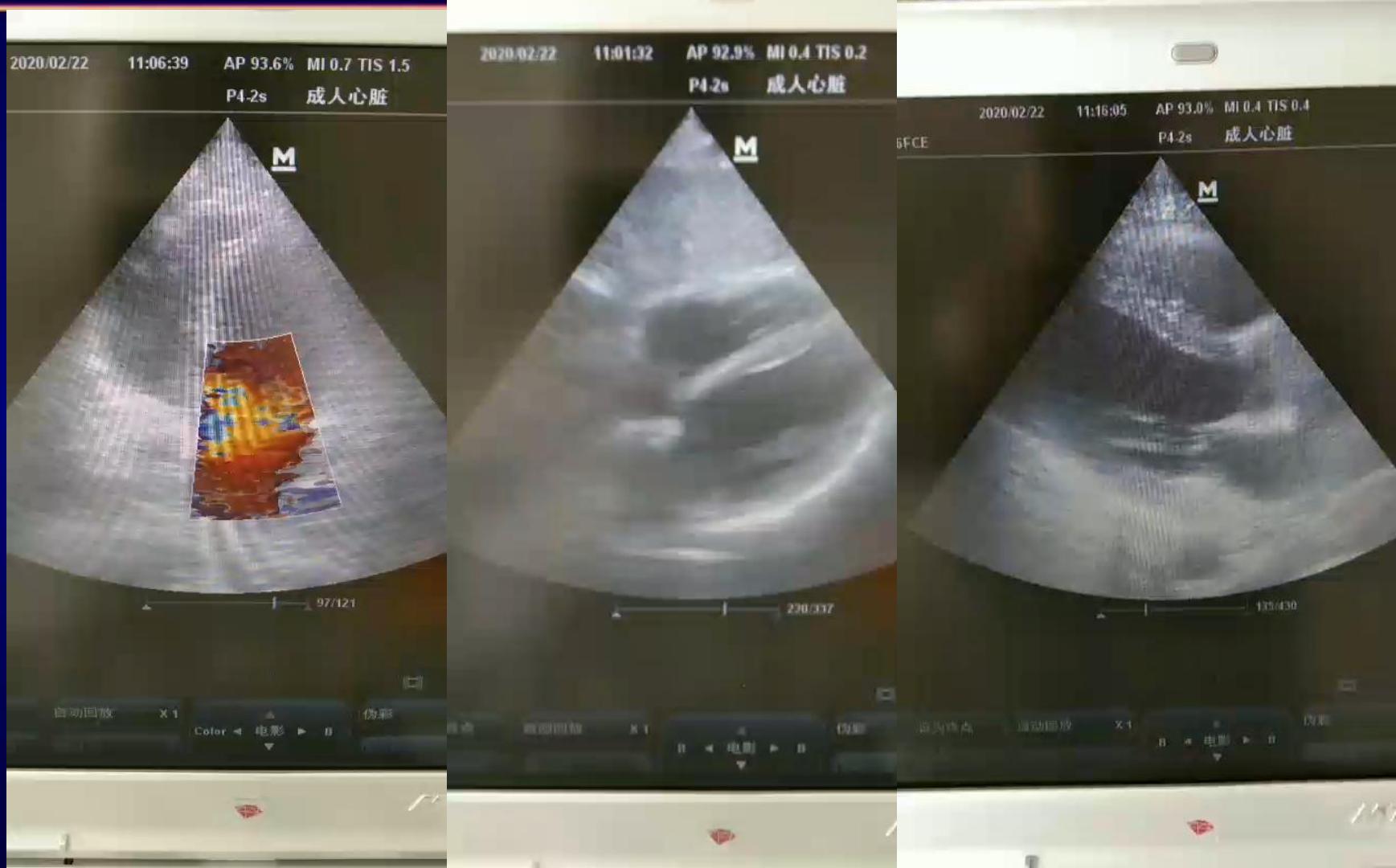


二维及 M 型超声		多普勒超声	
瓣膜结构	主动脉瓣 <input checked="" type="checkbox"/> 正常 <input type="checkbox"/> 增厚 <input type="checkbox"/> 钙化 <input type="checkbox"/> 畸形 肺动脉瓣 <input checked="" type="checkbox"/> 正常 <input type="checkbox"/> 增厚 <input type="checkbox"/> 钙化 <input type="checkbox"/> 畸形 二尖瓣 <input type="checkbox"/> 正常 <input type="checkbox"/> 增厚 <input type="checkbox"/> 钙化 <input type="checkbox"/> 畸形 三尖瓣 <input checked="" type="checkbox"/> 正常 <input type="checkbox"/> 增厚 <input type="checkbox"/> 钙化 <input type="checkbox"/> 畸形	流速 (cm/s)	压差 (mmHg)
		主动脉瓣	肺动脉瓣
腔室内径 (cm)	升主动脉 2.9 (2.5-3.2) 主肺动脉 1.8 (1.6-2.5) 左心房 3.1 (2.0-3.5) 左心室 4.4 (3.5-5.2) 右心房 3.6 (2.5-4.5) 右心室 1.9 (1.5-2.2) 室壁厚度 (cm)	123 87 97 /	63
LVEF	60 %	e' (cm/s)	组织多普勒
		a' (cm/s)	
		E/e'	71
超声特征:		超声提示:	
<p>心腔形态结构、血流动力学未见明显异常。</p> <p>左室前壁及室间隔运动幅度正常。</p>		 <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 运动正常 <input type="checkbox"/> 运动减低 <input type="checkbox"/> 无运动 <input type="checkbox"/> 平直运动 	



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Echo



24-hour inflow and outflow volume and central venous pressure



	Inflow (ml)	Outflow (ml)	CVP (cmH ₂ O)
2-29	2100	2300	15
3-1	2300	3300	10
3-2	1910	2100	15



Arterial Blood Gas Analysis

	2-29	3-1	3-2	3-3
PH	7. 4	7. 38	7. 46	7. 47
PCO2 mmol/L	24	30	32	38
PO2 mmol/L	290	129	120	124
BE (B) mmol/L	-8. 3	-6. 5	-0. 5	3. 8



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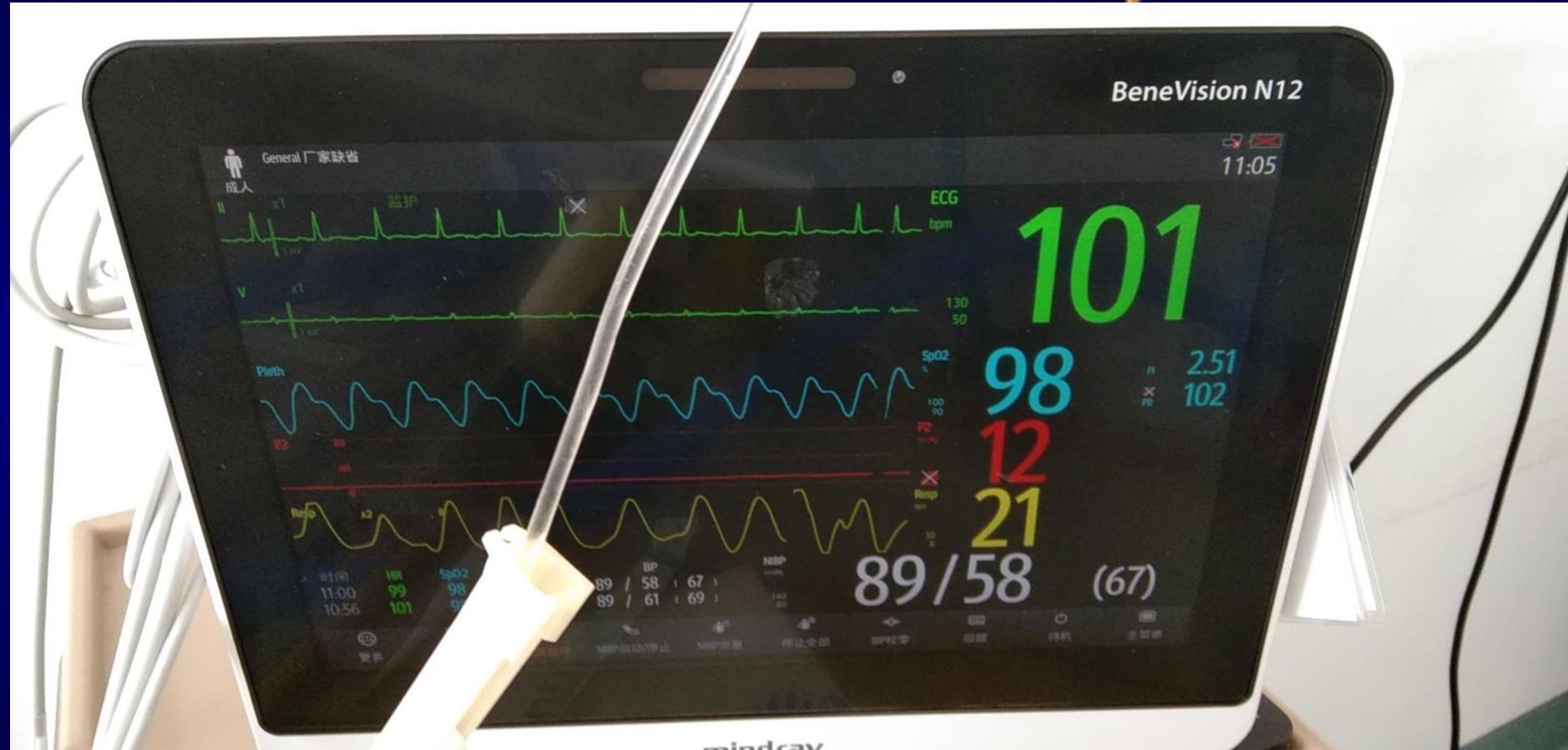
Laboratory test

	WBC	LYN	NEU	HB	PLT	CRP	PCT	CD4	CD8	IL6
2-29	2. 6	0. 41	1. 98	124	55	>200	3. 37	38	32	146
3-1	3. 96	0. 27	3. 42	118	91	123	2. 36	24	25	135
3-2	3. 69	0. 39	3. 02	105	94	>200	-	-	-	-
3-4	3. 51	0. 31	2. 89	110	141	106. 5	0. 33	-	-	20. 45

	BNP	cTNI	MYO	CK-MB	ALT	AST	Scr	LDH	K	Na	D-dimer
2-29	1651	0. 159	33	0. 6	189	110	55	380	3. 9	126	0. 96
3-1	4260	0. 45	29. 8	0. 78	104	52	64	268	4. 09	132	6. 69
3-2	2153	0. 114	19. 2	0. 27	76	27	61	218	3. 5	136	-
3-4	3399	0. 135	30. 37	0. 3	50	12	54	199	3. 48	144	3. 5



复旦大学附属
中山医院
ZHONGSHAN HOSPITAL





复旦大学附属
中山医院
ZHONGSHAN HOSPITAL





中山大學附屬
中山醫院
ZHONGSHAN HOSPITAL





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Problems and puzzles?

- Myocardial injury?
- Liver dysfunction?
- treatment plan?