Mimotělní plicní podpora u těžkých forem selhání plic

OA Dr. Stibor B.

ICU, Landesklinikum Baden bei Wien, Austria

no conflict of interest

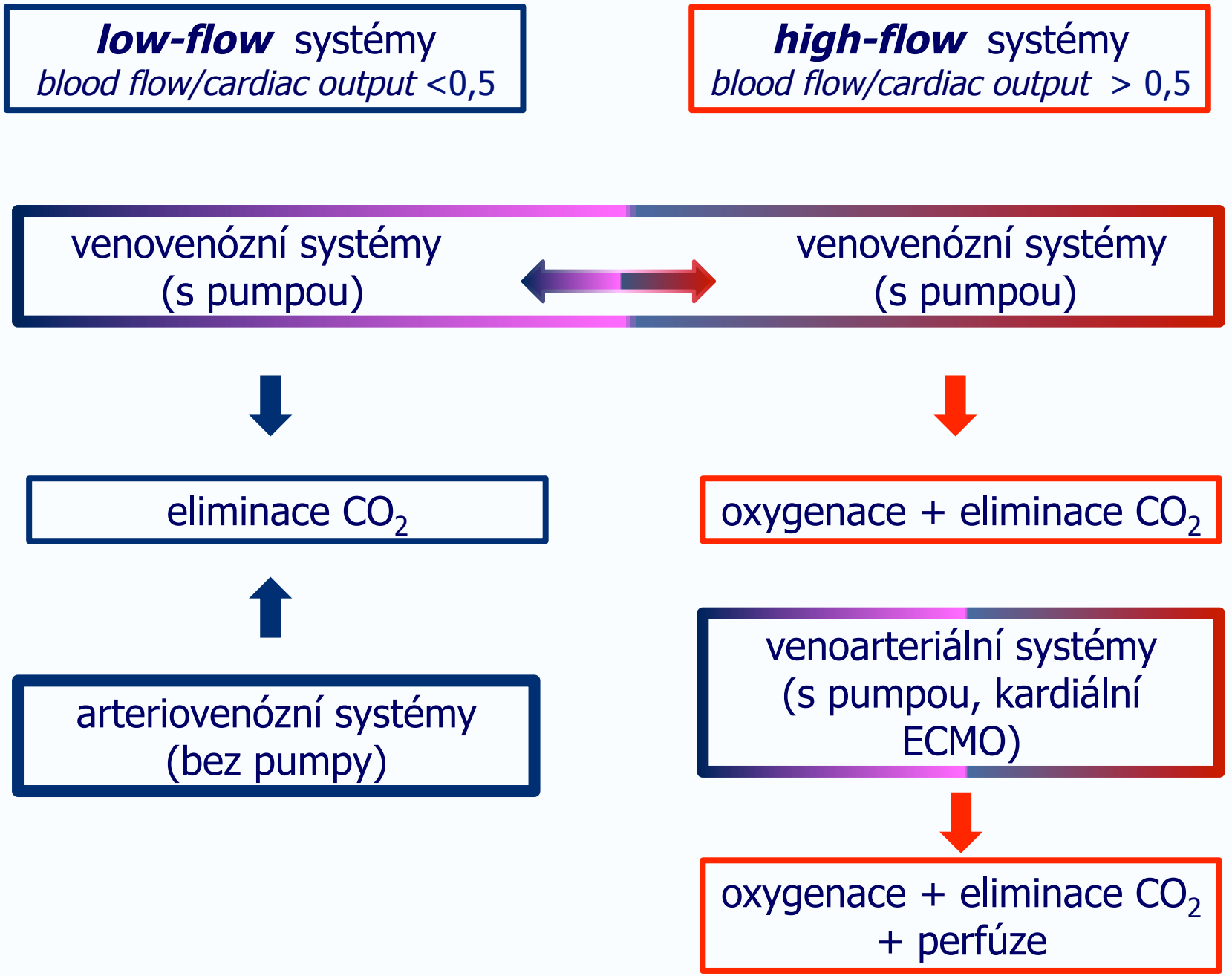
OA Dr. Stibor B.

ICU, Landesklinikum Baden bei Wien, Austria

přehled

1. ECLS – přehled
2. indikace
3. benefity
4. rizika
5. probíhající studie
6. *case report*
7. socio-ekonomický pohled

extracorporeal lung support (ECLS)

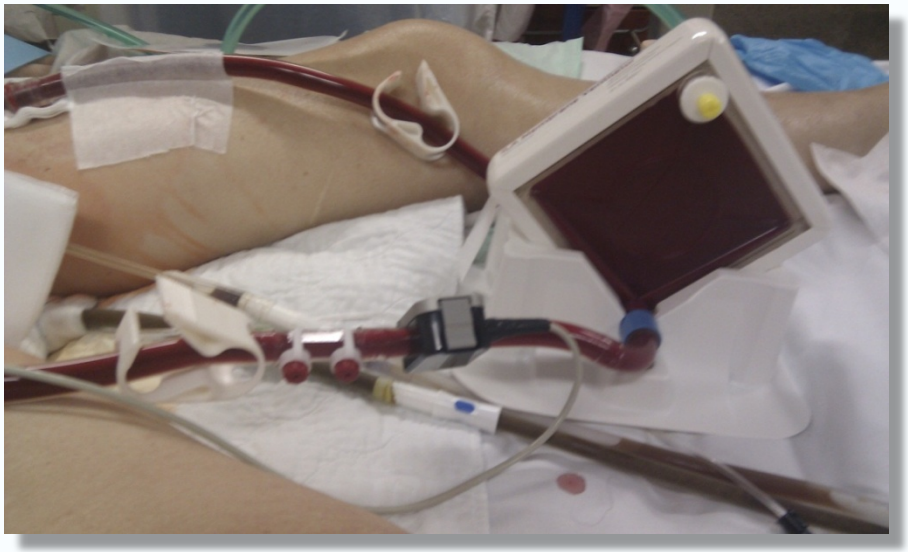

low-flow systémy
blood flow/cardiac output <0,5
high-flow systémy
blood flow/cardiac output > 0,5
venovenózní systémy (s pumpou)
venovenózní systémy (s pumpou)
eliminace CO_2
oxygenace + eliminace CO_2
arteriovenózní systémy (bez pumpy)
venoarteriální systémy (s pumpou, kardiální ECMO)
oxygenace + eliminace CO_2 + perfúze

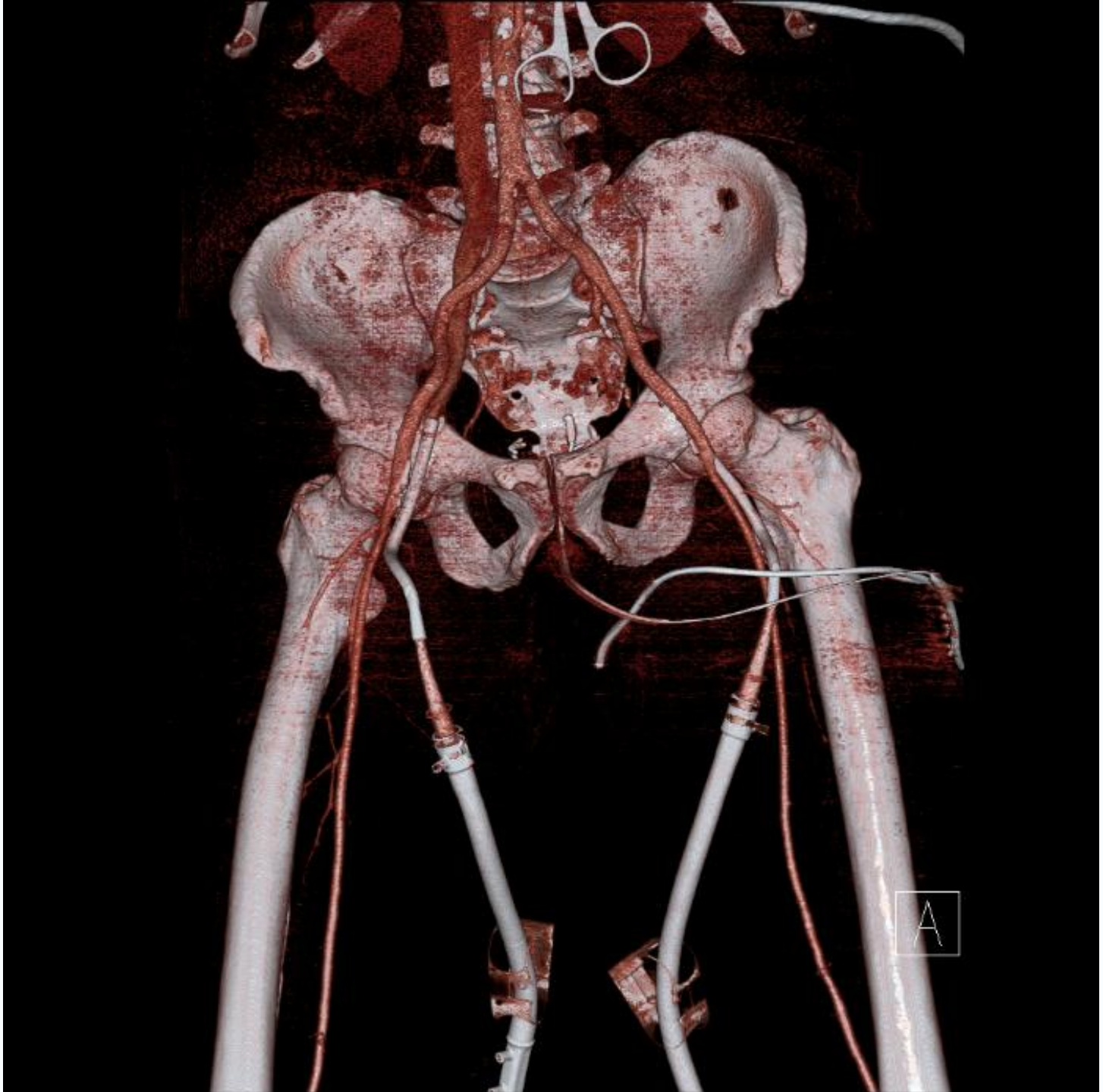
systémy arteriovenózní

arteriovenózní systémy

- ✓ účinná dekarboxylace, minimální oxygenace
- ✓ nutná kanylace arteriálního systému
- ✓ bez krevní pumpy
- ✓ „poháněno“ srdeční pumpou pacienta
- ✓ synonyma:
  - **pECLA** *pumpless extracorporeal lung-assist*
  - **AVCO_2R** *arterio-venous CO_2 removal*
  - **AV ECMO** *arteriovenózní ECMO* ***?!***


ecvalung




A

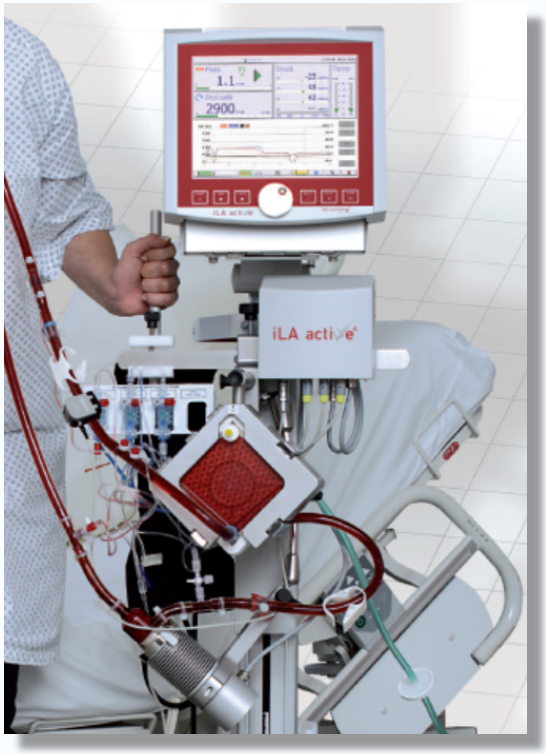
systémy venovenózní

Maquet

PALP®

Hemodec

Decap®



Novalung

iLA-activve®

Alung

Hemolung®

	„kardiální" ECMO	„pulmonální" ECMO	
napojení na cévní systém	***venoarteriální***	***venovenózní***	***arteriovenózní***
náhrada funkce plic	ano	ano	ano
náhrada srdeční pumpy	ano	ne	ne
oxygenace	ano	ano	minimální
dekarboxylace	ano	ano	ano
zajištění průtoku	krevní pumpa	krevní pumpa	srdeční pumpa
krevní průtok	3 - >7 $l.min^{-1}$	0,5 - 4,5 - 7 $l.min^{-1}$	0,35 - 2 $l.min^{-1}$
pracoviště zejména	kardioch. ICU	nekardioch. ICU	nekardioch. ICU, IMCU
antikoagulace	ano	ano	ano
transport pac. s přístrojem	obtížný	snadný	snadný
velikost kanyl arteriálních	14 – 20 F	---	13 – 15 F
velikost kanyl venózních	20 – 26 F	18 - 32 F	15 – 17 F
komplikace	časté	zřídkavé	zřídkavé
náročnost metody	značná	střední	nízká

CO_2 eliminace

oxygenace

perfúze

VV modus

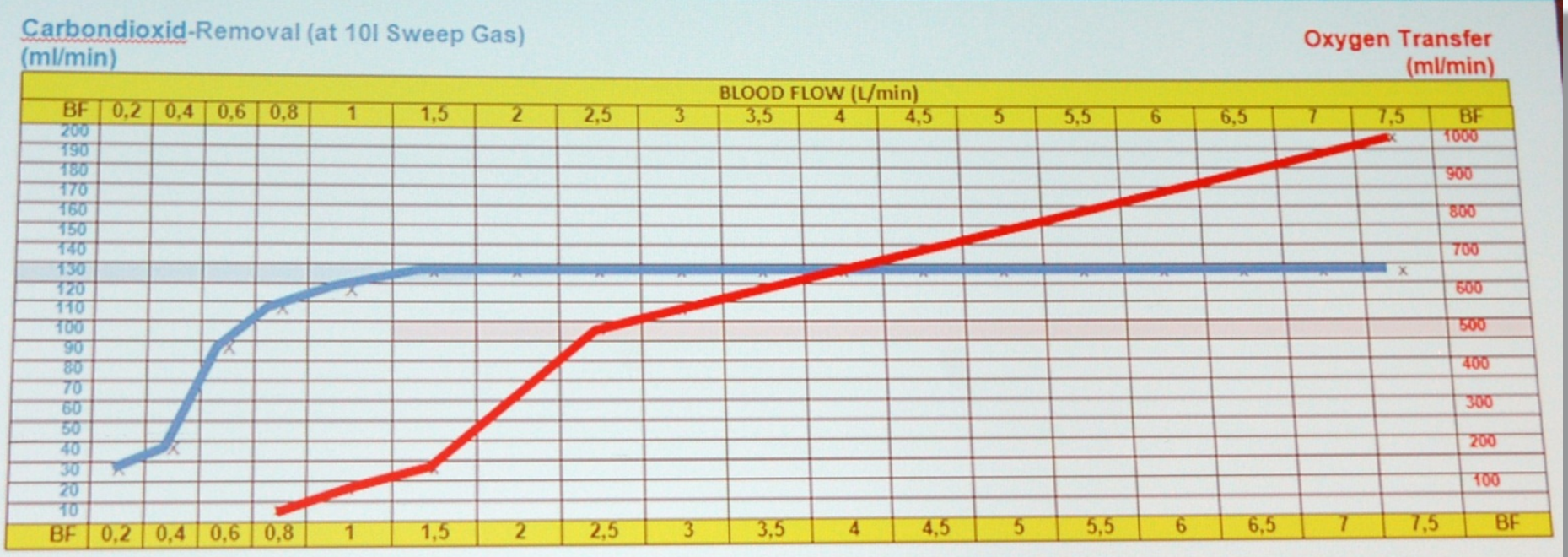
ECLS

modus VA

oxygenace a dekarboxylace

versus

blood a gas flow



Klinisches Problem:	Hyperkapnie	Schwere Hypoxämie
Effektivität der Oxygenierung:	O_2	Sicherheitsbereich
Effektivität der CO_2-Entfernung:	CO_2	
Notwendige Blutflüsse:	0,5 Blutfluss l/min 1,0	2,0 3,0 4,5

ECMO u ARDS

- jak často?

Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries

Giacomo Bellani, MD, PhD[1,2]; John G. Laffey, MD, MA[3,4]; Tài Pham, MD[5,6,7]; et al

JAMA. 2016;315(8):788-800.

- international, multicenter, prospective cohort study
- 4 consecutive weeks in the winter of 2014
- 459 ICUs from 50 countries across 5 continents
- 3022 of 29 144 patients admitted to participating ICUs, fulfilled ARDS criteria (10.4%)
- ARDS: mild 30,0%, moderate 46,6%, severe 23,4%
- **ECMO** was used in **6.6%** of patients with severe ARDS

Table 4. Use of Adjunctive and Other Optimization Measures in Invasively Ventilated Patients With Acute Respiratory Distress Syndrome[a]

	Patients of No. (%) [95% CI]				
	All (n = 2377)	Mild[a] (n = 498)	Moderate[a] (n = 1150)	Severe[a] (n = 729)	*P* Value[b]
Neuromuscular blockade	516 (21.7) [20.1-23.4]	34 (6.8) [4.8-9.4]	208 (18.1) [15.9-20.4]	274 (37.8) [34.1-41.2]	<.001
Recruitment maneuvers	496 (20.9) [19.2-22.6]	58 (11.7) [9.0-14.8]	200 (17.4) [15.2-19.7]	238 (32.7) [29.3-36.2]	<.001
Prone positioning	187 (7.9) [6.8-9.0]	5 (1.0) [0.3-2.3]	63 (5.5) [4.2-7.0]	119 (16.3) [13.7-19.2]	<.001
ECMO	76 (3.2) [2.5-4.0]	1 (0.2) [0.05-1.2]	27 (2.4) [1.6-3.4]	48 (6.6) [4.9-8.6]	<.001
Inhaled vasodilators	182 (7.7) [6.6-8.8]	17 (3.4) [02.0-5.4]	70 (6.1) [4.8-7.6]	95 (13.0) [10.7-15.7]	<.001
HFOV	28 (1.2) [0.8-1.7]	3 (0.6) [0.1-1.7]	14 (1.2) [0.7-2.0]	11 (1.5) [0.8-2.7]	.347
None of the above	1431 (60.2) [58.2-62.2]	397 (79.7) [75.9-83.2]	750 (65.2) [62.4-68.0]	284 (39.0) [35.4-42.6]	<.001
Esophageal pressure catheter	19 (0.8) [0.04-1.4]	2 (0.4) [0.04-1.4]	8 (0.7) [0.3-1.3]	9 (1.2) [0.6-2.3]	.233
Tracheostomy	309 (13.0) [11.6-14.4]	48 (9.6) [7.1-12.6]	155 (13.5) [11.6-15.6]	106 (14.5) [12.1-17.3]	.034
High-dose corticosteroids[c]	425 (17.9) [16.4-19.5]	61 (12.3) [9.5-15.5]	194 (16.9) [14.7-19.2]	170 (23.3) [20.3-26.6]	<.001
Pulmonary artery catheter	107 (4.5) [3.7-5.4]	9 (1.8) [0.8-3.4]	53 (4.6) [3.4-6.0]	45 (6.2) [4.5-8.2]	.001

- first 700 ARDS-pts in 59 ICUs from IX/2014 to I/2016
- ARDS: mild 14,1%, moderate 47,6%, severe 38,3%
- **ECMO** was used in **31,3%** of all patients !!!

Table 5 Occurrence of critical events and use of supportive measures in 700 patients with ARDS

Critical events and supportive measures	N	n (%)
Occurrence of critical events (multiple answers)		
Hypoxia[a]	670	180 (26.9)
Hypoglycaemia[b]	676	139 (20.6)
Unintended extubation	683	15 (2.2)
Re-intubation	682	115 (16.9)
Any of the above	684	320 (46.8)
Use of supportive measures (multiple answers)		
Tracheotomy	684	363 (53.1)
NO-inhalation	675	80 (11.9)
ECMO	691	216 (31.3)
Prone positioning	683	308 (45.1)
Neuro-muscular blockers	675	70 (10.4)
Prone positioning and/or neuro-muscular blockers and/or ecmo	692	425 (61.4)

ARDS, acute respiratory distress syndrome; ECMO, extracorporeal membrane oxygenation. [a], defined as a registration of SpO_2 <85% for at least 5 minutes; [b], defined as blood glucose measurement <70 mg/dL.

indikace

ECLS

patofyziologické indikace

primárně hypoxemické selhání *(např. ARDS)*

- $p_aO_2/FiO_2 < 100 – 150$ mmHg
- nutnost PEEP > 15 - 20 cm H_2O
- nutnost $FiO_2 > 0,60 - 0,80$
- nonrespondence na pronační polohu
- nutnost PIP > 30 cm H_2O

primárně hyperkapnické selhání *(např. COPD)*

- příznaky těžké hyperkapnie nereagující na NIV
- těžká respirační acidóza nereagující na NIV

klinické indikace

ARDS těžká forma

COPD akutně dekompenzovaná těžká forma

alternativa k umělé plicní ventilaci

- **COPD**, **ARDS**, *bridging to transplant*

transport pacienta s těžkou plicní patologií

barotrauma, obstrukce DC – *bridging to therapy*

kombinace výše uvedeného

EOLIA Trial (*ECMO to rescue Lung Injury in severe ARDS*)

Inclusion criteria

- PaO_2/FiO_2 < 50 mm HG with FiO_2 ≥80% for > 3 hours
- PaO_2/FiO_2 < 80 mm HG with FiO_2 ≥80% > 6 hours
- pH < 7.25 for > 6 hours with Pplat ≤ 32 cm H_20

Despite optimal mechanical ventilation

Exclusion criteria

- Mechanical ventilation ≥ 7 days
- Age < 18 years
- Pregnant
- BMI > 45 kg/m^2
- Prior O_2 dependence
- History of HITT
- Malignancy and fatal prognosis within 5 years
- Neurologic devastation
- DNR

Absolute
1. Intracranial bleeding or other major contraindication to anticoagulation
2. Previous severe disability
3. Poor prognosis because of the underlying disease (i.e., unresolved malignancy)

Relative
1. MV > 7 days

Conventional Ventilation or ECMO for Severe Adult Respiratory Failure

A: Indications

1. In hypoxic respiratory failure due to any cause considered when the risk of mortality is 50% or g mortality is 80% or greater.

a. 50% mortality risk is associated with a PaO2/FiO2 < 150 on FiO2 > 90% and/or Murray score 2-3.

b. 80% mortality risk is associated with a PaO2/FiO2 < 100 on FiO2> 90% and/or Murray score 3-4 despite optimal care for 6 hours or more.

2. CO2 retention on mechanical ventilation despite high Pplat (>30 cm H2O)

3. Severe air leak syndromes

4. Need for intubation in a patient on lung transplant list

5. Immediate cardiac or respiratory collapse (PE, blocked airway, unresponsive to optimal care)

benefity

ECLS

zlepšení **oxygenace** a **dekarboxylace**

minimalizace **VILI**

časná **mobilizace** pacienta

není nutnost hluboké **sedace** ev. **relaxace**

časný **perorální** příjem

umožní vyhnout se **intubaci** (COPD, Tx)

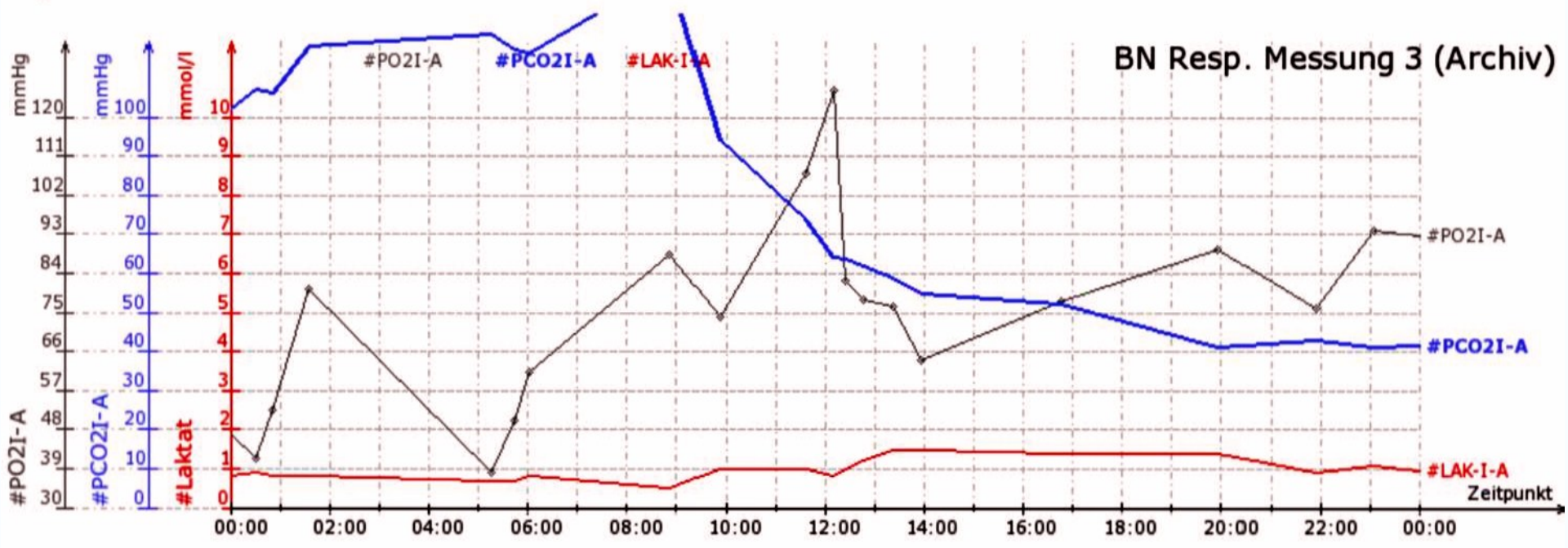
umožní **transportovat** pacienta

umožní operační výkon (**Tx**)

komplikace **?**

snížení **mortality**?

zlepšení dlouhodobého **outcome**?


BN Resp. Messung 3 (Archiv)
#PO2I-A
#PCO2I-A
#LAK-I-A
mmHg
mmHg
mmol/l
#PO2I-A
#PCO2I-A
#Laktat
120
111
102
93
84
75
66
57
48
39
30
100
90
80
70
60
50
40
30
20
10
0
10
9
8
7
6
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3
2
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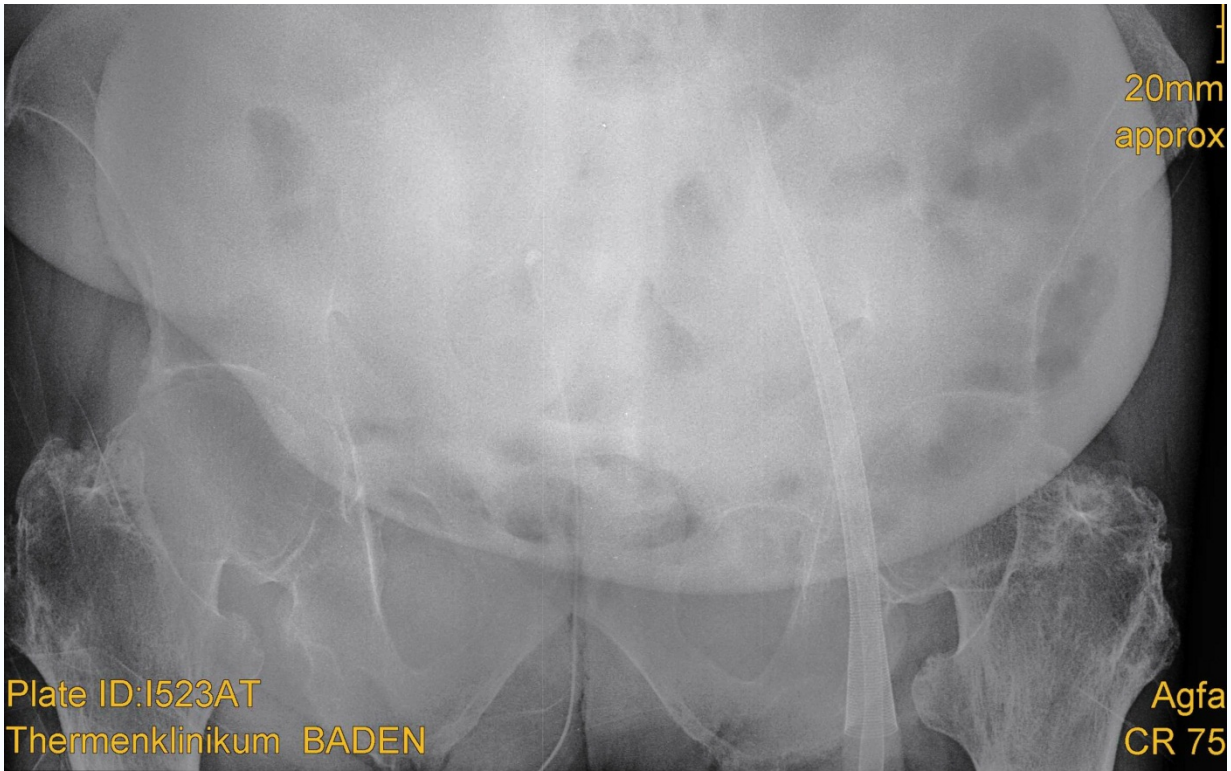
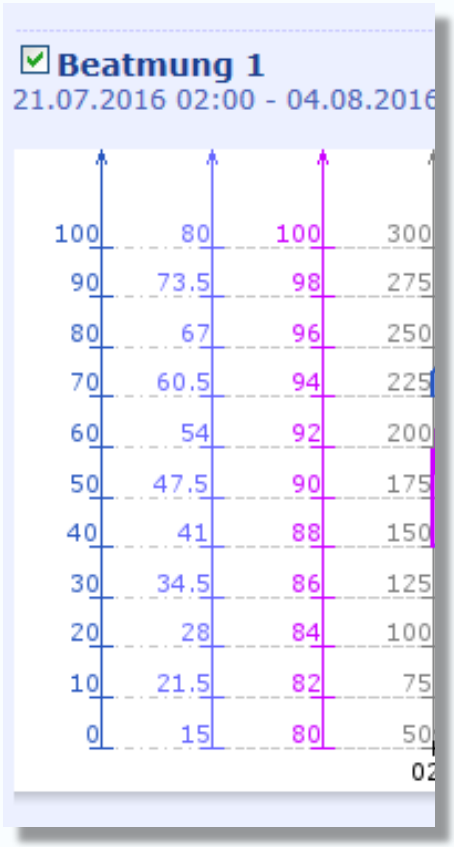
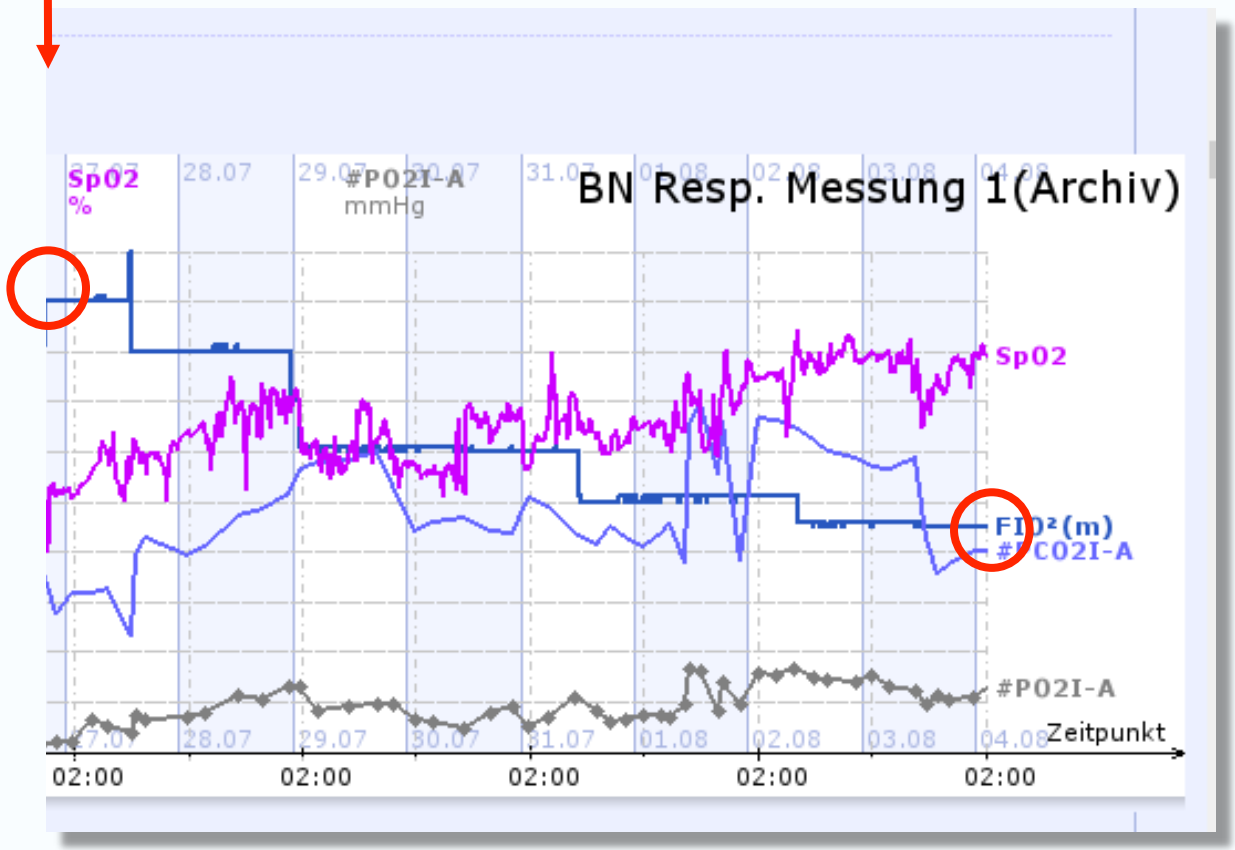
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Zeitpunkt


20mm
approx
Plate ID:I523AT
Thermenklinikum BADEN
Agfa
CR 75

ECMO


Beatmung 1
21.07.2016 02:00 - 04.08.2016
100 80 100 300
90 73.5 98 275
80 67 96 250
70 60.5 94 225
60 54 92 200
50 47.5 90 175
40 41 88 150
30 34.5 86 125
20 28 84 100
10 21.5 82 75
0 15 80 50


SpO2
%
#PO2I-A
mmHg
BN Resp. Messung 1(Archiv)
SpO2
FIO²(m)
#PCO2I-A
#PO2I-A
Zeitpunkt
27.07
28.07
29.07
30.07
31.07
01.08
02.08
03.08
04.08
02:00
02:00
02:00
02:00
02:00

rizika

ECLS

rizika spojená s **kanylací**

- poranění cévního systému

- infekční riziko

- intravaskulární trombóza/embolie

rizika spojená s **antikoagulací**

- krvácení, HIT

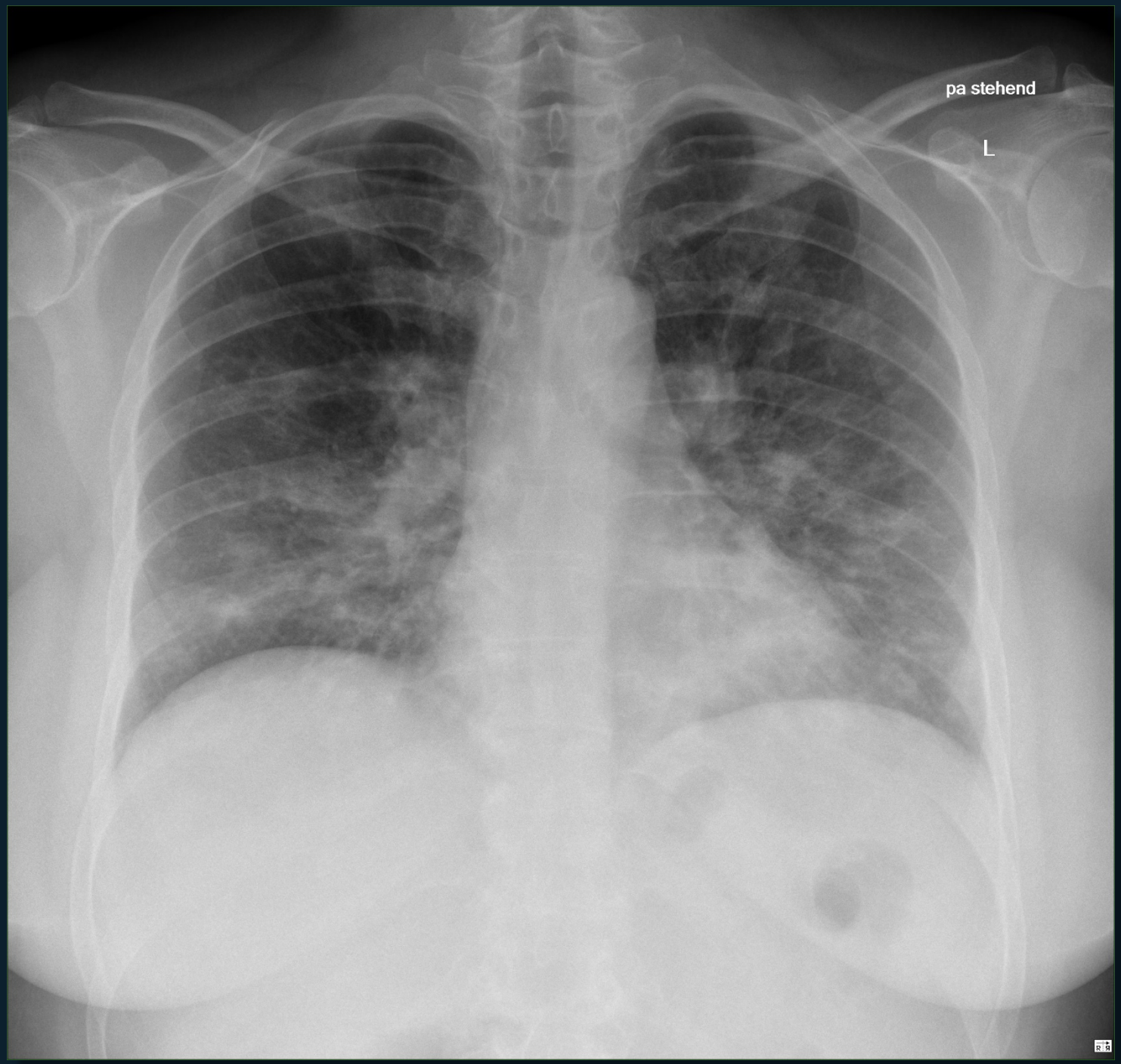
rizika spojená s **mimotělním okruhem**

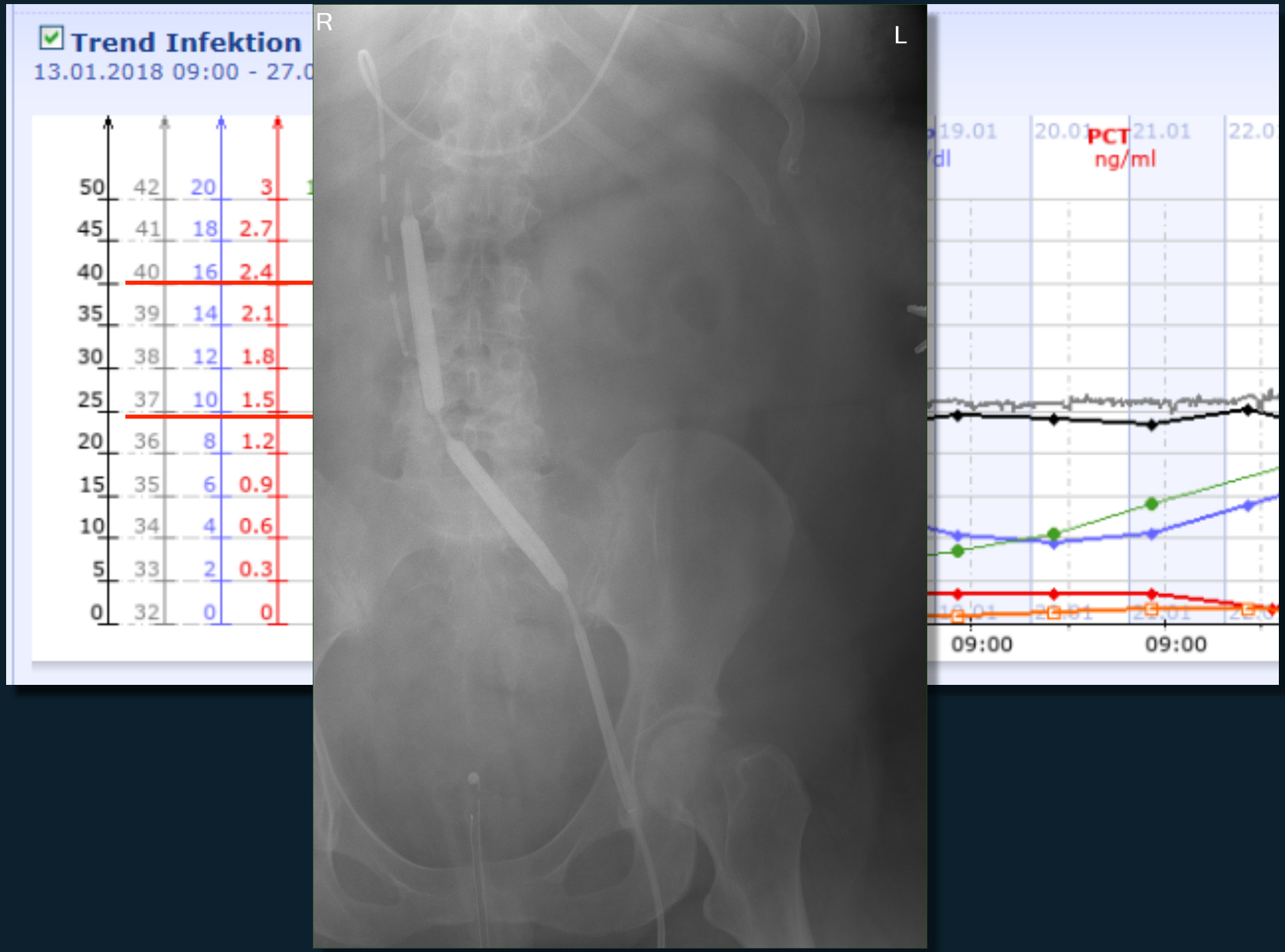
- trombocytopenie

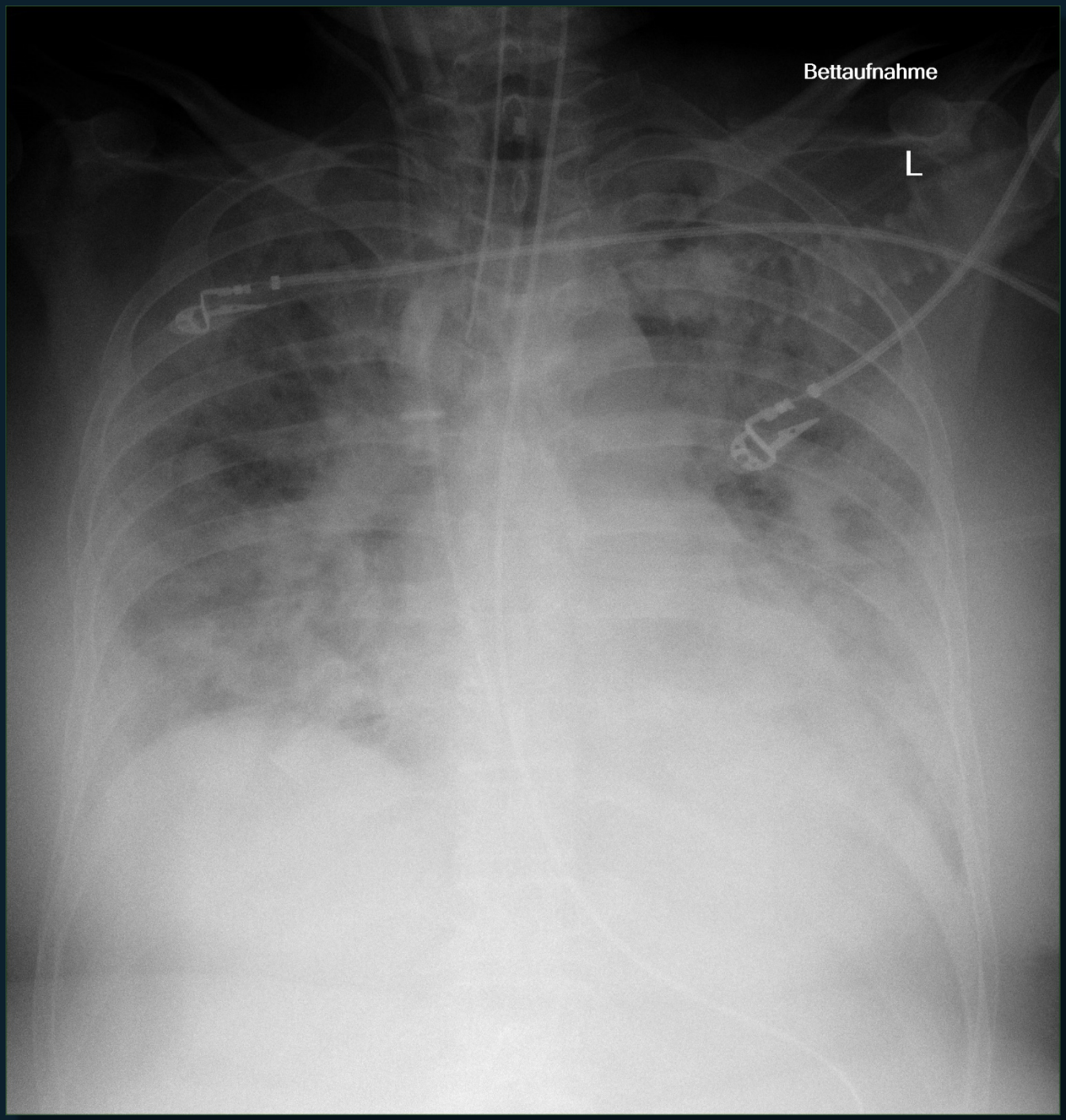
- technické problémy (rozpojení okruhu,…)

vysoké **finanční** náklady

case report


pa stehend
L

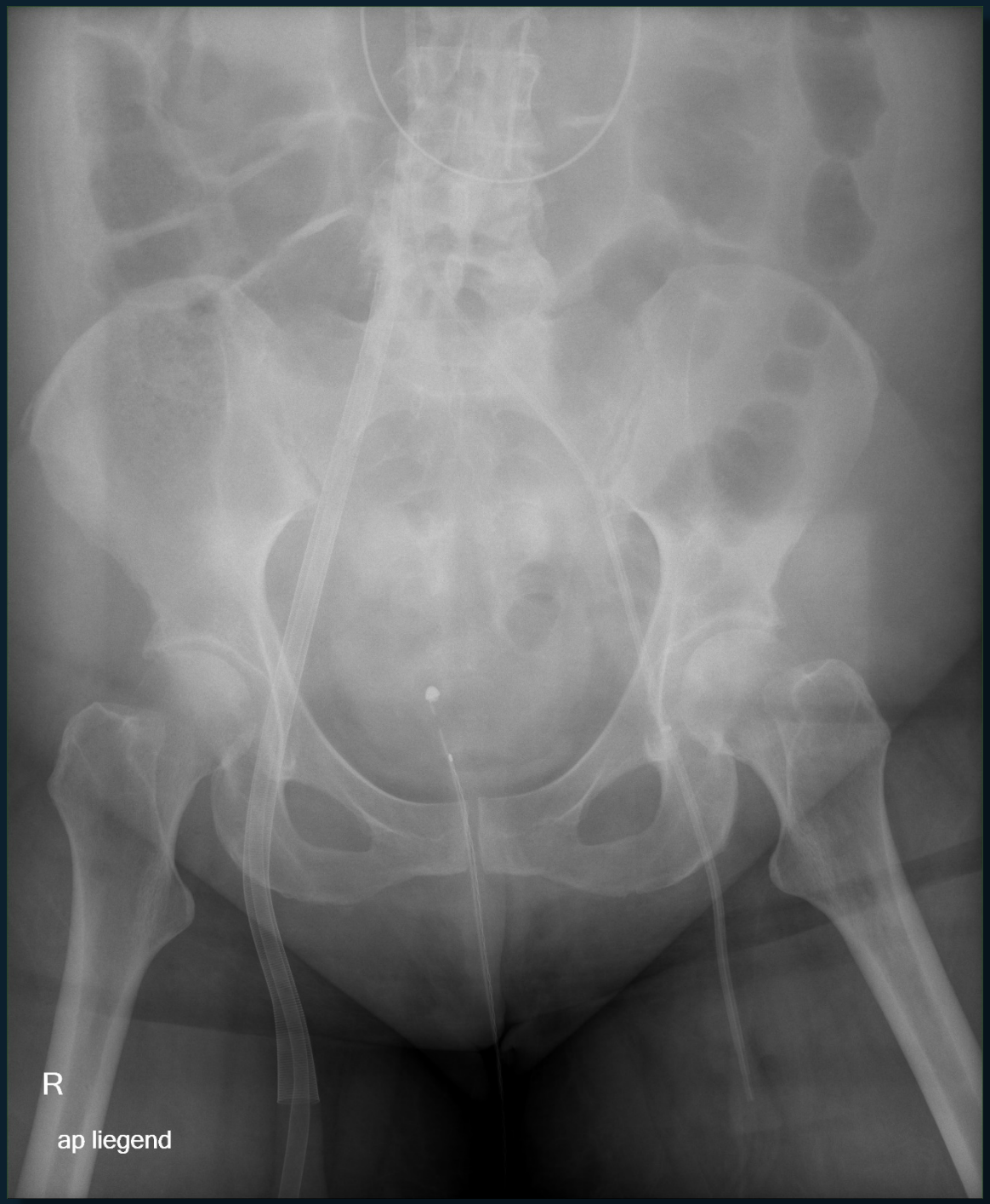

Trend Infektion
13.01.2018 09:00 - 27.0
50 42 20 3
45 41 18 2.7
40 40 16 2.4
35 39 14 2.1
30 38 12 1.8
25 37 10 1.5
20 36 8 1.2
15 35 6 0.9
10 34 4 0.6
5 33 2 0.3
0 32 0 0
R
L
19.01
20.01
21.01
PCT
ng/ml
09:00
09:00


Bettaufnahme
L

Beatmung

21.01.2018 23:00 - 22.01.2018 10:59

	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00
Hamilton Mod	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	APRV	APRV	APRV	APRV
FIO²(m) [%]	69	69	69	70	69	69	69	69	69	69	98	70
f total [/min]	27	27	25	29	28	28	27	28	38	38	37	21
f spontan [/min]	27	27	25	29	28	28	27	28	20	20	19	3
VTinsp(m) [ml]	569	572	604	539	550	592	545	526	435	514	513	610
VTexp(m) [ml]	508	511	540	507	495	553	506	492	197	468	486	558
ExpMinVol [l/min]	13.6	13.6	12.9	14.2	13.6	16.7	13.8	13.7	13.6	11.5	13.5	10.9
Ppeak (m) [cmH2O]	29	29	29	31	30	31	31	30	30	30	33	33
PEEP(m) [cmH2O]	12	12	12	12	12	12	12	12	13	14	14	14
PEEPint [cmH2O]	7	4	8		8	3			6	1	8	17
I:E(m)	0.36	0.34	0.37	0.37	0.34	0.43	0.42	0.36	0.53			
Tinsp(m) [s]	1	1	1	1	1	1	1	1	1			
Texp(m) [s]	2	2	2	2	2	2	2	2	1			
	-											
SpO2 [%]	95	93	94	93	93	92	92	93	92	93	97	92
#SO2I-A [%]			94.5				92.9					95.6
#PO2I-A [mmHg]			65.6				58					74.3
#PCO2I-A [mmHg]			44.4				41.8					45.5
#PHI-A			7.55				7.57					7.53
#LAK-I-A [mmol/l]			2.1				2.3					2
	BGA ven											
	Index											
OxInd			94				83					106


R
ap liegend

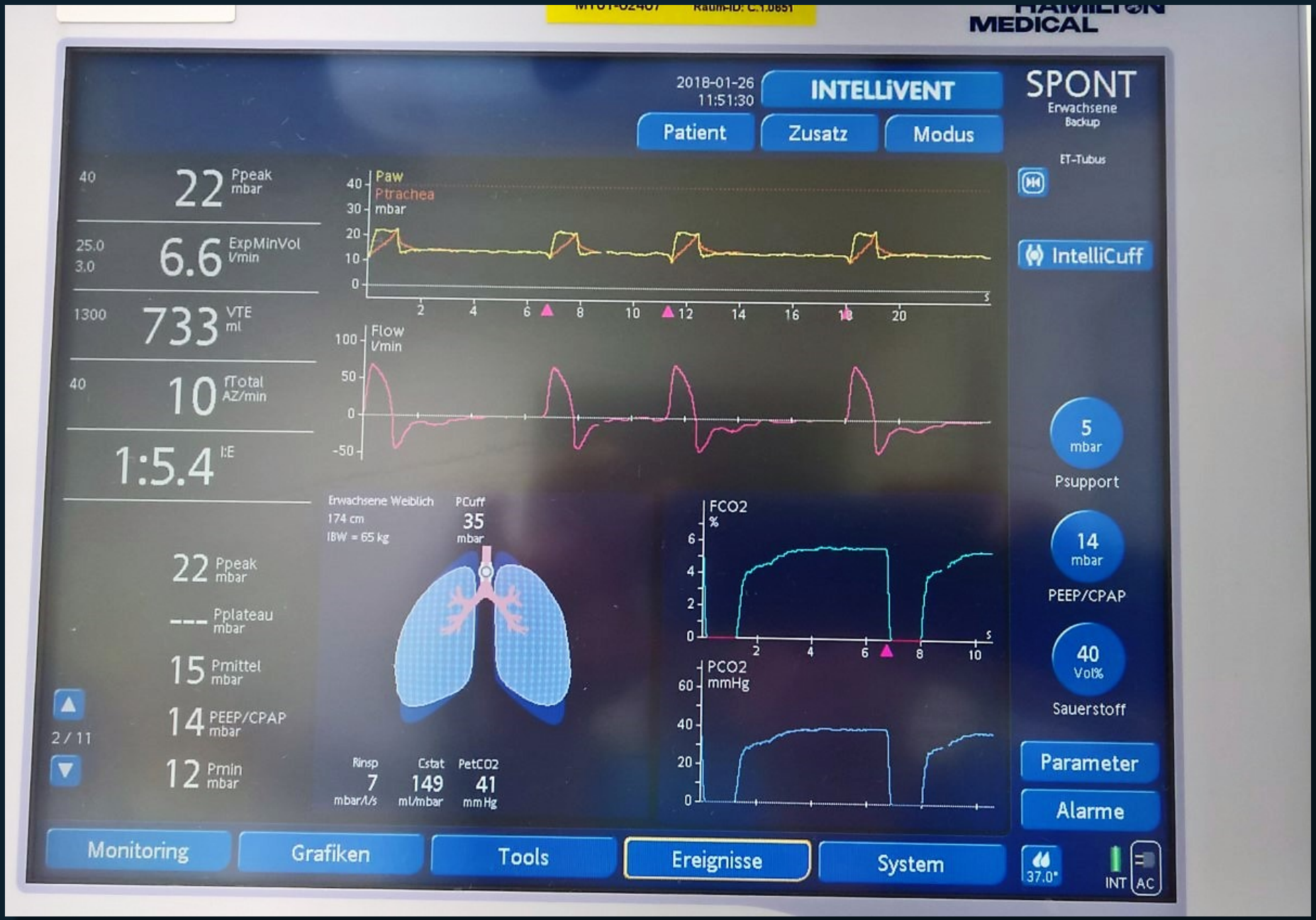

Fluss
2.0 l/min
Druck
-43
172
162
Drehzahl
5900 1/min
iLA active
novalung
PATIENTEN-TEMPERATUR
36.6°C
Lo 28.0°C
Hi 42.0°C
MAX. AUFWÄRMEN
ZIELTEMP
RATE
37.0°C
MAX
2018-01-26 / 11:46
MAX. KÜHLEN
Target Temp
Rate Deg/Hr
Press for Menu / Enter
Standby / Run
ZOLL


DISTAL

ECMO

22.01.2018 11:00 - 22.01.2018 22:59

	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
Hamilton Mod	APRV	APRV	APRV	APRV	APRV	APRV	APRV	APRV	APRV	APRV	APRV	APRV
FIO²(m) [%]	69	69	69	69	69	49	50	50	50	49	49	50
f total [/min]	21	25	47	19	19	20	18	19	14	13	11	17
f spontan [/min]	3	7	29	1	1	10	10	11	6	5	3	9
VTinsp(m) [ml]	528	463	479	558	505	469	298	411	566	254	285	353
VTexp(m) [ml]	507	444	355	521	487	430	523	522	481	474	652	300
ExpMinVol [l/min]	9.5	8.4	14.9	9.7	7.3	6.3	7.2	6	5	4.6	4.3	6.5
Ppeak (m) [cmH2O]	33	31	31	32	31	25	27	26	25	25	28	28
PEEP(m) [cmH2O]	14	14	12	14	14	15	15	15	15	15	15	15
PEEPint [cmH2O]	17	15	13	0	15	1	2	10	5	2	8	8
I:E(m)								16.67				
	-											
SpO2 [%]	98	99	92	98	97	96	94	96	96	97	97	94
#SO2I-A [%]					95.5	96.4		96.2			97.6	97.6
#PO2I-A [mmHg]					71.4	79.6		78.4			90.1	89.4
#PCO2I-A [mmHg]					43.2	48.9		50.6			49.6	52.9
#PHI-A					7.53	7.5		7.49			7.5	7.47
#LAK-I-A [mmol/l]					1.6	1.7		1.2			1.1	1
	BGA ven											
	Index											
OxInd					102	159		157			180	179

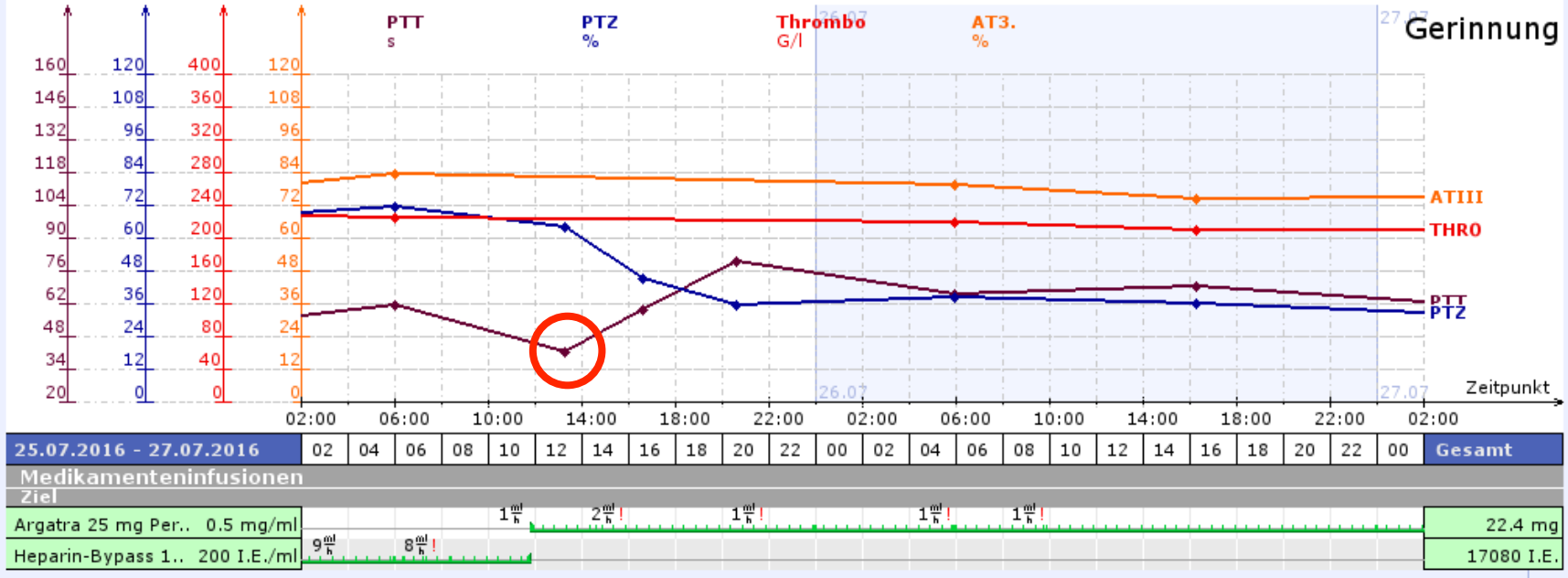

HAMILTON MEDICAL
2018-01-26
11:51:30
INTELLiVENT
Patient
Zusatz
Modus
SPONT
Erwachsene
Backup
ET-Tubus
IntelliCuff
40
22 Ppeak mbar
25.0
3.0
6.6 ExpMinVol l/min
1300
733 VTE ml
40
10 fTotal AZ/min
1:5.4 I:E
Paw
Ptrachea
mbar
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
s
Flow
l/min
100
50
0
-50
Erwachsene Weiblich
174 cm
IBW = 65 kg
PCuff
35
mbar
22 Ppeak mbar
--- Pplateau mbar
15 Pmittel mbar
14 PEEP/CPAP mbar
12 Pmin mbar
2 / 11
Rinsp
7
mbar/l/s
Cstat
149
ml/mbar
PetCO2
41
mmHg
FCO2
%
6
4
2
0
2
4
6
8
10
s
PCO2
mmHg
60
40
20
0
5
mbar
Psupport
14
mbar
PEEP/CPAP
40
Vol%
Sauerstoff
Parameter
Alarme
Monitoring
Grafiken
Tools
Ereignisse
System
37.0°
INT
AC

26.01.2018 21:00 - 27.01.2018 08:59

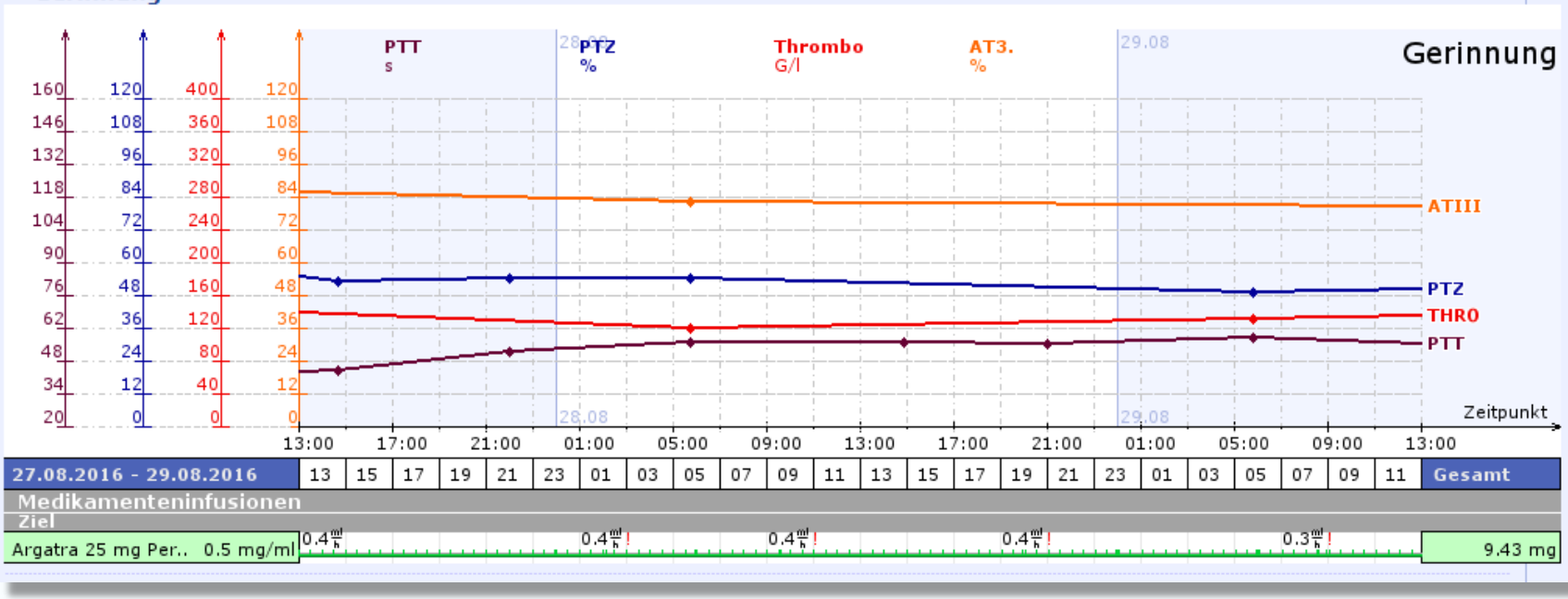
	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Hamilton Mod	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	SPONT	
FIO²(m) [%]	40	40	40	40	40	40	40	40	40	36	35	35
f total [/min]	11	10	10	9	10	14	10	9	11	9	11	10
f spontan [/min]	11	10	10	9	10	14	10	9	11	9	11	10
VTinsp(m) [ml]	675	567	697	651	625	772	674	690	579	739	687	705
VTexp(m) [ml]	570	521	645	621	590	721	619	617	541	713	646	660
ExpMinVol [l/min]	6.2	5.1	7.4	5.9	6	9.3	5.8	5.8	5.9	6.9	7.3	6.9
Ppeak (m) [cmH2O]	20	20	21	20	20	22	20	20	20	20	20	19
PEEP(m) [cmH2O]	12	12	12	12	12	12	12	12	12	10	10	10
PEEPint [cmH2O]	2	3	1	1	0	1		0	0	0	0	
I:E(m)	0.18	0.22	0.21	0.19	0.2	0.21	0.23	0.19	0.2	0.19	0.21	0.2
Tinsp(m) [s]	1	1	1	1	1	1	1	1	1	1	1	1
Texp(m) [s]	5	5	6	6	5	5	6	6	5	6	5	5
	-											
SpO2 [%]	98	98	98	98	98	99	98	98	97	98	97	98
#SO2I-A [%]	98.3				98.9				99.5			
#PO2I-A [mmHg]	98.2				113				147			
#PCO2I-A [mmHg]	39				44.7				40			
#PHI-A	7.52				7.48				7.53			
#LAK-I-A [mmol/l]	1.3				1.2				1.3			
	BGA ven											
	Index											
OxInd	246				283				368			

antikoagulace

Gerinnung

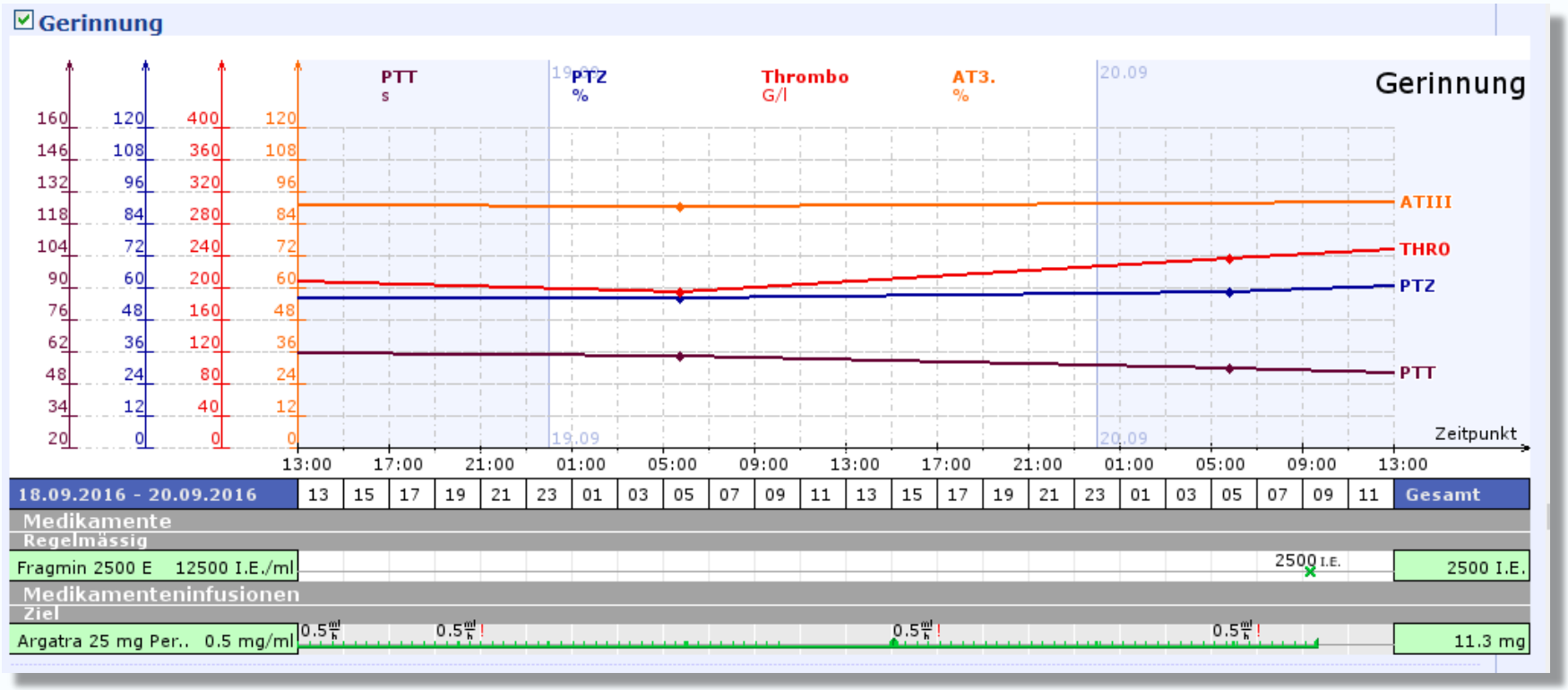


Gerinnung



ECMO STOP

Argatra STOP



očekávané studie

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 24, 2018 VOL. 378 NO. 21

Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

A. Combes, D. Hajage, G. Capellier, A. Demoule, S. Lavoué, C. Guervilly, D. Da Silva, L. Zafrani, P. Tirot, B. Veber, E. Maury, B. Levy, Y. Cohen, C. Richard, P. Kalfon, L. Bouadma, H. Mehdaoui, G. Beduneau, G. Lebreton, L. Brochard, N.D. Ferguson, E. Fan, A.S. Slutsky, D. Brodie, and A. Mercat, for the EOLIA Trial Group, REVA, and ECMONet*

CONCLUSIONS

Among patients with very severe ARDS, 60-day mortality was not significantly

15:10-15:30 **PP** **Umělá plicní ventilace po studii EOLIA**

Pavel Dostál (Hradec Králové)

number, NCT01470703.)

Gattinoni *et al. Critical Care* (2018) 22:171
https://doi.org/10.1186/s13054-018-2098-6

Critical Care

EDITORIAL Open Access

Use of E
really he

Luciano Gattinoni*,

Since 1979, four ra
fectiveness of extr
(ECMO) in respirat
ference between pat
lation (MV) alone
ECMO [1]. The grou
ECMO and FiO_2, w
tilation variables. Fi
pared conventiona
combined with mi

/unit/year). Note-
control group re-
). The patients on
dence of bleeding
28%) and severe

deserve closer con-
y of ECMO trials.
ve proved or dis-

a) *Emergency ECMO improves outcome by "buying time" in extremely hypoxemic patients.*
Of the 35 patients switched from conventional therapy to rescue ECMO (median SaO_2 77%; nine cardiac arrest events), 15 survived. It is unlikely that they would have survived without ECMO, regardless of the statistical relevance of these observations.

b) *ECMO improves outcome by reducing the invasiveness of mechanical ventilation.*
During ECMO, tidal volume was reduced by 43% and respiratory rate by 23%, while PEEP remained essentially unchanged. This represents an estimated 66% reduction in the mechanical power applied to the lungs (from 28 J/min to 10 J/min). This reduction was associated with a higher survival rate (81/124 patients) in the ECMO group (vs 68/125 controls).

DACAPO study

backround:
- ca 40.000 ARDS pts per year in Germany (survival ca 60%)
study:
- 2400 pts, started III/ 2014, 3 years
- ARDS-Netzwerk Deutschland (59 Kliniken)
- follow-up phase 1 year
endpoints:
- mortality reduction, costs reduction
- quality of life improvement, **return to work** …

preliminary report

September **2014** and May **2016**	
62 ICUs all over Germany (65% in ARDS-Netzwerk)	
- 48% ICU‘s of University hospitals	
- 18% maximum level of care	
- 34% others	
mortality *(after 700 pts)*	
- death during ICU	**33,6%**
- discharged alive	**66,4%**
- length of stay until death/discharge	**21** (13-34) **days**

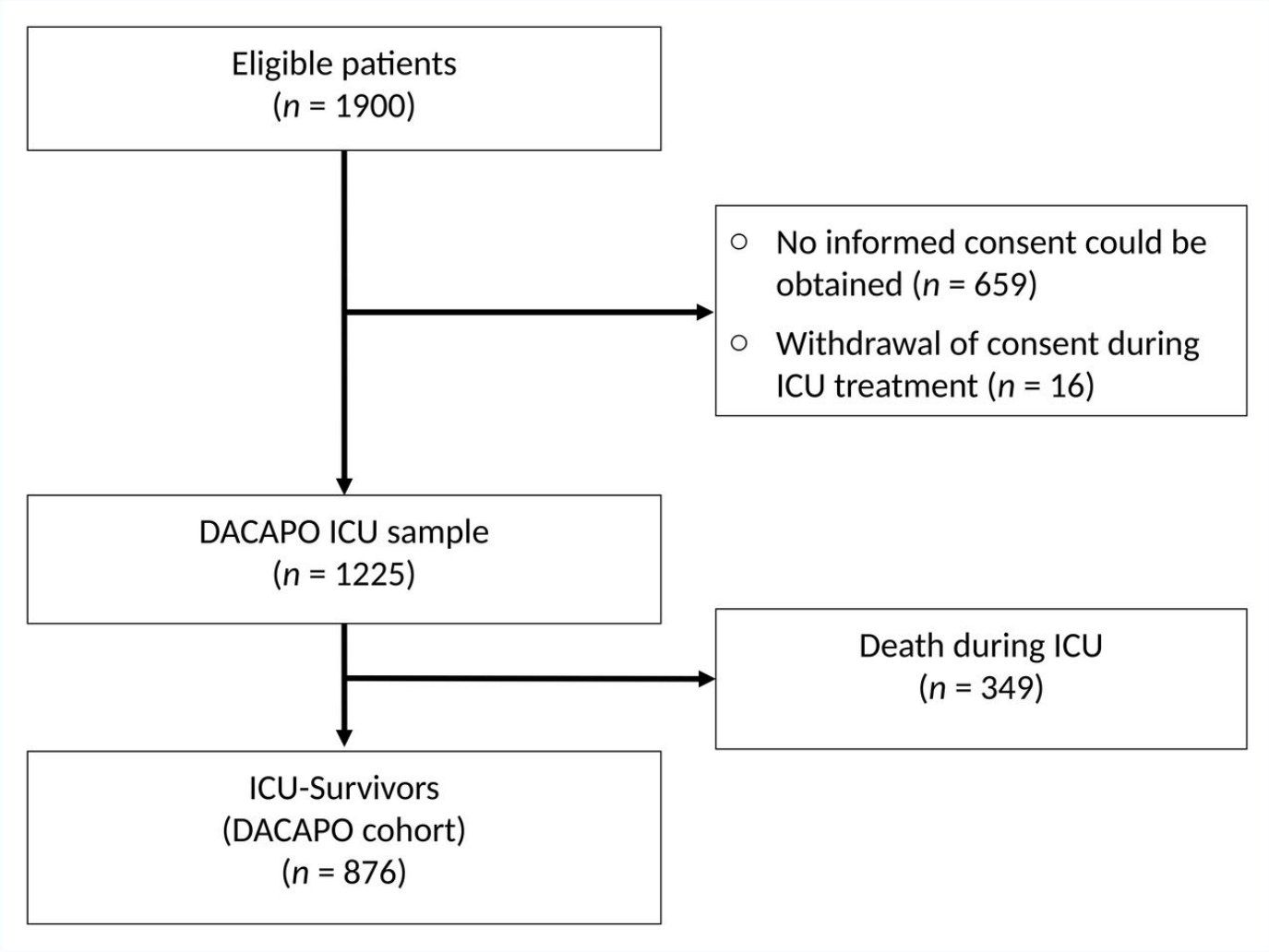
- first 700 ARDS-pts in 59 ICUs from IX/2014 to I/2016
- ARDS: mild 14,1%, moderate 47,6%, severe 38,3%
- **ECMO** was used in **31,3%** of all patients !!!

Table 5 Occurrence of critical events and use of supportive measures in 700 patients with ARDS

Critical events and supportive measures	N	n (%)
Occurrence of critical events (multiple answers)		
Hypoxia[a]	670	180 (26.9)
Hypoglycaemia[b]	676	139 (20.6)
Unintended extubation	683	15 (2.2)
Re-intubation	682	115 (16.9)
Any of the above	684	320 (46.8)
Use of supportive measures (multiple answers)		
Tracheotomy	684	363 (53.1)
NO-inhalation	675	80 (11.9)
ECMO	691	216 (31.3)
Prone positioning	683	308 (45.1)
Neuro-muscular blockers	675	70 (10.4)
Prone positioning and/or neuro-muscular blockers and/or ecmo	692	425 (61.4)

ARDS, acute respiratory distress syndrome; ECMO, extracorporeal membrane oxygenation. [a], defined as a registration of SpO_2 <85% for at least 5 minutes; [b], defined as blood glucose measurement <70 mg/dL.

Patient flow of the DACAPO cohort. ICU, intensive care unit.

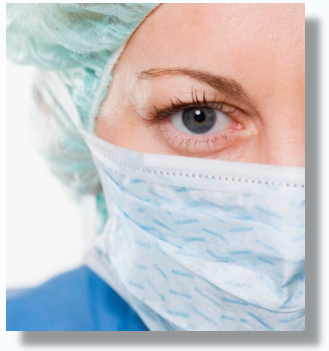


Frank Dodoo-Schittko et al. BMJ Open 2018;8:e019342

BMJ Open

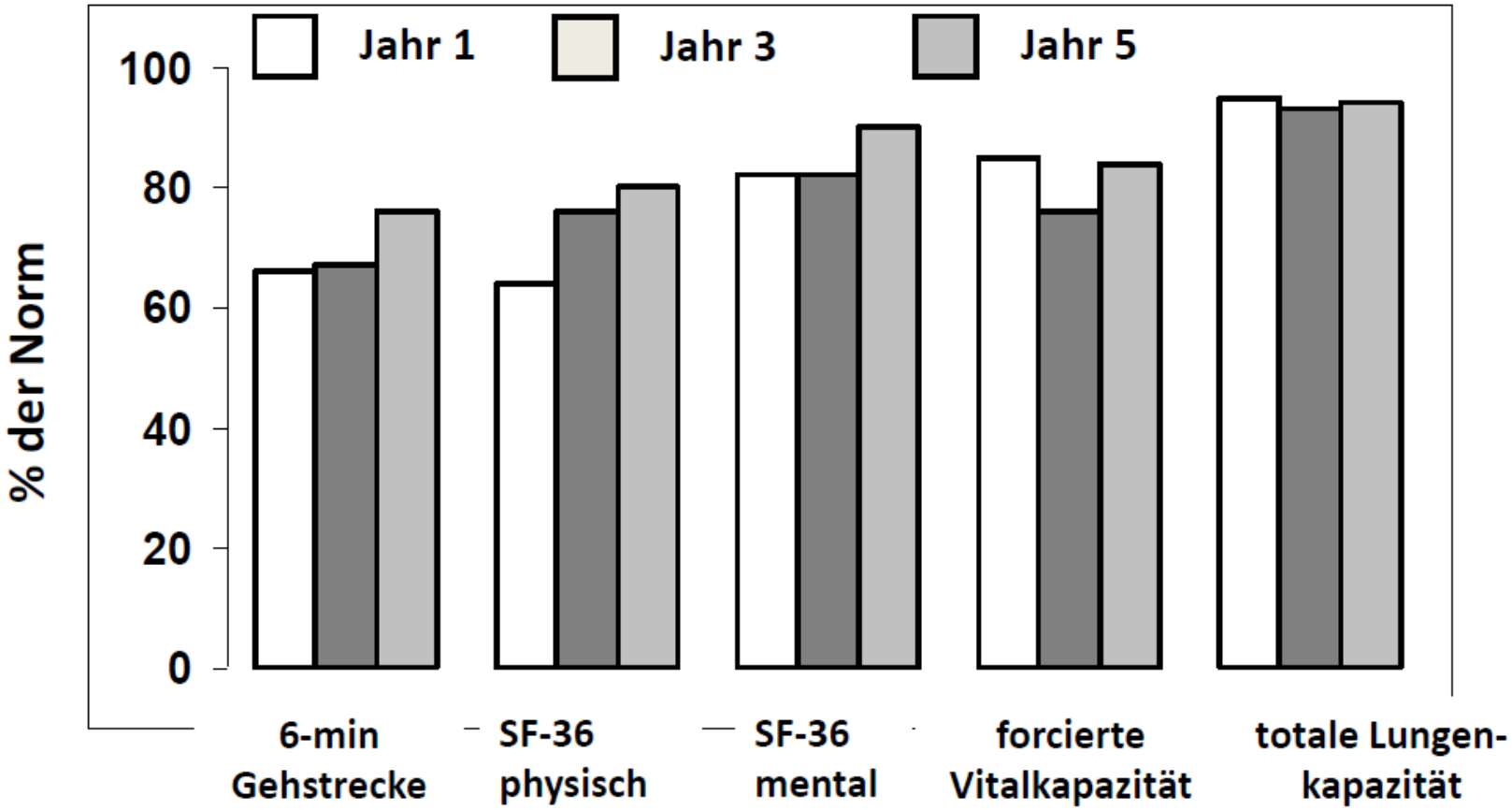
socio-ekonomická problematika

ARDS survivors



- reduced lung function
- psychological problems
- **return to work** delayed, limited or impossible
- …

Lebensqualität nach überlebtem ARDS



Herridge MS N Engl J Med 2011; 364:1293

Long-term survival of critically ill patients treated with prolonged mechanical ventilation: a systematic review and meta-analysis

Emily Damuth, MD, Jessica A Mitchell, MD, Jason L Bartock, MD, Brian W Roberts, MD, Dr Stephen Trzeciak, MD

Published: 20 May 2015

Lancet 2015;3(7):544-53

- 124 studií ze 16 zemí, cca 14.000 pacientů
- inclusion: UPV> 14 dní nebo tracheostomie

výsledky:

- přežití **hospitalizace**: **71%**
- přežití po **1 roce**: **38%**
- pobyt **doma** po **1 roce**: **19%**

vývoj

Cannula AND Endotracheal Tube

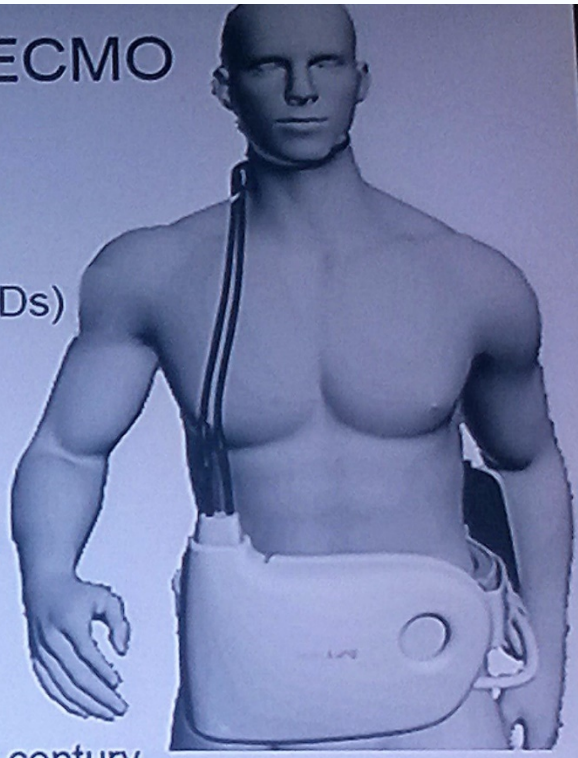
The Age Of Intelligent Machines (Ray Kurzweil):

iLAvista integrates mechanical ventilation and iLA to create intelligent lung assist

- *Two in one solution allows integrated, safer, flexible lung assist, provides cost saving and improved usability*
- *Integrated decision making software can improve lung healing and protection: We need a clinical steering committee that guides software development*
- *Runs all novalung iLA Patient Kits and next gen iLA thus providing dedicated patient kits for any performance level*

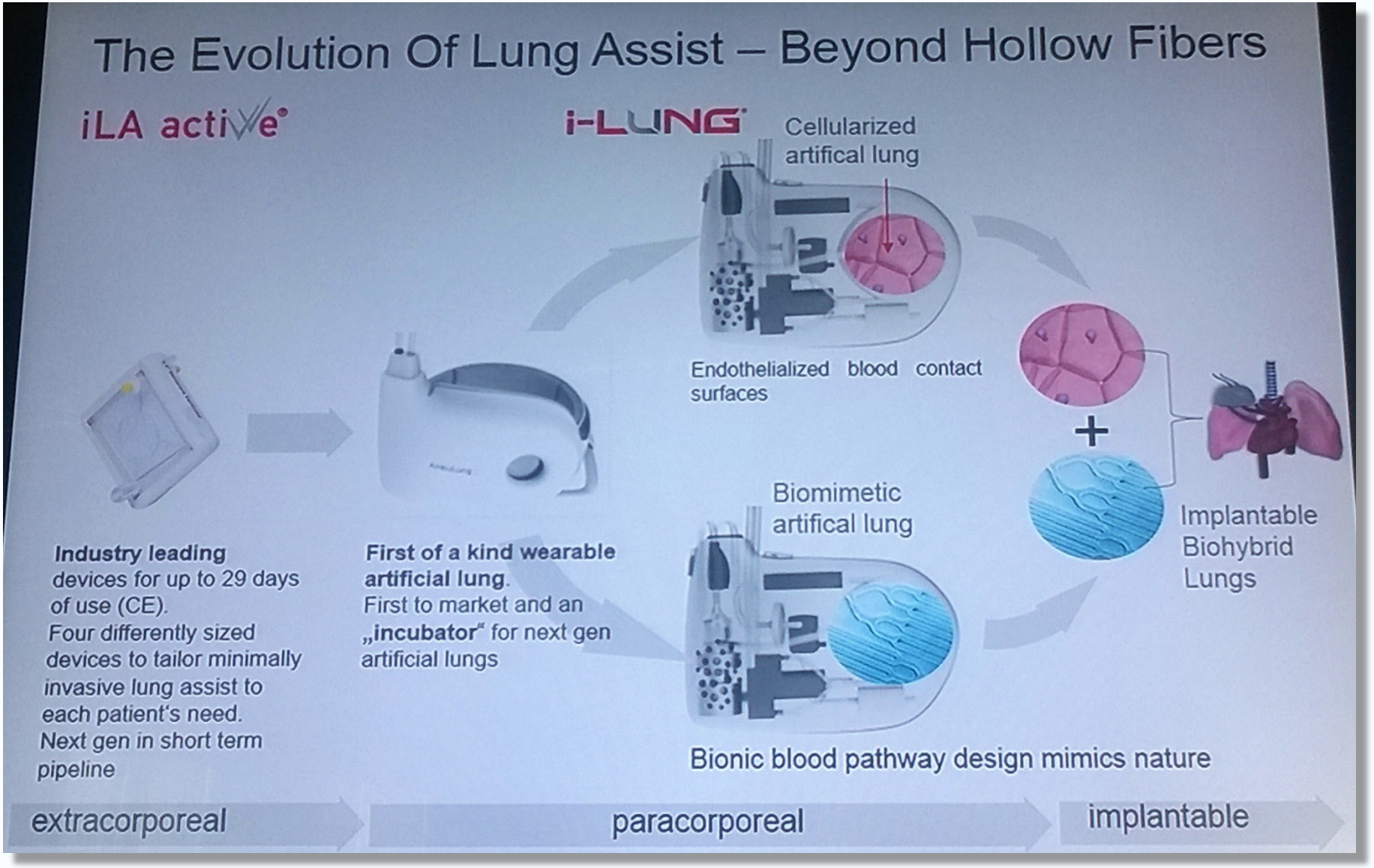
Artificial Lungs Depart From ECMO

i-LUNG®



- i-lung creates a new class of lung assist devices (LADs)
- Learn from the history of VADs

- LADs will be different from VADs thus allowing more rapid adoption:
  - No arterial emboli
  - Failure will not lead to the patient's immediate death
  - No refrigerator sized consoles: i-lung starts in the 21st century
  - The durability of artificial lungs is the main driver of progress
  - The use of room air to prevent heavy oxygen / air cylinders is the second most important driver of progress (see Breethe, Hemovent etc.)
  - Miniaturization of devices / electronics and more efficient batteries are important drivers („from PC to smartphone“)



on ICU in hospital out of hospital


Happy Birthday
40