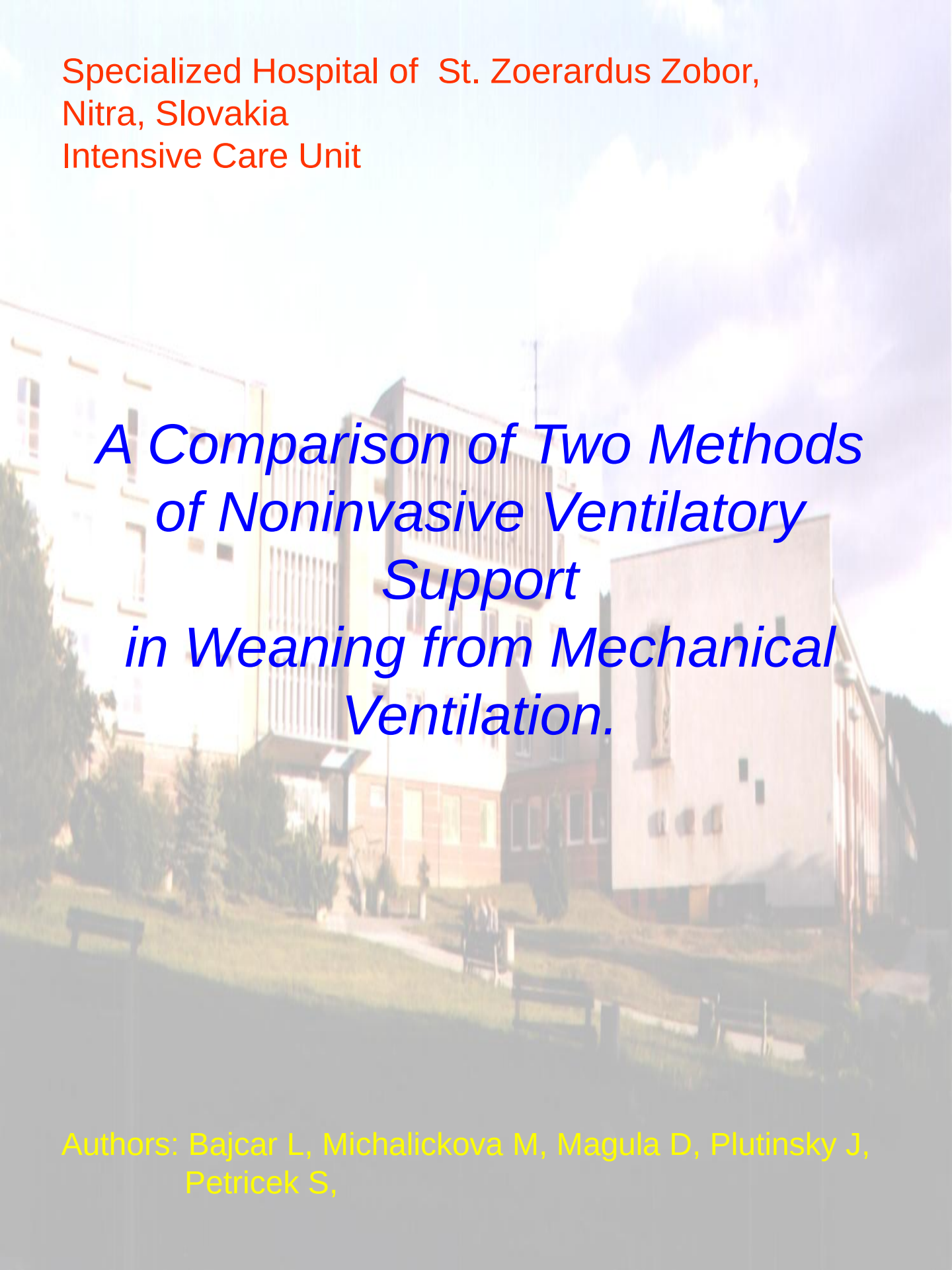
Specialized Hospital of St. Zoerardus Zobor,
Nitra, Slovakia
Intensive Care Unit



A Comparison of Two Methods of Noninvasive Ventilatory Support in Weaning from Mechanical Ventilation.

Authors: Bajcar L, Michalickova M, Magula D, Plutinsky J, Petricek S,

Introduction

The need for reintubation after extubation and discontinuation of mechanical ventilation (MV) is not uncommon and is associated with increased mortality.

Noninvasive ventilation has been suggested as a promising method for prevention and therapy of patients with respiratory failure after extubation.

In our ICU we use two methods of Noninvasive ventilation (NIV) for prevention of failure after extubation:

1. Bilevel positive airway pressure (BiPAP)
2. High frequency jet ventilation (HFJV)

Aim

To find out whether two methods of NIV (BiPAP and HFJV) are equally effective in weaning from mechanical ventilation.

Methods

- We used retrospective analysis in group of patients who required MV
- Years 2007 and 2008
- Inclusion criteria – need of MV continuing at least 24 hours
- Exclusion criteria – patients after cardiopulmonary resuscitation
- For statistical analysis we applied Mann-Whitney test, ANOVA and Regression analysis.

Weaning from MV – clinical assessment

- Adequate (equally effective) cough
- Absence of excessive tracheobronchial secretion
- Resolution of acute phase of the disease for which the patient was intubated
- Stable cardiovascular and metabolic status
- Adequate consciousness
- No sedation

Weaning from MV - Objective measurements

- Adequate oxygenation SaO_2 >90%

  ($FiO_2 \leq 0.4$)
- PEEP ≤ 8 cmH_2O
- Respiratory frequency ≤ 35 breaths · min^{-1}
- MIP ≤ 20-25 cm H_2O
- *V*T > 5 ml · kg–1
- VC > 10 ml · kg–1
- Airways closing pressure (CP) < 7 cm H_2O
- PaO_2 (FiO_2 = 0.4) > 60 mm Hg (8 kPa)
- Increasing $PaCO_2$ < 8 mm Hg (1 kPa)
- pH > 7.300

MIP = maximal inspiratory pressure

VT = volume tidal

VC = vital capacity

*Weaning from MV - **Technique of weaning:***

- We use assisted ventilatory modes

  (pressure support, SIMV, PAV, APRV)
- We use follow with Aeyr T-piece

  (spontaneous breathing trial)
- Extubation when possible
- Noninvasive ventilation
- Consistent monitoring of patients

Weaning from MV – use of BiPAP

- We applied BiPAP via nasal (facial) mask
- Every hour for the duration of twenty minutes
- FiO_2 = 0.35
- IPAP = 12-25 cm H_2O
- EPAP = 4-6 cm H_2O
- Medical device: BiPAP S/T D-30

Weaning from MV – use of HFJV

- We applied HFJV via facial mask
- Every hour for the duration of twenty minutes
- Respiratory frequency = 120 breaths pre minute
- FiO_2 = 0.65
- Inspiratory press = 25 cm H_2O
- Inspiratory Time : Expiratory Time ratio = 1 : 1
- Medical device: Paravent PAT

Results

- 55 mechanical ventilated patients:
  33 died (60.00%)
  22c survived (40.00%)
- 34 patients, who met the criteria for weaning from MV
- 17 patients – BiPAP in weaning
- 17 patients – HFJV in weaning
- Reasons for need of MV are shown in graph 1

- *Results in subgroup 34 patients*

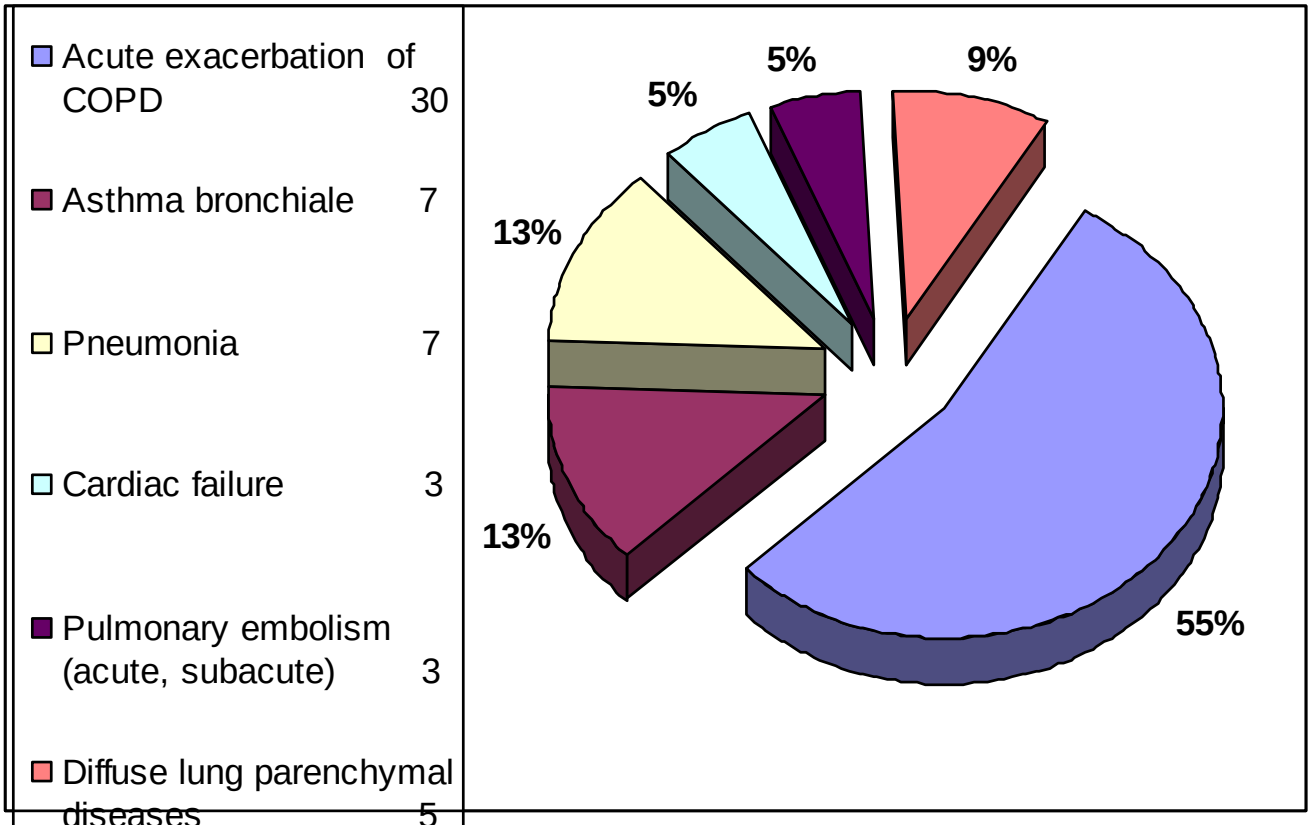
- 34 patients started weaning from MV
- Weaning was successful in 22 patients (64.71%)
- Weaning was not successful in 12 patients (35.29%)
- **The difference between successfully weaned patients and non-weaned patients was statistically significant: (p Mann-Whitney 0.0376)**

Characteristic of subgroup 34 patients

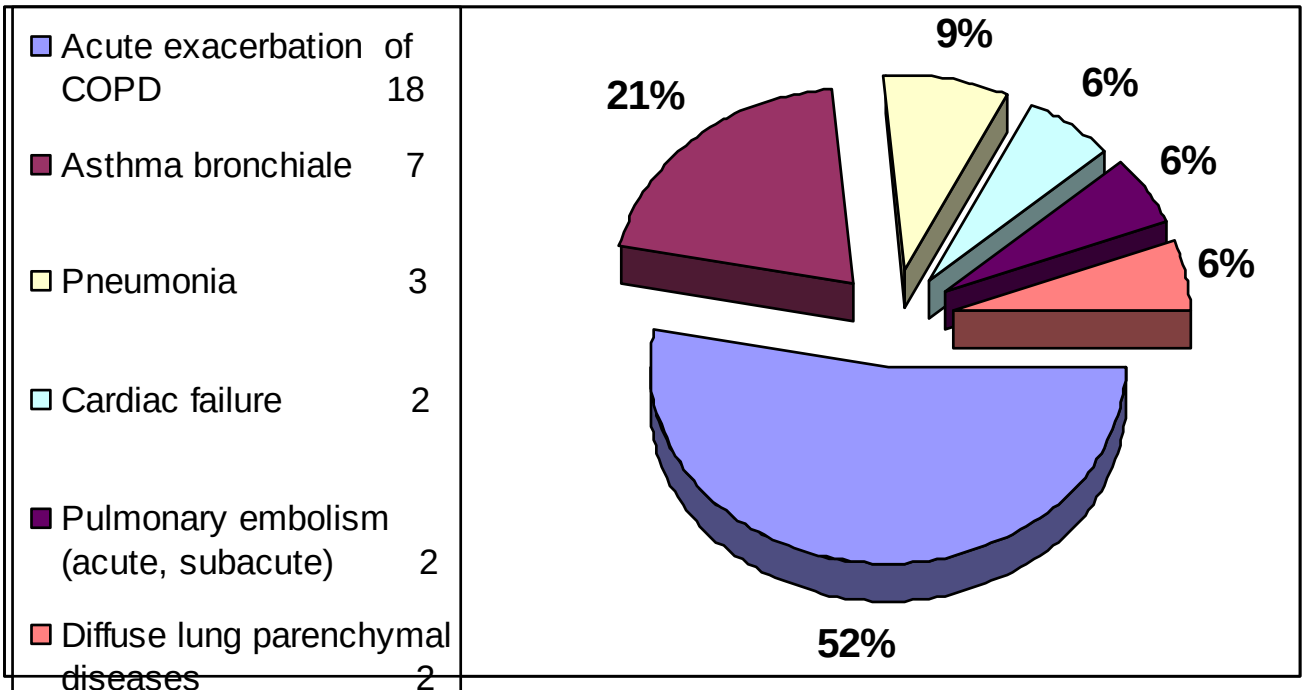
	Number	Mean ± SD
survived	22	
died	12	
Age ∗ (years)		64,82 ± 9,84
BMI ∗ (kg x m^{-1})		31,36 ± 9,55
pH ∗		7,301 ± 0,050
$PaCO_2$ ∗ (kPa)		7,97 ± 2,36
PaO_2 ∗ (kPa)		5,68 ± 0,76
Leucocytes ∗ (10^9 / ml)		11,27 ± 5,05
CRP ∗(mg/ml)		61,42 ± 35,37

∗ Values at admission in mean ± SD

Reasons of respiratury failure (group 55 pts.)



Reasons of respiratury failure (subgroup 34 pts.)



Differences between BiPAP and HFJV in survived patients

	BiPAP survived	HFJV survived	p BiPAP / HFJV ANOVA	p BiPAP / HFJV Mann-Whitney
Number of pts.	10	12		NS
Age (years) Mean ± SD	59.30 ± 6.90	63.33 ± 7,98	NS	
pH ∗	7.316 ± 0,.027	7.338 ± 0.014	0.0293	
PaO_2 ∗ (kPa)	5.74 ± 0.76	6.05 ± 0.79	NS	
CRP ∗ (mg/l)	64.82 ± 38.52	41.35 ± 30.34	NS	

∗ Values at admission in mean ± SD

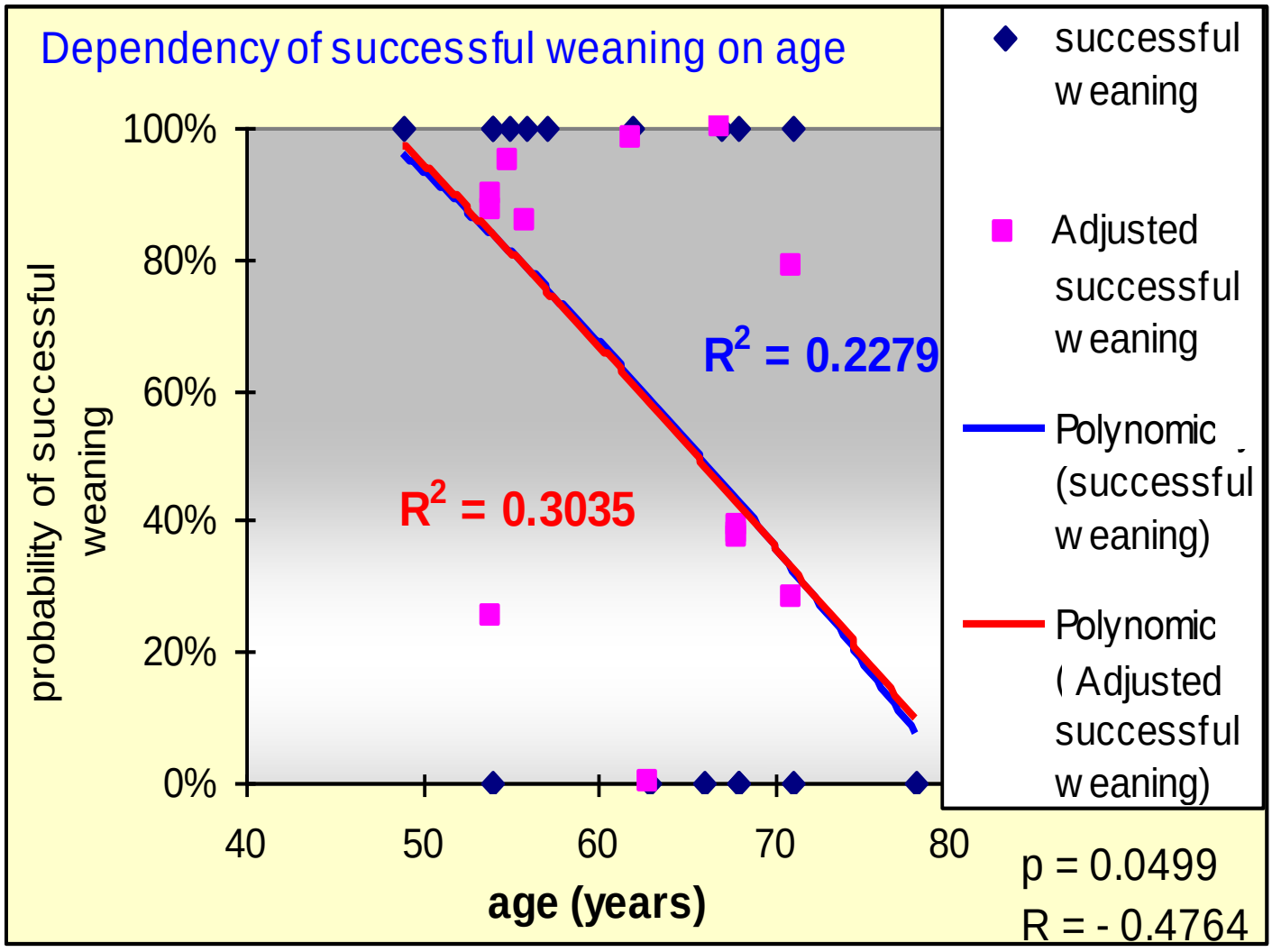
Differences between BiPAP and HFJV in patients who died

	BiPAP died	HFJV dead	p BiPAP / HFJV ANOVA
Age (years) Mean ± SD	66.86 ± 6,81	76,60 ± 11.59	NS
pH ∗	7.237 ± 0.040	7.276 ± 0.053	NS
PaO_2 ∗(kPa)	5.10 ± 0.50	5.49 ± 0.31	NS
CRP ∗ (mg/l)	74.86 ± 25.70	83.96 ± 25.58	NS
	BiPAP died	HFJV died	p BiPAP / HFJV Mann-Whitney
Number of patients	2	1	NS
Respiratory failure ∗∗	4	3	NS
MODS ∗∗	3	2	NS

∗ Values are in in mean ± SD at admission
∗∗ As the reason od death
MODS = Multiple Organ Dysfunction Syndrome

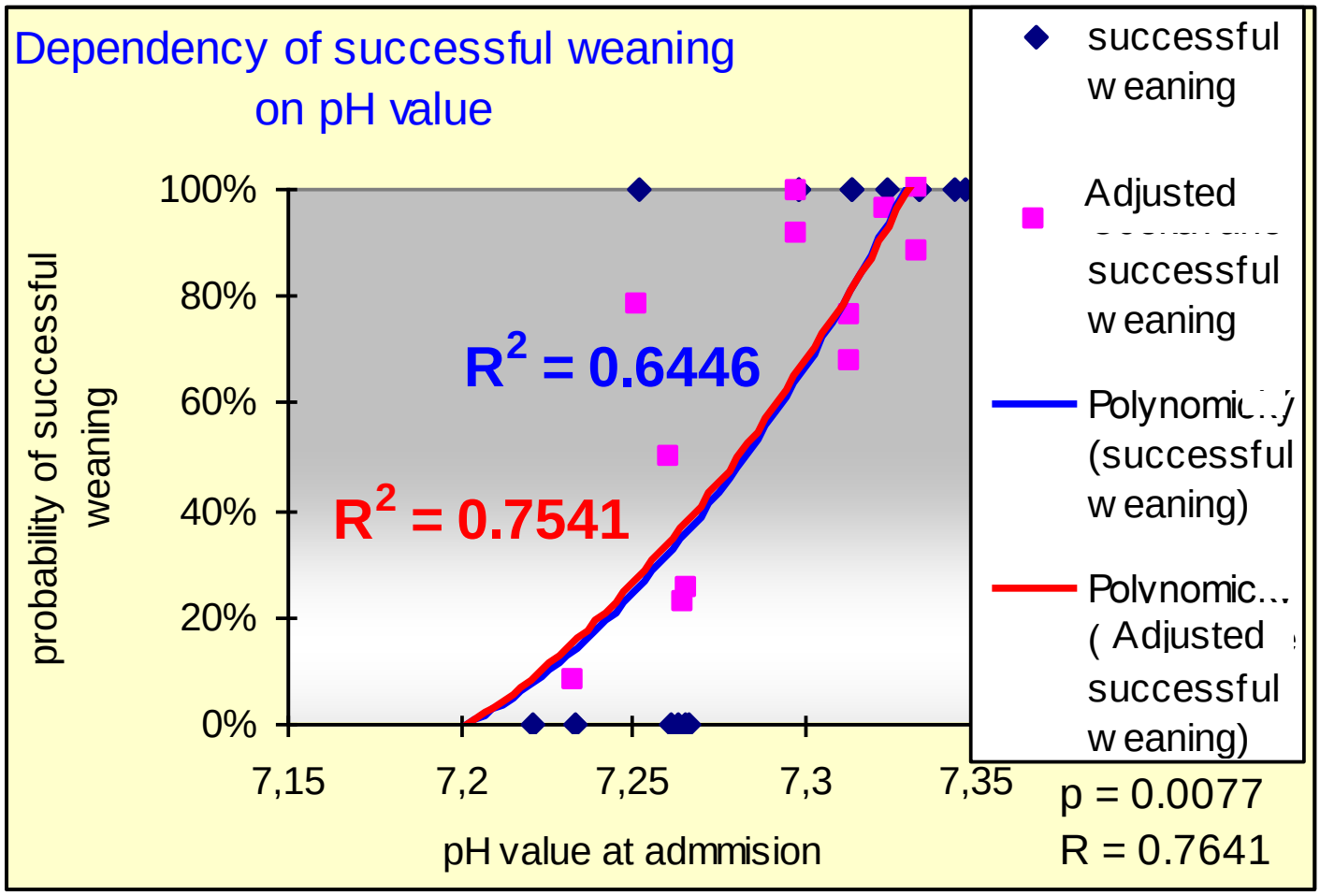
BiPAP - Regression analysis – probability of successful weaning from MV - 1

Probability of successful weaning	Parameter	p	R	R^2 model	R^2 adjusted	CI
↓	Age	0.0499	-0.4764	22.79%	30.35%	95%



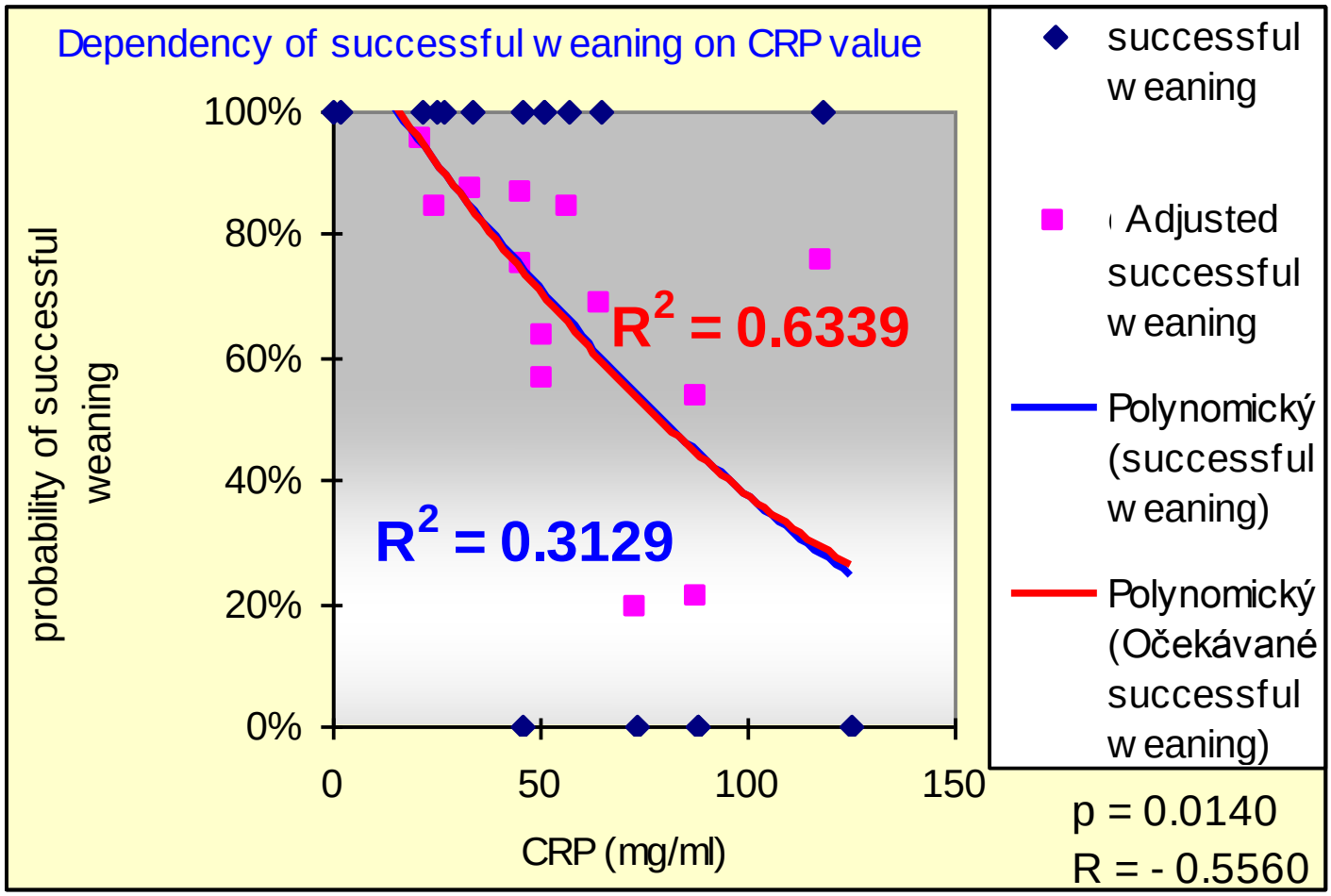
BiPAP - Regression analysis – probability of successful weaning from MV - 2

Probability of successful weaning	Parameter	p	R	R^2 model	R^2 adjusted	CI
↑	Value at admission pH	0.0077	0.7641	64.46%	75.41%	95%



HFJV - Regression analysis – probability of successful weaning from MV

Probability of successful weaning	Parameter	p	R	R^2 model	R^2 adjusted	CI
↓	CRP	0.0149	- 0.5560	31.29%	63.39%	95%



Comparison of BiPAP and HFJV (Length of hospitalization, length of NIV aand day of extubation are only in 22 successfully weaned patients)

	BiPAP (B) Number Average ± SD	HFJV (H) Number Average ± SD	p – B / H ANOVA	p – B / H Mann-Whitney
Survived patients	10 (58.82%)	12 (70.59%)		NS
Dead patients	7 (41.18%)	5 (29.41%)		NS
Length of hospitalization *	15.90 ± 3.78	14.08 ± 3.30	NS	
Day of extubation *	9.90 ± 4.16	8.17 ± 4.06	NS	
Length of NIV after extubation *	3.80 ± 0.60	4.00 ± 1.29	NS	

* Values are in days mean ± SD

DISCUSSION

- It was shown that noninvasive ventilation improves the results of weaning patients from mechanical ventilation.
- Literature reports about frequency of weaning failure from 25.50% (Esteban) to 42.40% (Vallverdu)
- Authors applied two methods NIV in weaning from mechanical ventilation: BiPAP and an unusual mode - HFJV.
- Applying HFJV in weaning was effective in 70.59% .
- Applying BiPAP in weaning was effective in 58.82%.
- Weaning failure:

  29.41% in HFJV subgroup

  41.18% in BiPAP subgroup
- When comparing two methods of NIV in weaning, we found that HFJV:

  shorter length of hospitalization

  but there is a longer need of application after extubation.

Factors, which can worsen weaning from mechanical ventilation

- Instable cardiovascular status (circulatory support is needed)
- Nutrition (obesity or malnutrition)
- Metabolic disturbances (e.g. hyperglycaemia)
- Treatment with corticosteroids
- Ventilator induced diaphragm dysfunction
- Anaemia
- Delirium
- Anxiety, depression

Conclusion

Both methods of NIV:
(BiPAP and HFJV)
were successful
in the weaning from MV.

HFJV mode was slighter more effective,
the differences were not
statistically significant

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