Early Treatment of TBI
A Prospective Study from Austria

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Background

In a study done 2001-2005, we found that the **only guideline** that had significant effects upon outcomes after severe TBI was the guideline that recommends **to restore oxygenation and perfusion as rapidly as possible**

Rusnak M, Janciak I, Majdan M, Wilbacher I, MAURITZ W: Severe Traumatic Brain Injury in Austria VI: Effects of guideline-based management. Wien Klin Wochenschr. 2007; 119:64-71

New Study

Thus, between 4/2009 und 4/2010, 16 Austria centers enrolled **446 TBI patients** into an **observational study** of prehospital as well as early hospital care

The study was funded by the Ministry of Health and the AUVA (Austrian Trauma Insurance)

METHODS

OBSERVATIONAL STUDY, NO „CONTROL GROUP“;
INTERIM ANALYSIS AT HALF-TIME
STUDY WILL CONTINUE UNTIL 4/2012

Data Collected

For each patient

- Prehospital status & treatment
- Status & treatment in the Trauma Room
- Times
- ICU treatment summary
- Hospital & 6-months outcome

Data Calculated

For each patient

- Intervals (EMS-Hosp; Arr-CT, CT-OR, etc)
- Probability of mortality = P_M
- Probability of poor outcome = P_P

Hukkelhoven CW, Steyerberg EW, Habbema JD, et al. Predicting outcome after traumatic brain injury: development and validation of a prognostic score based on admission characteristics. J Neurotrauma 2005;22(10): 1025-1039

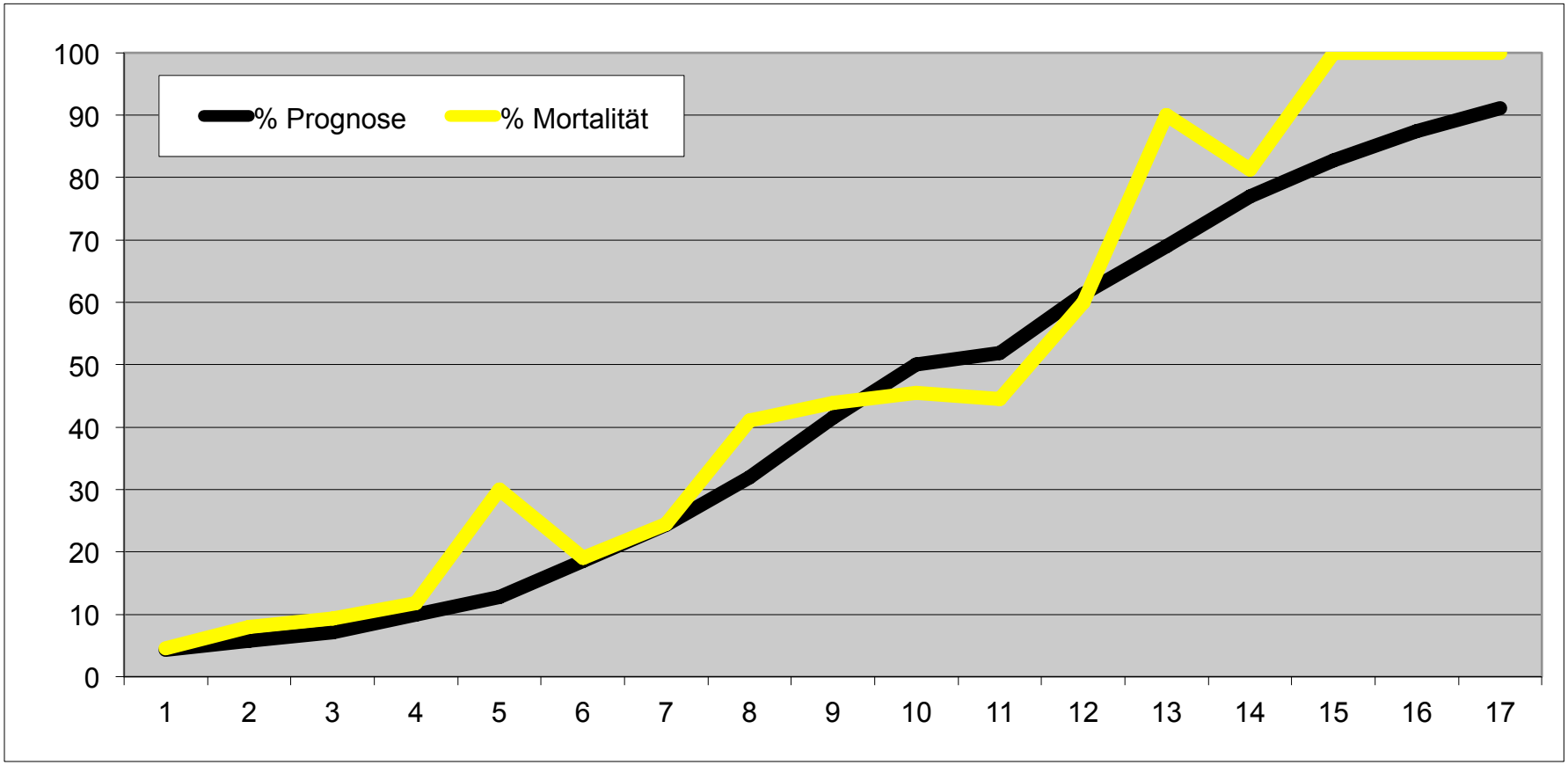
Hukkelhoven-Score

Prognosis of death or poor outcome for patients with traumatic brain injury (%) – validated in >5000 pts!

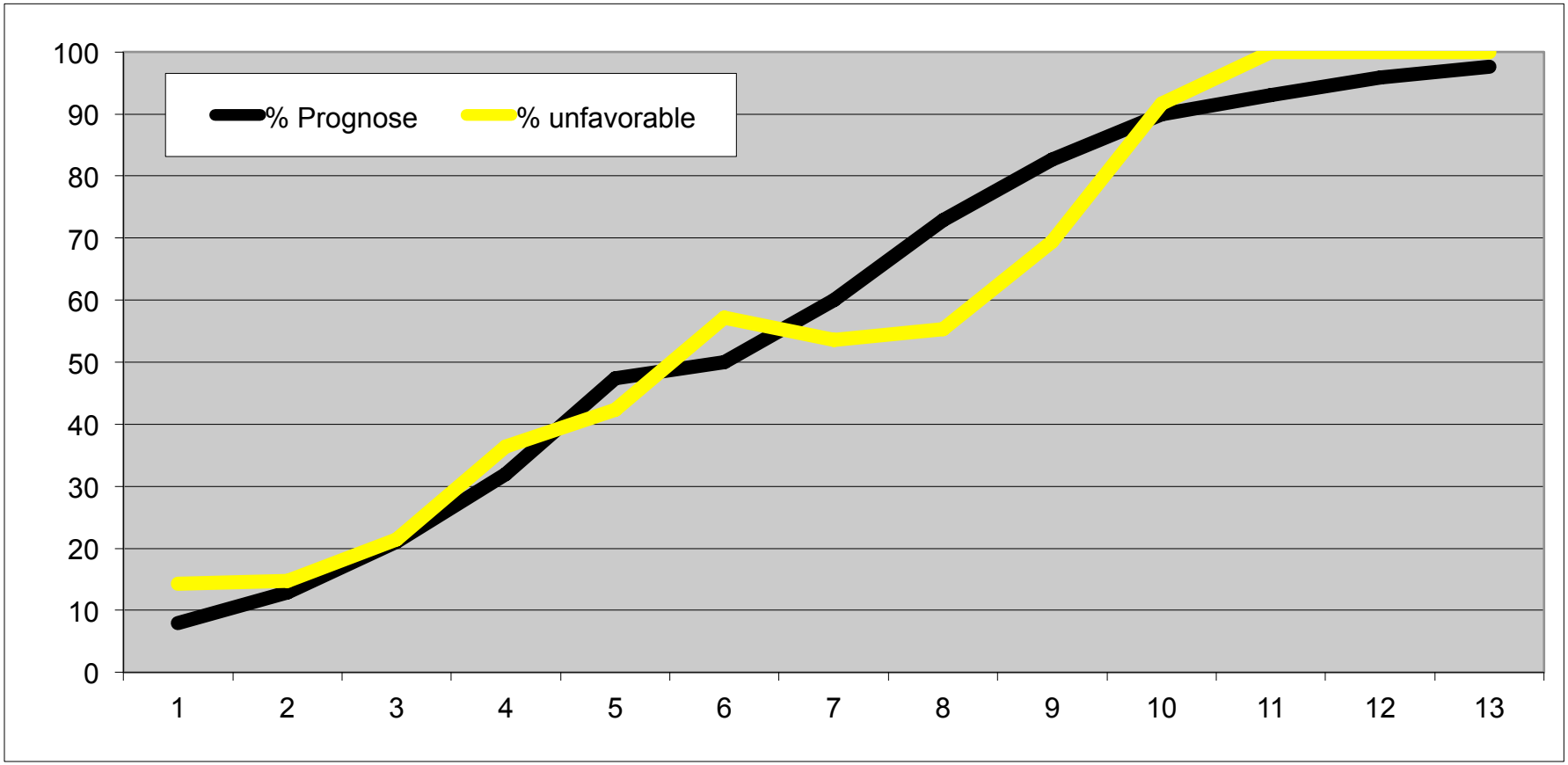
points	0	1	2	3	4	5	6	7	8
P_{mort} (%)	4,3	5,7	7,1	10,0	12,8	18,6	24,3	32,0	41,5
P_{poor} (%)	7,9	12,9	21,0	32,0	47,4	60,0	72,9	82,6	90,0

points	9	10	11	12	13	14	15	16
P_{mort} (%)	51,9	61,4	69,0	77,0	82,7	87,4	91,1	95,9
P_{poor} (%)	93,1	95,9	97,6	99,0				

Mortality vs. Prognosis



Poor Outcome vs. Prognosis



Data Calculated

For treatment options

- P_M and P_P were calculated (mean P of all patients who DID or DID NOT have the treatment)
- The **ratio** between **observed mortality or rate of poor outcome** and **predicted probability** was calculated for all treatment options **(O/E ratio)**

O/E Ratio

- If the O/E ratio is **>1**, a treatment option is **associated with a higher mortality** or a higher rate of poor outcome than expected
- If the O/E ratio is **<1**, a treatment option is associated with a **lower mortality** or a lower rate of poor outcome than expected

RESULTS

PREHOSPITAL TREATMENT OPTIONS

Intervall EMS Arr. – Hospital Arr.

	% mort	O/E R mort	% unfav	O/E R unfav
0-45 min	32,0	**1,1160**	51,4	1,0156
46-90 min	33,8	**1,1299**	45,1	0,8818
91-135 min	25,0	**1,2784**	35,0	0,8581
total	32,3	1,1272	47,7	0,9440

Short interval is associated with lower mortality

Definitions of Treatment Efforts

- ✓ Maximal:
  - ✓ Venous access, intubation, ventilation, monitoring incl. capnography and blood pressure, infusion 500+ mL
- ✓ Standard:
  - ✓ Venous access, intubation, ventilation, basic monitoring (ECG, pulse oximetry), Infusion
- ✓ Minimal:
  - ✓ Venous access y/n, monitoring y/n, infusion y/n

Prehospital Treatment Effort

	% mort	O/E R mort	% unfav	O/E R unfav
maximal	31,9	**1,0565**	50,8	**0,9210**
standard	31,3	**1,2349**	48,5	**1,1108**
minimal	31,8	0,9537	45,2	0,7616

Maximal effort is associated with better outcomes

Transport

	% mort	O/E R mort	% unfav	O/E R unfav
Patients (all)	31,8	1,1106	47,7	0,9440
Transport				
Helicopter	31,0	**1,1117**	49,7	0,9918
Ambulance	34,9	**1,2193**	49,0	0,9658

Treatment and transport by aeromedical teams are associated with lower mortality

Treatment Heli vs. Ambulance

Prehospital treatment effort	Heli	Amb	total
maximal	**86**	56	142
standard	**93**	89	182
minimal	5	**38**	43
total	184	183	367

The better outcome of patients treated by aeromedical teams is **due to differences in treatment**; the intervals EMS arrival – hospital arrival were similar (49 vs. 50 min)

Intubation & Ventilation

	% mort	O/E R mort	% unfav	O/E R unfav
Patients (all)	31,8	1,1106	47,7	0,9440
Intubation				
no	25,6	**1,1061**	37,6	0,8858
yes	36,1	**1,1310**	54,5	0,9842
pCO2				
<34 mmHg	33,8	1,0363	50,8	0,9337
34-38 mm Hg	27,6	**0,9573**	46,2	**0,8818**
38-45 mmHg	18,2	0,9524	60,0	1,3996

Monitoring

	% mort	O/E R mort	% unfav	O/E R unfav
Patients (all)	31,8	1,1106	47,7	0,9440
Pulse oximetry				
no	32,1	1,0385	66,7	**1,4347**
yes	31,8	1,1234	49,1	**0,9793**
Capnography				
no	32,4	**1,2548**	48,2	**1,0561**
yes	32,9	1,0804	53,1	0,9669

Volume Replacement

		% mort	O/E R mort	% unfav	O/E R unfav
Patients (all)		31,8	1,1106	47,7	0,9440
Lact. Ringer's	no	31,4	1,1408	47,8	**0,9718**
	yes	33,3	1,1246	52,5	1,0168
Ringer's	no	32,9	1,1836	49,8	1,0073
	yes	30,0	**1,0243**	48,5	**0,9409**
HES	no	30,6	1,1310	48,5	1,0125
	yes	34,6	1,1307	51,0	**0,9175**
NaCl hyperton	no	31,2	1,1402	48,9	0,9952

„Errors“

29 patients with a GCS <9 were not intubated on the scene

- O/E-Ratio for mortality was 1,1874 (slightly higher than average)
- O/E-Ratio for poor outcome was 0,8162 (15% better than averge!)

RESULTS

TRAUMA ROOM TREATMENT OPTIONS

Interval Hospital Arr. – CT scan

	% mort	O/E R mort	% unfav	O/E R unfav
CT first	**22,6**	**0,9196**	34,5	**0,7602**
0-10 min	**23,2**	**0,7159**	38,5	**0,7223**
11-20 min	38,9	1,1893	61,6	1,0957
21-30 min	29,4	1,1533	45,2	0,9218
31-40 min	37,0	1,4590	47,6	1,0462
41-60 min	29,5	1,1499	42,9	0,8773
61-180 min	34,5	1,4345	50,0	1,1092

Interval CT-OP

	% mort	O/E R mort	% unfav	O/E R unfav
0-30 min	31,6	**0,9272**	50,0	**0,8924**
31-60 min	38,2	1,3269	52,4	1,0357
61-90 min	30,8	0,9170	52,0	0,9648
91-120 min	33,3	1,0522	59,1	1,0880
121-180 min	19,0	0,7647	55,0	1,2031
3-12 h	30,6	1,1281	60,0	1,1946

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- ✓ Maximal:
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- ✓ Standard:
  - ✓ Venous access, intubation, ventilation, basic monitoring (ECG, pulse oximetry), Infusion
- ✓ Minimal:
  - ✓ Venous access y/n, monitoring y/n, infusion y/n

Treatment Effort

	% mort	O/E R mort	% unfav	O/E R unfav
maximal	20,0	**0,7649**	36,0	**0,7705**
standard	36,7	1,2200	52,8	1,0007
minimal	44,1	1,5591	57,6	1,1661

The Trauma Room is the place where treatment efforts should be maximized

ASS, Clopidogrel & Co.

	alive	dead	total	% mort	% unfav
Patients (all)	**304**	**142**	**446**	**31,8**	**47,7**
No medication (%)	82,9	76,8	80,9	30,2	45,6
1 medication (%)	16,8	18,3	17,3	**33,8**	**53,5**
2 medications (%)	0,3	4,9	1,8	**87,5**	**87,5**
total	**100,0**	**100,0**	**100,0**	**31,8**	**47,7**

Incidence: 0-40 years: 1% 41-60 years: 9%
61-80 years: **38**% 81-99 years: **62**%

TEG

	% mort	O/E R mort	% unfav	O/E R unfav
Patients (all)	31,8	1,1106	47,7	0,9440
no	35,0	1,1522	50,4	0,9879
yes	**24,3**	**0,8130**	44,9	**0,8719**

Use of thrombelastography in the trauma room is associated with **a significant reduction in mortality**

Corticosteroids

	% mort	O/E R mort	% unfav	O/E R unfav
Patients (n)	31,8	1,1106	47,7	0,9440
no	29,1	0,9845	43,5	0,8464
yes	**52,9**	**2,3322**	68,8	**1,5940**

17 patients received corticosteroids: their mortality was significantly higher ($p < 0,05$)!

Corticosteroids **more than doubled** the odds for mortality!

Cooling

	% mort	O/E R mort	% unfav	O/E R unfav
Patients (all)	31,8	1,1106	47,7	0,9440
no	29,9	1,0480	44,4	0,8769
yes	**32,4**	**1,1713**	56,5	**1,1520**

Contrary to patients after CPR cooling was associated with higher mortality

Conclusions

In addition to the results shown here, this study confirmed that

- age
- severity of TBI (= GCS score, pupils), and
- severity of trauma

are the **most important factors after TBI**; together these factors explain **>80%** of the outcomes!

Conclusions

- **Significant effect of time:**
  - Rapid transport to the best facility available
  - CT scan prior to or immediately after trauma room admission
  - Short interval between CT scan and start of neurosurgery

Conclusions

- **Adequate monitoring:**
  - Use of capnography in all patients who are ventilated
  - Early use of TEG to optimize coagulation (especially important in patients aged > 60 years!)

Conclusions

- **Volume therapy:**
  - Avoid lactated Ringer‘s
  - Use of Ringer‘s or HES is recommended
  - Hypertonic NaCl should be considered in all patients with shock

Conclusions

- **Adequate ventilation:**
  - The goal is **normoventilation**
  - Hyperventilation must be avoided
  - Ventilation must be monitored be capnography
- **Corticosteroids must no be used**