

IFIMP 25/26. 6. 2010

## Flüssigkeitstherapie am NAW und im SR Die Qual der Wahl

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... conflict of Interest:

Baxter, Braun, CSL Behring, Fresenius,  
NovoNordisk, Octapharm, Pentapharm




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### Klinische Zeichen bei akutem Blutverlust

10-15%	kompensiert, Ängstlichkeit
15-30%	sympathikoton Herzfrequenz diastol. Druck ↑ kalte Extremitäten Hyperventilation, Durst
30-40%	hämorrhagischer Schock MAP ↓ Herzfrequenz >100 Verwirrtheit Hyperventilation Blässe Diurese ↓
>40%	lebensbedrohlich (50% Mort. in 15min) kein Puls kein Druck messbar vitale Organsysteme betroffen

*Garrioch MA The body's response to blood loss. Vox Sang 2004*

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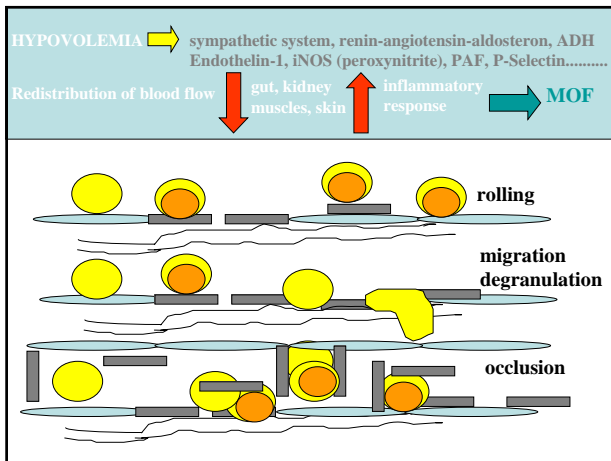
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### VOLUMENERSATZ ?

Pro: Perfusion, Sauerstofftransport  
Con: Dilution mit Konsequenzen

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### Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries

Bickell W.H. et al. NEJM 1994; 331: 1105-9

> „immediate fluid resuscitation“ (n= 309): 62% survivors

> „delayed fluid resuscitation“ (n=289): 70% survivors **p=0.04**

**but : ...**

- > 22 patients within the „delayed group“ received fluid
- > 70 patients died before surgery (41/29)

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## aber.....

•Patientenpopulation	31a, männl., Schussverl.
•Kurze Transportzeiten	12-13min
•Schwere der Verletzung	RR >100 vor OP
•Volumengabe nach Random. vs. individueller Bedarf	
•Mort. im OP	NS
•ICU Mortalität	NS
•Mortalität nach Ausschluß prähosp. †	NS
•Dilutionskoagulopathie	2L Kristalloid
•Kausalität	Transfusionsbedarf gleich

Flüssigkeitstherapie ohne Rationale unsinnig

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### Hypotensive Resuscitation during active hemorrhage: Impact on in-hospital Mortality Dutton RP. J Trauma 2002;52:114-6.

systol RR >100 vs. 70mmHg

110 Pat., 31a, 79% männl., 51% penetrierendes Trauma  
Randomisierung ab SR

Stop der aktiven Blutung : 3 h vs 2,6 h NS

Häufigkeit aktiver Blutung: gleich

Mortalität : gleich

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### Kritischer MAP ???

•Hunde, Ratten Affen MAP 40 mmHg für 60 min

•The role of secondary brain injury in determining outcome from severe head injury.  
Chesnut RM. J Trauma 1993; 34:216-22.

•A brief episode of hypotension increases mortality in critically ill trauma patients. Zenatti MS. J Trauma 2002; 53:232-7.

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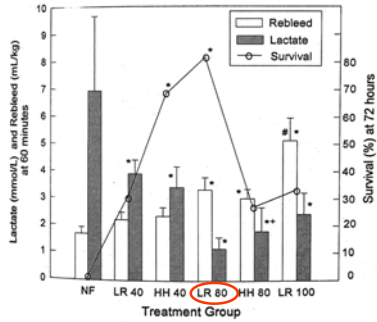
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**Controlled Resuscitation for uncontrolled hemorrhagic shock**

Buris D. et al. Journal of Trauma 1999; 46:216-223




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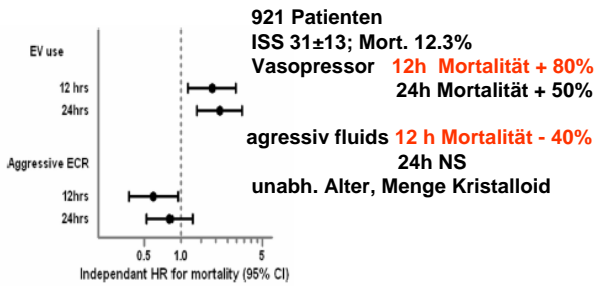
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**Early use of vasopressors after injury: Caution before Constriction.**

Sperry JL. J Trauma 2008;64:9-14




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**Evidenced Based Literature (Cochrane Library)**

Is the normalisation of blood pressure in bleeding trauma patients harmful? Roberts I Lancet 2001  
 „...no evidence for effectiveness ...“  
 „...resuscitation practice can at best be regarded as experimental“

Timing and volume of fluid administration for patients with bleeding following trauma. Kwan I 2003  
 ...uncertainty about the best fluid administration strategy in bleeding trauma patients ...

Colloid solutions for fluid resuscitation. Bunn F 2003  
 ... no evidence that one colloid is more effective or safe than any other ...

Hypertonic versus isotonic crystalloid fluid resuscitation in critically ill patients. Bunn F 2002  
 ...not enough data to be able to say whether hypertonic crystalloid is better than isotonic crystalloid ...

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**European Guidelines Update 2010**

**Volume Replacement  
Recommandation 18, 19**

- ✓ Target systolic blood pressure 80-100mm Hg
- ✓ Low volume approach contraindicated in TBI
- ✓ Vasopressor no substitute for fluid resuscitation
- ✓ Crystalloids initially
- ✓ Consider hypertonic solutions also
- ✓ Colloids within prescribed limits in the unstable patient

„.....It is still unclear which type of fluid.....“

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**Flüssigkeitstherapie  
und Konsequenzen**



BV-ersetzt (%)	GF (%initial)
50%	60%
75%	50%
<b>100%</b>	<b>37%</b>
150%	22%
200%	14%

↓  
Ery-Fib-TZ-Thrombinbildung- FXIII  
↑  
Hyrostatisher Druck-Perfusion- Ödeme

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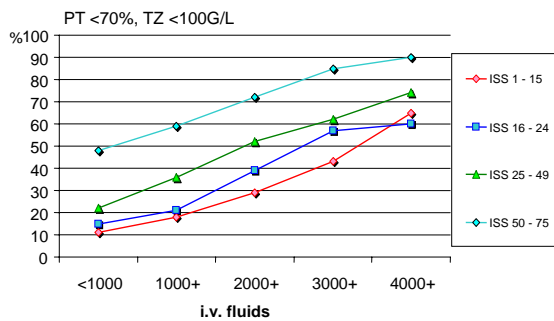
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**Early coagulopathy in multiple injury: An analysis from  
the German Trauma Registry on 8724 patients.**

Maegele M. Injury 2007;38:298




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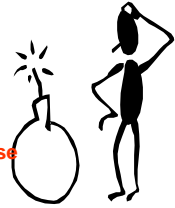
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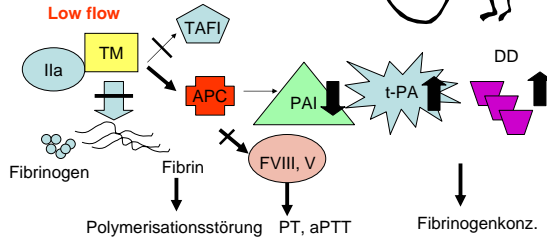
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### Hypovolämie die andere Seite.....

Brohi K. Ann Surg 2007; 245:812-18  
 J Trauma 2008;64:1211-17



### System. Endogene AK und Hyperfibrinolyse




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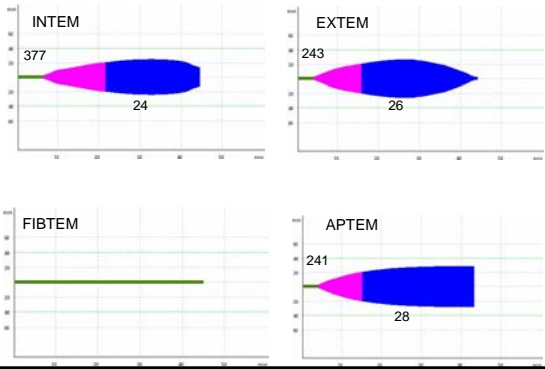
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### SHT, Mittelgesichtsfrakturen, OS Frakt. bds

Hb 7.0, BE - 6.8




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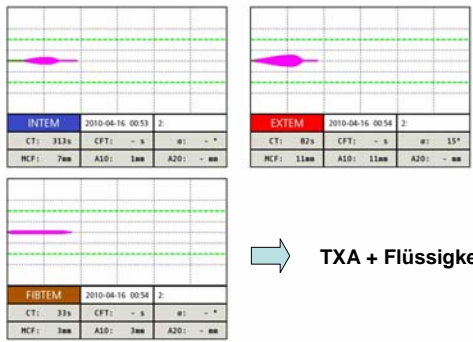
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abominelle Blutung  
 ansprechbar, ängstlich, Atemnot, zittrig  
 Puls 130, systol. RR 85




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## Normovolämie?

### Messwerte:

- Hämodynamik (MAP, ZVD, PCWP ??)
- TEE, Doppler
- Diurese

### Labor:

- BE
- pH
- Lactat falsch niedrig ?
- Hb falsch hoch ?



### Klinische Zeichen:

- Perfusion, Vigilanz, Atemfrequenz
  - Verletzungsmuster, Zeitintervall, Transportzeit
- G. Kühbacher

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### Kristalloide

### Kolloide

Verteilung PV und IF  
 Volumeneffekt 25% (1:4)  
 KOD  
 interst. Comp.  
**Dilutionsazidose (NaCl)**  
 Leukozytenaktivierung  
 O<sub>2</sub> Radikale, Apoptose  
 endotheliale Dysfunktion

Verteilung PV (IF)  
 Volumeneffekt 100% (1:1)  
 KOD  
 interst. p<sub>onk</sub>  
**Fibrinogenpolymerisation**  
 Anaphylaxie  
 Nierenversagen  
 Viskosität- Mikrozirkulation ?




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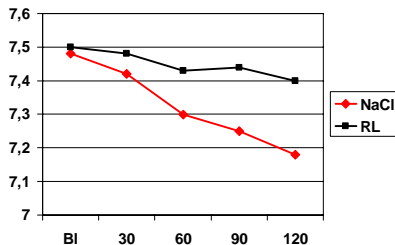
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## Unterschiede zwischen NaCl und RL ?

Kiraly L. J Trauma 2006;61:57  
 20 Schweine, Leberverletzung, MAP 90



alle TEG Parameter besser mit RL  
 doppelte Menge NaCL nötig  
 Blutverlust 34 vs 24 ml/kg, kein Unterschied in Mortalität

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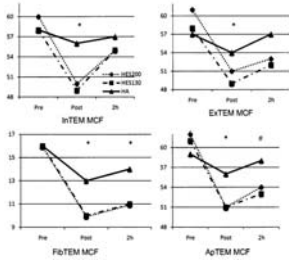
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## HES in cardiac surgery



Volume administration (15 ml/kg) after admission to ICU (n=45):

HES 200/0,5

HES 130/0,4

Albumin 4%

(no difference in drainage vol.)

... decreased clot firmness after administration of HES

Schramko, Anesth Analg 2009

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+ Perfusion, O<sub>2</sub> Transport, Mikrozirkulation

- Gerinnungsstörung, Blutverlust, Ödem, Azidose...

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### Rationale für Therapie

- Grösse des Blutvolumens
- Ausmaß des Blutverlustes
- Verletzungsmuster (stumpf, penetrierend, SHT)
- Patientenfaktoren (Alter, Koerkrankungen)
- Transportzeiten
- Dynamik beachten

Kristalloide: Hydratation, Bikarbonatquelle

Kolloide: Plasmaersatz

HyperHES: gute Volumenwirkung, geringe Dilution

**Kenntnis der potentiellen Nebenwirkungen**  
 ➡ **entsprechende Therapie**

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