

# **Volumenmanagement zur Optimierung der enteralen Ernährung**

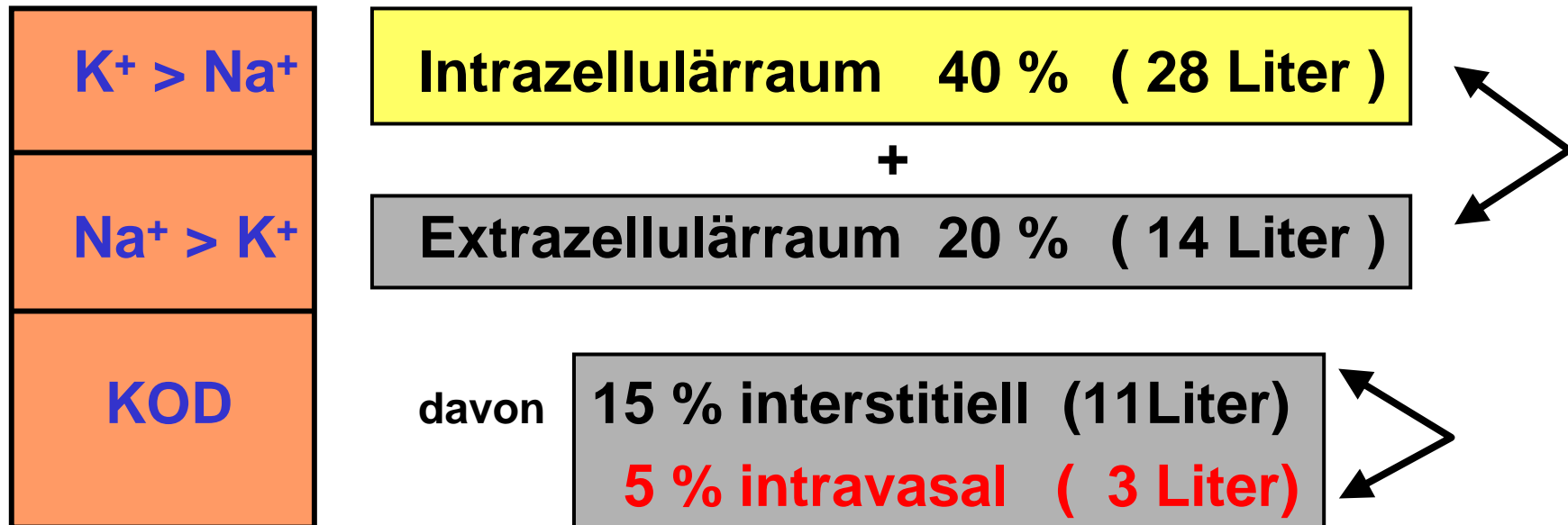
**Irsee, den 28.10.2005**

**H.-J. Dieterich**

# Körperwasserverteilung Erwachsenen

( KG 70 kg , 60 % Wasser , d.h. ca. 42 Liter )

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# Physiologischer Flüssigkeitsbedarf - Erhaltungsbedarf

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**Erwachsener**                      **2 ml / kg / h**

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**Kinder**                                      **4–2–1– Schema**

4 ml / kg / h für die ersten 10 kg Körpergewicht  
+2 ml / kg / h für jedes kg über 10 kg Körpergewicht  
+1 ml / kg / h für jedes kg über 20 kg Körpergewicht

J. Schumacher, K.-F. Klotz, ains 2001

# Elektrolytbedarf bei Kindern

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<b>Na<sup>+</sup></b>	<b>3 mmol /kg KG / d</b>
<b>K<sup>+</sup></b>	<b>2 mmol /kg KG / d</b>
<b>Mg<sup>++</sup></b>	<b>1 mmol /kg KG / d</b>
<b>Cl<sup>-</sup></b>	<b>2 mmol /kg KG / d</b>

**gleich wie Erwachsene**

# Erhaltungsbedarf

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## „Pädiatrie – Lösungen“

**Viertel**                      **(30 mmol Na<sup>+</sup> / l)**

**Drittel**                      **(50 mmol Na<sup>+</sup> / l)**

**Halb**                         **(70 mmol Na<sup>+</sup> / l)**

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**Volumenersatz**

**Kristalloide (VEL)**

# **Na<sup>+</sup> - reduzierter Volumenersatz**

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**Hyponatremia in the postoperative  
craniofacial pediatric patient population:  
a connection to cerebral salt wasting  
syndrome and management of this  
disorder**

**Plast Reconstr Surg 2001; 108 (6) 1501 -08**



# Perioperativer Flüssigkeitsbedarf

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<b>Erhaltungsbedarf</b>		<b>2 ml / kg / h</b>
kleine Eingriffe	<b>+</b>	<b>4 ml / kg / h</b>
mittlere Eingriffe	<b>+</b>	<b>6 ml / kg / h</b>
große Eingriffe	<b>+</b>	<b>8 ml / kg / h</b>

**Veraltet Datenlage !**

**Nüchternheitsgebot**

**Orthograde Darmspülung**

# Fast Track Chirurgie

H. Kehlet, Dänemark

## Kasten

### Pathologische Ursachen der verzögerten Rekonvaleszenz nach operativen Eingriffen

- posttraumatische Stressreaktion
- Schmerz
- Immobilisation
- Fasten – gastrointestinale Atonie
- perioperative Hypothermie
- postoperative Übelkeit und Erbrechen (PONV)
- perioperative Flüssigkeitsüberlastung
- kontinuierliche und episodische Hypoxämie
- Schlafstörungen
- Fatigue
- chirurgische und anästhesiologische Traditionen
- psychosoziale Faktoren

Wolfgang Schwenk<sup>1</sup>  
Claudia Spies<sup>2</sup>  
Joachim M. Müller<sup>1</sup>

## Beschleunigte Frührehabilitation in der operativen Medizin

„Fast-track“-Rehabilitation

Deutsches Ärzteblatt | Jg. 102 | Heft 21 | 27. Mai 2005

Tabelle 1

## Prinzipien des aktuellen „Fast-track“-Rehabilitationsprogramms bei elektiven Kolonresektionen der Charité Campus-Mitte

Zeitpunkt	„Fast-track“-Rehabilitation bei elektiven Kolonresektionen
präoperativ	Operationsaufklärung; Gespräch mit Patient und Angehörigen; avisierte Entlassung ab 3. postoperativen Tag; präoperativer Informationsbogen; PONV-Prophylaxe* <sup>1</sup> ; verkürzte präoperative Nüchternheit* <sup>1</sup>
intraoperativ	total intravenöse Anästhesie* <sup>1</sup> ; thorakale kombinierte Periduralanalgesie (Lokalanästhetikum/Opioid)* <sup>1</sup> , Nichtopioid-Analgetikum; konvektive aktive Normothermiemaßnahmen* <sup>1</sup> ; quere/gebogene Laparotomien oder 5 Trokar-Laparoskopie* <sup>1</sup> ; Magensonde bei Extubation entfernen* <sup>1</sup> , keine Drainagen* <sup>2</sup>
Operationstag	Verlegung via Aufwachraum auf die Normalstation; kontinuierliche PDA (LA/Opioid)* <sup>1</sup> ; Nichtopioid-Analgetikum i. v., Vermeidung systemischer Opioidgaben* <sup>1</sup> ; Magnesiumcitrat 300 mg 3 x tgl. bis 1. Stuhlgang; ab 2. postop. Stunde: 1 500 mL Tee; 2 Proteindrinks oder Joghurt; 5. postop. Stunde: Mobilisation in den Stuhl für 2 Stunden und Laufen auf dem Stationsflur
1. postop. Tag	kontinuierliche PDA (LA/Opioid)* <sup>1</sup> ; Nichtopioid-Analgetikum oral; Vermeidung systemischer Opioidgaben* <sup>1</sup> ; Vollkost + Proteindrinks; Trinkmenge > 1 500 ml beachten; Mobilisation aus dem Bett mindestens 8 Stunden; mindestens zweimal Laufen auf dem Stationsflur
2. postop. Tag	Periduralkatheter entfernen; Nichtopioid-Analgetikum oral; Vermeidung systemischer Opioidgaben* <sup>1</sup> ; Vollkost; Trinkmenge > 1 500 mL beachten; vollständige Mobilisation (im Bett zur Mittagsruhe und nachts); Entlassungsgespräch mit Patienten, Angehörigen; Informationsbogen poststationärer Verlauf; Ernährungsberatung
3. postop. Tag	Nichtopioid-Analgetikum; Vollkost; Trinkmenge > 1 500 mL beachten; Vollkost; vollständige Mobilisation (im Bett zur Mittagsruhe und nachts); Abschlussgespräch, Entlassung ab mittags nach Wunsch der Patienten möglich; sonst weiter analoges Vorgehen bis zur Entlassung; Informationsbogen für Hausarzt
8. postop. Tag	ambulante Wiedervorstellung; Entfernen des Hautnahtmaterials; Besprechung des histologischen Befundes; ggf. Terminierung der adjuvanten Therapie
PONV, postoperative Übelkeit und Erbrechen; PDA, Periduralanalgesie; LA, Lokalanästhetikum * <sup>1</sup> Maßnahme durch randomisierte, kontrollierte Studien belegt; * <sup>2</sup> Maßnahme nach randomisierten, kontrollierten Studien nicht erforderlich	

# Postoperative GI-tract Dysfunction PGID

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**PGID**            intolerance of enteral nutrition  
                      nausea, vomiting

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433 pat.,            prospective blinded Cohort-Study  
                      diverse group of routine, moderate risk,  
                      elective risk surgery

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**PGID**            most common:  
                      POD 5 , 8, 15 : 55%, 51%, 52%

# Präoperative Dehydratation

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*Acta Anaesthesiol Scand 2002; 46: 1089–1093*

## Compensatory fluid administration for preoperative dehydration – does it improve outcome?

K. HOLTE and H. KEHLET

*Department of Surgical Gastroenterology, Hvidovre University Hospital, Denmark*

pain. Administration of  $\geq 1$  litre fluid generally reduced post-operative drowsiness and dizziness, while the effects on post-operative nausea, vomiting and thirst has not been clarified.

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## Effect of intraoperative intravenous crystalloid infusion on postoperative nausea and vomiting after gynaecological laparoscopy: comparison of 30 and 10 ml kg<sup>-1</sup>

J. J. Magner<sup>1</sup>\*, C. McCaul<sup>2</sup>, E. Carton<sup>1,3</sup>, J. Gardiner<sup>1,3</sup> and D. Buggy<sup>3</sup>

**Background.** I.V. fluid administration has been shown to reduce postoperative nausea and vomiting (PONV). The optimum dose is unknown. We tested the hypothesis that administration of i.v. crystalloid of 30 ml kg<sup>-1</sup> would reduce the incidence of PONV compared with 10 ml kg<sup>-1</sup> of the same fluid.

**Conclusion.** I.V. administration of CSL 30 ml kg<sup>-1</sup> to healthy women undergoing day-case gynaecological laparoscopy reduced the incidence of vomiting, nausea and anti-emetic use when compared with CSL 10 ml kg<sup>-1</sup>.

# Intraoperatives Volumenmanagement

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## Pathophysiology and clinical implications of perioperative fluid excess

K. Holte<sup>1\*</sup>, N. E. Sharrock<sup>2</sup> and H. Kehlet<sup>1</sup>

*Br J Anaesth* 2002; **89**: 622–32

**Dry Regimen in pulmonary surgery:  
pulmonary morbidity ↓**

**supports safety of low – volume regimen  
in high-risk patients undergoing major surgery**

# Intraoperatives Volumenmanagement

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Effects of Intravenous Fluid Restriction on Postoperative  
Complications: Comparison of Two Perioperative  
Fluid Regimens

*A Randomized Assessor-Blinded Multicenter Trial*

*Birgitte Brandstrup, MD, PhD,\* Hanne Tønnesen, MD, DMSc,\* Randi Beier-Holgersen, MD,*

*(Ann Surg 2003;238: 641–648)*

# Intraoperatives Volumenmanagement

**TABLE 1.** Intraoperative Fluid Therapy

	Restricted Regimen	Standard Regimen
Preloading of epidural analgesia	No preloading.	500 mL HAES 6%.*
Third space loss	No replacement	Normal saline 0.9%: 7 mL/kg/h first hour; 5 mL/kg/h second and third hour; 3 mL/kg/h following hours.
Loss during fast (maintenance)	500 mL of glucose 5% in water less oral fluid intake during fast.	500 mL of normal saline 0.9% independent of oral intake.
Blood loss	Volume-to-volume with HAES 6% with allowance for max. 500 mL extra. Blood component therapy started at approximate loss >1500 mL dependent on hematocrit.	Loss up to 500 mL: 1000–1500 mL of normal saline; Loss >500 mL, additional HAES 6%. Blood component therapy started at approximate loss >1500 mL dependant on hematocrit.

\*Hydroxyethyl starch 6% in normal saline.

(*Ann Surg* 2003;238: 641–648)

# Intraoperatives Volumenmanagement

TABLE 3. Number of Patients With Complications (Per-Protocol Analysis)

	Blinded Assessment			Unblinded Assessment		
	Restricted Group	Standard Group	<i>P</i> value	Restricted Group	Standard Group	<i>P</i> value
Overall complications	21	40	0.003	21	43	0.000
Major complications <sup>†</sup>	8	18	0.040	8	19	0.026
Minor complications <sup>†</sup>	15	36	0.000	15	37	0.000
Tissue-healing complications <sup>†</sup>	11	22	0.040	10	24	0.009
Cardiopulmonary complications <sup>†</sup>	5	17	0.007	4	18	0.002

n = 69 in restricted group and n = 72 in standard group.

<sup>†</sup>Number of patients in subgroups does not add up to number of overall complications because some patients had more than 1 complication.

(*Ann Surg* 2003;238: 641–648)

# Intraoperatives Volumenmanagement

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## Effect of salt and water balance on recovery of gastrointestinal function after elective colonic resection: a randomised controlled trial

*Dileep N Lobo, Kate A Bostock, Keith R Neal, Alan C Perkins, Brian J Rowlands, Simon P Allison*

Present practice	$\geq 3$ L water , 154 mmol sodium per day
Restricted intake	$\leq 2$ L water , 77 mmol sodium per day

*Lancet 2002; 359: 1812–18  
See Commentary page 1792*

# Intraoperatives Volumenmanagement

	Standard group (n=10)	Restricted group (n=10)	Difference (95% CI)	p
Total intravenous sodium input (mmol)	1440 (1330 to 1620)	520 (490 to 590)	915 (740 to 1100)	<0.0001
Total urinary sodium output (mmol)	685 (400 to 940)	490 (315 to 645)	141 (-90 to 425)	0.20
Sodium balance (mmol)	750 (490 to 1090)	80 (-180 to 230)	720 (365 to 1045)	0.001
Total water (intravenous+oral) input (L)	18.0 (16.4 to 19.3)	11.6 (10.4 to 12.2)	6.4 (4.8 to 8.1)	<0.0001
Total water (urine+vomit/nasogastric aspirate) output (L)	10.5 (8.7 to 11.8)	7.7 (6.4 to 8.6)	2.5 (0.8 to 4.5)	0.008
Water balance (L)	7.2 (5.9 to 9.3)	3.7 (2.6 to 4.7)	3.8 (2.2 to 5.6)	<0.0001
Estimated insensible losses over 5 days (at 0.7 L/day)	3.5	3.5	..	..
Net estimated water balance (L)	3.7 (2.4 to 5.8)	0.2 (-0.9 to 1.2)	..	<0.0001

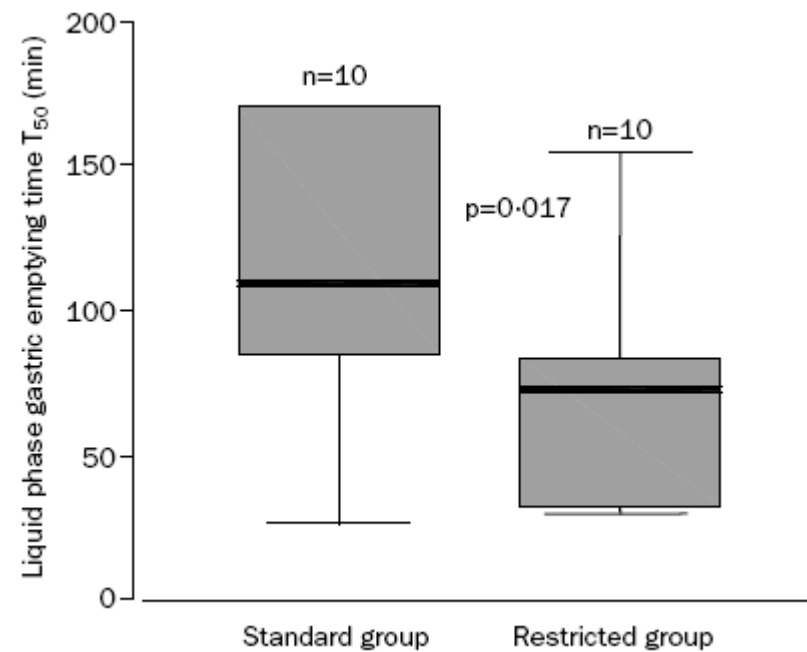
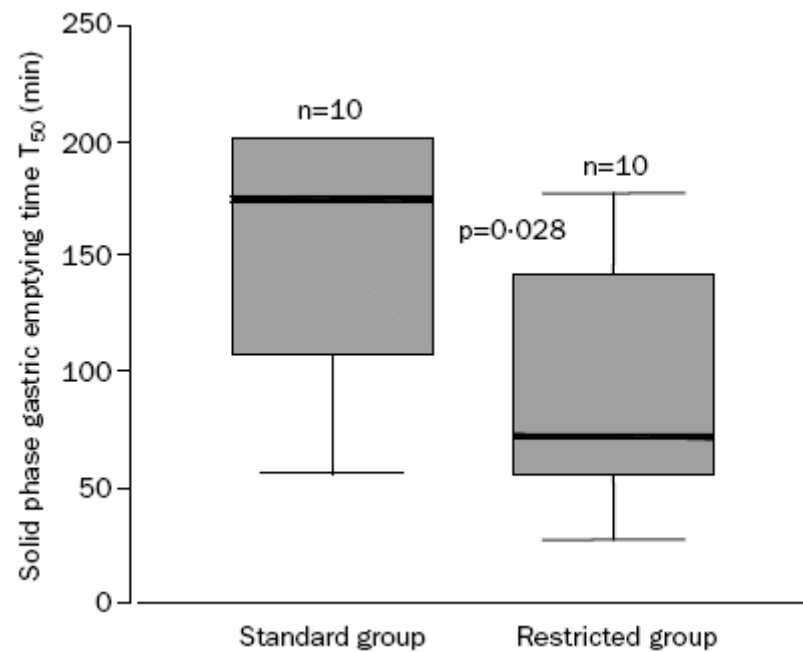
All values median (IQR), Mann Whitney *U* test.

Table 2: **Cumulative sodium and water balance over days 0-4**

Lancet 2002; **359**: 1812-18

See Commentary page 1792

# Intraoperatives Volumenmanagement



Lancet 2002; **359**: 1812–18  
See Commentary page 1792

# Intraoperatives Volumenmanagement

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	Standard group (n=10)	Restricted group (n=10)	Difference (95% CI)	p
<b>Endpoints</b>				
Day on which flatus first passed	4.0 (4.0–5.0)	3.0 (2.0–3.0)	2 (1–2)	0.001
Day on which stool first passed	6.5 (5.8–8.0)	4.0 (3.0–4.0)	3 (2–4)	0.001
Day on which intravenous infusion discontinued	6.0 (4.8–6.3)	4.0 (3.8–4.0)	2 (1–3)	0.001
Day on which solid food intake resumed	6.5 (5.5–7.0)	4.0 (4.0–4.3)	2 (1–3)	0.002
Postoperative hospital stay (days)	9.0 (7.8–14.3)	6.0 (5.0–7.0)	3 (1–8)	0.001

Values are median (IQR), Mann Whitney *U* test applied.

*Lancet* 2002; **359**: 1812–18

See Commentary page 1792

# Intraoperatives Volumenmanagement

Anesthesiology 2005; 103:25-32

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## *Effect of Intraoperative Fluid Management on Outcome after Intraabdominal Surgery*

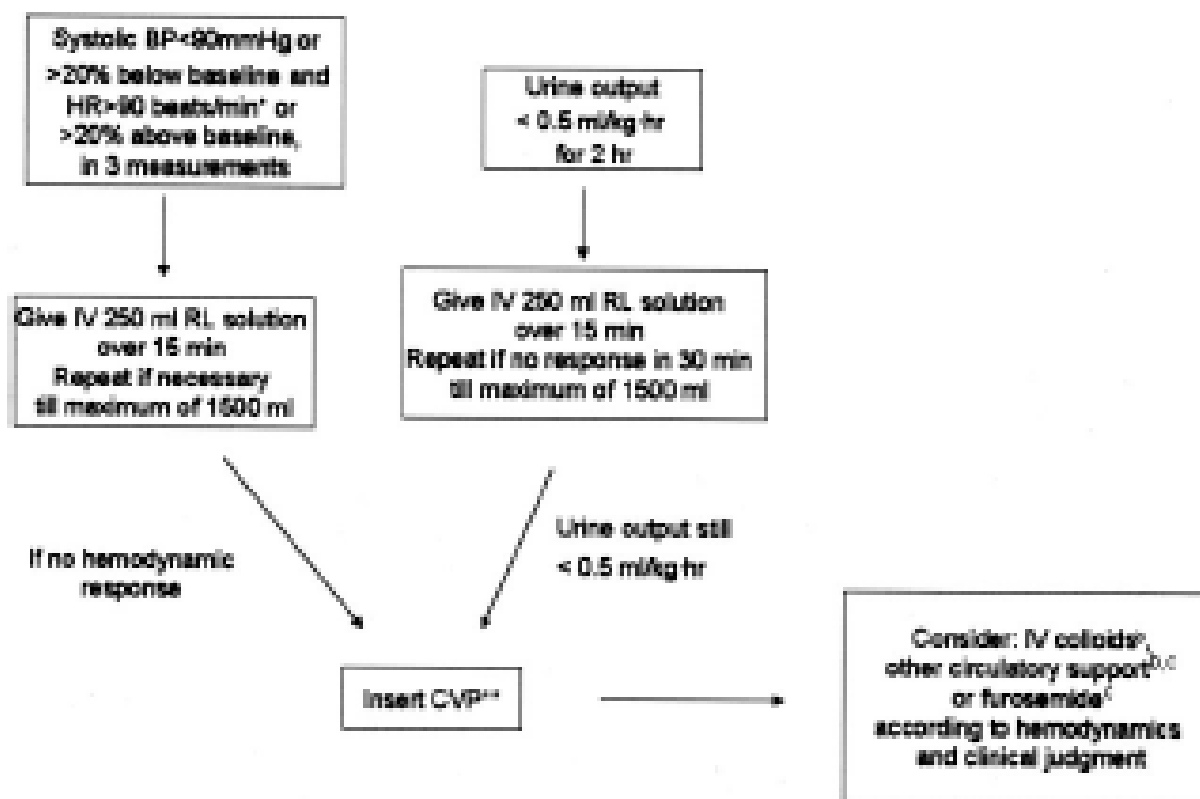
Vadim Nisanevich, M.D.,\* Itamar Felsenstein, M.D.,† Gidon Almogy, M.D.,† Charles Weissman, M.D.,‡ Sharon Einav, M.D.,§ Idit Matot, M.D.||

	Liberal Protocol (n=75)	Restrictive Protocol (n=77)
<b>Bolus</b>	10 mL / kg BW	---
<b>Cont.</b>	12 mL / kg / h	4 mL / kg / h

## Effect of Intraoperative Fluid Management on Outcome after Intraabdominal Surgery

Vadim Nisanevich, M.D.,\* Itamar Felsenstein, M.D.,† Gidon Almogy, M.D.,† Charles Weissman, M.D.,‡ Sharon Einav, M.D.,§ Idit Matot, M.D.||

### Algorithm for intraoperative fluids<sup>a</sup>



## *Effect of Intraoperative Fluid Management on Outcome after Intraabdominal Surgery*

Vadim Nisanevich, M.D.,\* Itamar Felsenstein, M.D.,† Gidon Almogy, M.D.,† Charles Weissman, M.D.,‡  
Sharon Einav, M.D.,§ Idit Matot, M.D.||

	<b>LPG</b>	<b>RPB</b>
Total volume of fluid administered, ml, median (range)	3,670 (1,880-8,800)	1,230 (490-7,810)*
Estimated blood loss, ml, median (range)	440 (50-1,800)	400 (50-2,100)
Patients receiving bolus of fluids (as indicated by fluid algorithm),	1 (1.3)	26 (33)*
Number of patients receiving 6% hydroxyethyl starch	0	3
Patients receiving blood transfusion, %	19 (25)	12 (15.5)

## *Effect of Intraoperative Fluid Management on Outcome after Intraabdominal Surgery*

Vadim Nisanevich, M.D.,\* Itamar Felsenstein, M.D.,† Gidon Almogy, M.D.,† Charles Weissman, M.D.,‡ Sharon Einav, M.D.,§ Idit Matot, M.D.||

**Table 4. Perioperative Complications**

Complications	Liberal Protocol Group (n = 75)	Restrictive Protocol Group (n = 77)
Infectious		
Wound dehiscence/infection	11	7
Peritonitis/anastomotic leak/ intraabdominal abscess	3	2
Pneumonia	5	3
Urinary tract infection	2	3
Sepsis	1	0
Gastrointestinal		
Bleeding	0	0
Bowel obstruction	2	0
Pulmonary		
Acute respiratory distress syndrome	2	0
Death	0	0
Total number of complications	32	17
Total number of patients with complications	23	13*

\*  $P < 0.05$  vs. liberal protocol group.

## ***Goal-directed Intraoperative Fluid Administration Reduces Length of Hospital Stay after Major Surgery***

Tong J. Gan, M.B., B.S., F.R.C.A.,\* Andrew Soppitt, B.Sc., M.B., B.S., F.R.C.A.,† Mohamed Maroof, M.D.,‡  
Habib El-Moalem, Ph.D.,§ Kerri M. Robertson, M.D.,\* Eugene Moretti, M.D.,† Peter Dwane, M.D.,‡  
Peter S. A. Glass, M.B., F.F.A. (S.A.)||

***Conclusions:*** Goal-directed intraoperative fluid administration results in earlier return to bowel function, lower incidence of postoperative nausea and vomiting, and decrease in length of postoperative hospital stay.

In summary, for patients undergoing moderate- and high-risk surgery, goal-directed fluid administration with 6% hetastarch is associated with improved patient outcome and a slight reduction in the length of hospital stay.

# Intraoperatives Volumenmanagement

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## **Intraoperative Colloid Administration Reduces Postoperative Nausea and Vomiting and Improves Postoperative Outcomes Compared with Crystalloid Administration**

Eugene W. Moretti, MD, Kerri M. Robertson, MD, Habib El-Moalem, PhD, and Tong J. Gan, MB, FRCA, FFARCS(I)

and HS-BS versus LR). Both the HS-NS and HS-BS (colloid) groups had a significantly less frequent incidence of nausea and vomiting, use of rescue antiemetics, severe pain, periorbital edema, and double vision. We concluded that intraoperative fluid resuscitation with colloid, when compared with crystalloid administration, is associated with an improvement in the quality of postoperative recovery.

(Anesth Analg 2003;96:611-7)

# Intraoperatives Volumenmanagement

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## Intraoperative oesophageal Doppler guided fluid management shortens postoperative hospital stay after major bowel surgery

H. G. Wakeling<sup>1\*</sup>, M. R. McFall<sup>1</sup>, C. S. Jenkins<sup>1</sup>, W. G. A. Woods<sup>2</sup>, W. F. A. Miles<sup>2</sup>, G. R. Barclay<sup>3</sup> and S. C. Fleming<sup>4</sup>

**Conclusions.** Intraoperative oesophageal Doppler guided fluid management was associated with a 1.5-day median reduction in postoperative hospital stay. Patients recovered gut function significantly faster and suffered significantly less gastrointestinal and overall morbidity.

*Br J Anaesth* 2005; **95**: 634–42 [Epub ahead of print]

# Intraoperatives Volumenmanagement

Table 2 Postoperative hospitalization and recovery of gut function. IQR, interquartile range; MWU, Mann–Whitney *U*-test

	Control group Median (IQR)	SVO group	<i>P</i> -value (test)
Postoperative hospitalization (days)	11.5 (4.75)	10 (5.75)	0.031 MWU
Time until fit for discharge (days)	11 (4.0)	9.5 (5)	0.012 MWU
Bowel recovery (days)			
Flatus	4 (2)	3 (2)	0.085 MWU
Bowels opening	5 (2)	4 (3)	0.014 MWU
Full diet	7 (2)	6 (2)	<0.001 MWU

# Intraoperatives Volumenmanagement

## Control group

Routine cardiovascular monitoring

Plus

**CVP 12 – 15 mm Hg**

## Study group

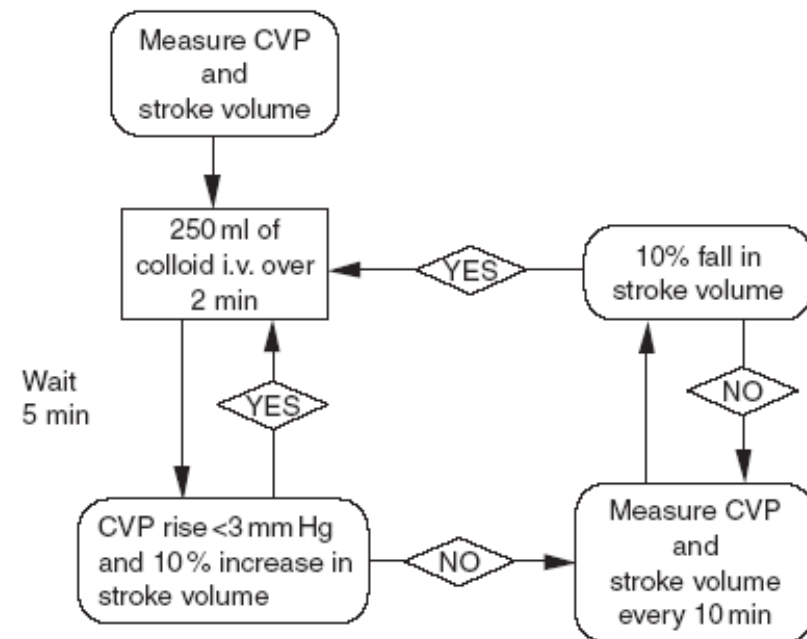


Fig 1 SVO fluid algorithm.

# Intraoperatives Volumenmanagement

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## Präoperatives Defizit

**keine gezielte Kompensation  
bei elektiven Eingriffen**

# **Intraoperatives Volumenmanagement**

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## **Laparoskopie , ambulante Chirurgie**

**Kristalloide**

**Kolloide ?**

# Intraoperatives Volumenmanagement

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**Große Nicht – Kardiochirurgische Eingriffe**

**Multimodal: Atraumatisch**

**Normotherm**

**Magensonde ↓**

**Volumenmanagement**

<b>Restriktiv</b>	<b>4 ml / kg / h</b>
<b>Kolloid</b>	<b>(HES)</b>