Anesthesia for Major Abdominal Cancer Resection

John E. Ellis MD
Adjunct Professor
University of Pennsylvania
johnellis1700@gmail.com

Conflicts of Interest

Upper Abdominal Surgery

- Focus on oncologic surgery
- Epidemiology
- Preoperative assessment
- Intraoperative hemodynamic derangements
- Fluid management
- Respiratory complications
- Anesthesia / analgesia

Operations

- Colon Cancer
- Pancreatic Cancer
- Renal Cell Carcinoma
- **Hepatic Metastases**
- **Transhiatal esophagectomy**
- Not the endocrine procedures

The New England Journal of Medicine

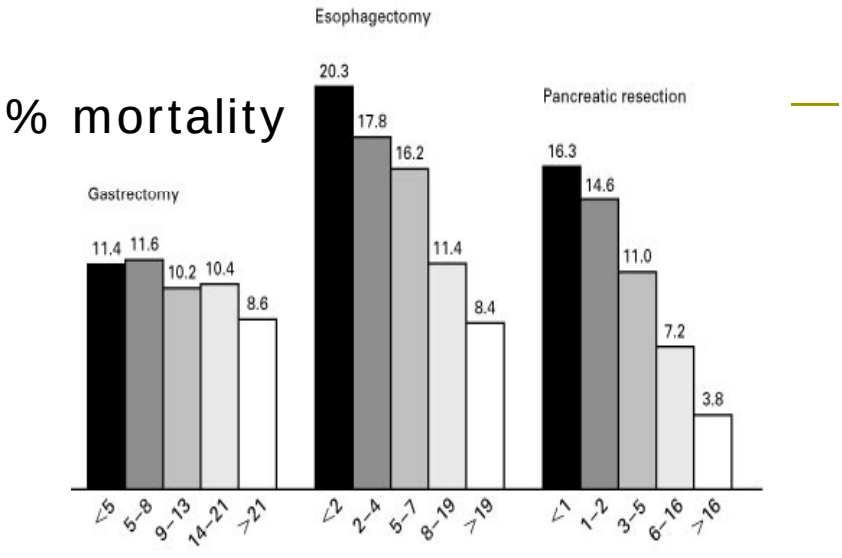
Special Article

HOSPITAL VOLUME AND SURGICAL MORTALITY IN THE UNITED STATES

JOHN D. BIRKMEYER, M.D., ANDREA E. SIEWERS, M.P.H., EMILY V.A. FINLAYSON, M.D., THERESE A. STUKEL, PH.D., F. LEE LUCAS, PH.D., IDA BATISTA, B.A., H. GILBERT WELCH, M.D., M.P.H., AND DAVID E. WENNBERG, M.D., M.P.H.

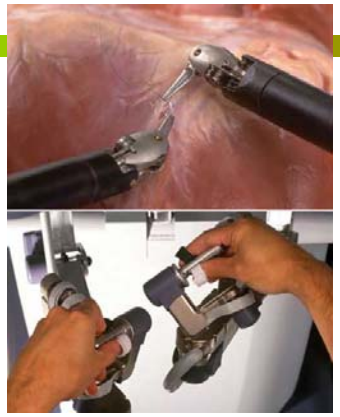
- Surgeons/hospitals that do more of these procedures have lower mortality
- Related to lower complication rates.
- More so for cancer operations than CV

(N Engl J Med 2002;346:1128-37.)



(N Engl J Med 2002;346:1128-37.)

Does "less-invasive" surgery change these considerations?



Conventional esophagectomy

http://www.med.kyushu-u.ac.jp/surgery1/naisikyou/open-e.jpg

Throracoscopic esophagectomy

http://www.med.kyushu-u.ac.jp/surgery1/naisikyou/laparo-e.jpg

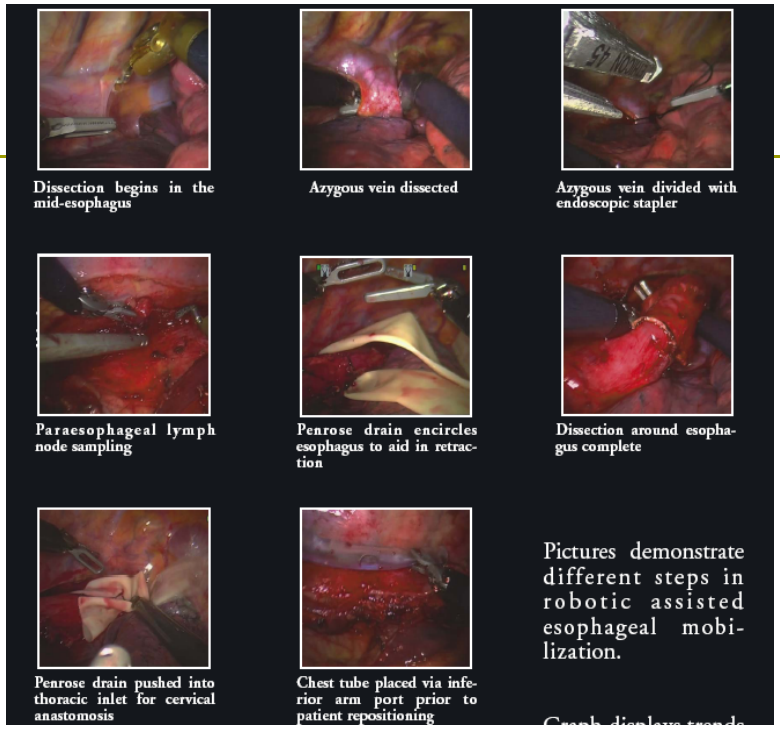
ROBOTIC ASSISTED TRANSTHORACIC ESOPHAGECTOMY

Authors: Scott J. Belsley, MD, Joseph J.DeRose Jr., MD, Cliff C. Connery, MD, James J. McGinty, MD, Oliver Rothschild, Robert C. Ashton, Jr., MD

St. Luke's Roosevelt

University Hospital of Columbia University College of Physicians and Surgeons

Robotic Assisted Transthoracic Esophagectomy.
Society of American Gastrointestinal Endoscopic Surgeons,
Denver, Colorado. April 2004.



Many patients are elderly

With significant medical comorbidity

Extended Hepatic Resection: A 6-Year Retrospective Study of Risk Factors for Perioperative Mortality

Jose Melendez, MD, Enrico Ferri, MD, Michael Zwillman, MD, Mary Fischer, MD, Ronald DeMatteo, MD, Denis Leung, PhD, William Jarnagin, MD, Yuman Fong, MD, Leslie H Blumgart, MD

Table 2. Prevalence of Comorbid Medical Conditions in 226 Patients Treated with Extended Hepatic Resection

Condition	n	%
Hypertension	62	27.4
Coronary artery disease	57	25.2
Smoking	43	19.0
Pulmonary disease	34	15.0
Diabetes	15	6.6
Myocardial infarction	10	4.4
Cholangitis	5	2.2
Stroke	0	0.0

Extended Hepatic Resection: A 6-Year Retrospective Study of Risk Factors for Perioperative Mortality

Jose Melendez, MD, Enrico Ferri, MD, Michael Zwillman, MD, Mary Fischer, MD, Ronald DeMatteo, MD, Denis Leung, PhD, William Jarnagin, MD, Yuman Fong, MD, Leslie H Blumgart, MD

- 14 deaths (6%) in 226 patients.
- Preoperative variables
  - Cholangitis
  - creatinine > 1.3 mg/dL
  - total bilirubin > 6 mg/dL
- Operative variables
  - EBL > 3000 ml
  - Vena cava resection

Can anesthetic management reduce complications and improve outcome?

Preoperative Evaluation

Maintaining vital organ perfusion

Stress reduction and analgesia

Fluid management

- Normovolemic hemodilution for hepatic resection
- Low CVP for hepatic resection
- Goal-directed fluid resuscitation
- Colloid vs. crystalloid
- How to monitor adequacy of resuscitation?

Normovolemic hemodilution

Normovolemic Hemodilution

Anesthesiology 2002; 97:794–800

Effectiveness of Acute Normovolemic Hemodilution to Minimize Allogeneic Blood Transfusion in Major Liver Resections

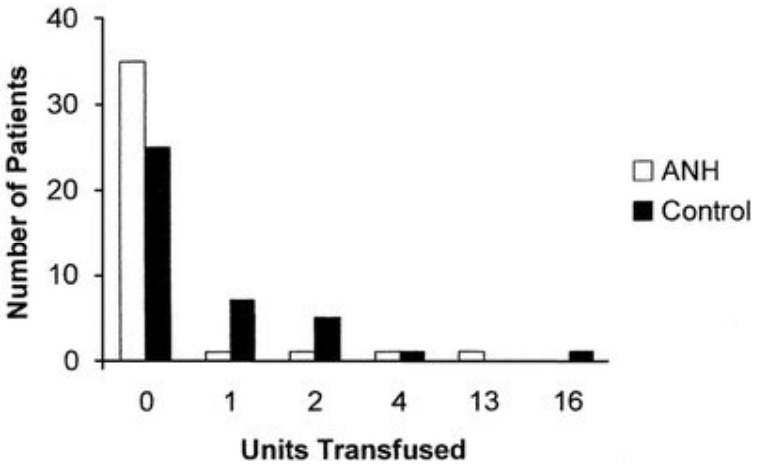
Idit Matot, M.D., Olga Scheinin, M.D.,† Oded Jurim, M.D.,‡ Ahmed Eid, M.D.‡*

- 78 “healthy” patients with Aline, CVP, ST segs
- ANH via 8.5 F introducer
  - Hct = 40.5 ± 2.7 to 23.5 ± 1.2%
- **Average blood off = 2,020 ± 412 ml**
- Hetastarch 20 ml/kg, 5% albumin via 2 large bore PIV
  - 2,210 ±458 ml
- No significant changes in MAP, HR, ST segs

Anesthesiology 2002; 97:794–800

Effectiveness of Acute Normovolemic Hemodilution to Minimize Allogeneic Blood Transfusion in Major Liver Resections

Idit Matot, M.D., Olga Scheinin, M.D.,† Oded Jurim, M.D.,‡ Ahmed Eid, M.D.‡*



Wolters Kluwer Health | Lippincott Williams & Wilkins

ANNALS OF SURGERY
A Monthly Review of Surgical Science Since 1885

A Prospective Randomized Trial of Acute Normovolemic Hemodilution Compared to Standard Intraoperative Management in Patients Undergoing Major Hepatic Resection

Author(s): Jarnagin, William R. MD*; Gonen, Mithat PhD†; Maithel, Shishir K. MD*; Fong, Yuman MD*; D'Angelica, Michael I. MD*; DeMatteo, Ronald P. MD*; Grant, Florence MD*; Wuest, David MDS; Kundu, Kuhali BA*; Blumgart, Leslie H. MD*; Fischer, Mary MD‡

Issue: Volume 248(3), September 2008, pp 360-369
Publication Type: [Original Articles]

From the Departments of *Surgery, †Epidemiology and Biostatistics, ‡Anesthesiology, and §Clinical Laboratories, Memorial Sloan-Kettering Cancer Center, New York, New York.

DOI: 10.1097/SLA.0b013e318184db08

Ann Surg 248(3), 2008, pp 360-369

ANH for hepatic resection

- Patients randomized
- Goal: CVP ≤ 5 mmHg
  - Fluid restriction
  - Morphine, NTG
- Arterial lines
  - ABG and Hct q 30 min

Ann Surg 248(3), 2008, pp 360-369

ANH Protocol

Blood was withdrawn through central venous catheters into standard blood collection bags

- Baxter-HC/Fenwal Autologous Blood Collection Kit

Stored at room temperature

- In the operating room
- Labeled with the patients':
  - name
  - medical record number
  - date of birth

Medscape® www.medscape.com

All patients

	ANH (n = 63)	STD (n = 67)	P
Allogeneic RBC transfusion (Total)			0.067
Patients	8 (12.7%)	17 (25.4%)	
Units*	28	47	
Allogeneic RBC transfusion (Intraoperative)			0.036
Patients	1 (1.6%)	7 (10.4%)	
Units*	2	12	
FFP transfusion (Total)			0.14
Patients	11 (17.5%)	19 (28.4%)	
Units*	50	114	
Any transfusion			0.13
Patients	14 (22.2%)	23 (34.3%)	
Units*	78	161	

*Refers to total number of units per arm.

Ann Surg 248(3), 2008, pp 360-369

Medscape® www.medscape.com

Patients EBL > 800 ml

	ANH (n = 33)	STD (n = 29)	P
Allogeneic RBC transfusion (Total)			0.045
Patients	6 (18.2%)	12 (42.4%)	
Units*	24	35	
Allogeneic RBC transfusion (Intraoperative)			0.013
Patients	1 (3%)	7 (24%)	
Units*	2	12	
FFP transfusion (Total)			0.025
Patients	7 (21.2%)	14 (48.3%)	
Units*	32	94	
Any transfusion			0.025
Patients	9 (27.3%)	16 (55.2%)	
Units*	56	129	

*Refers to total number of units per arm.

Source: Ann Surg © 2008 Lippincott Williams & Wilkins

Ann Surg 248(3), 2008, pp 360-369

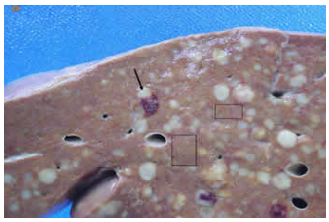
Medscape® www.medscape.com

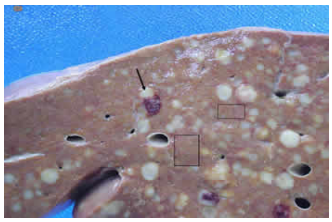
	ANH (n = 63)	STD (n = 67)	P
Allogeneic RBC transfusion (Total)			0.067
Patients	8 (12.7%)	17 (25.4%)	
Units*	28	47	
Allogeneic RBC transfusion (Intraoperative)			0.036
Patients	1 (1.6%)	7 (10.4%)	
Units*	2	12	
FFP transfusion (Total)			0.14
Patients	11 (17.5%)	19 (28.4%)	
Units*	50	114	
Any transfusion			0.13
Patients	14 (22.2%)	23 (34.3%)	
Units*	78	161	

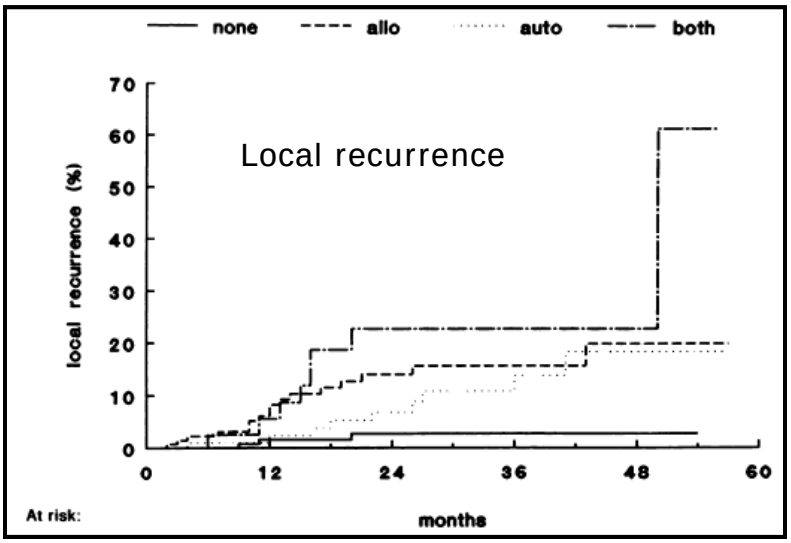
*Refers to total number of units per arm.

Ann Surg 248(3):360-369, 2008

Does transfusion promote metastases?







Busch OR, et al: Blood transfusions and local tumor recurrence in colorectal cancer: Evidence of a noncausal relationship. Ann Surg 1994; 220:791-7

Bigger tumors bleed more?
Therefore, more transfusion?

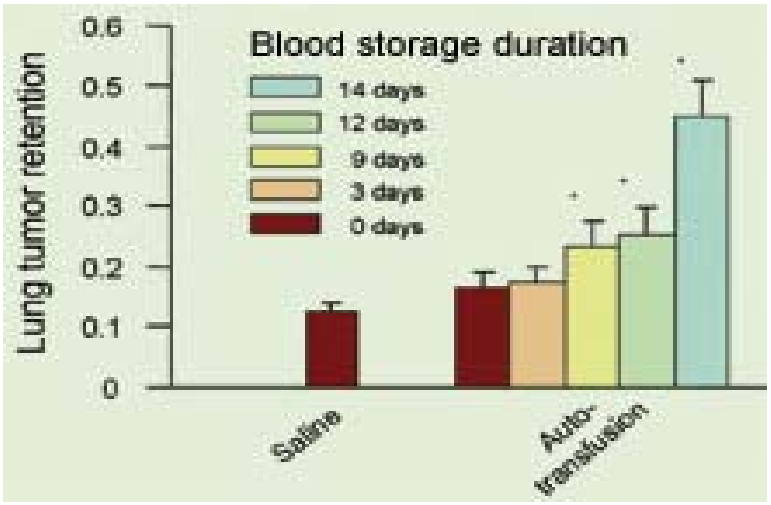
Or is the transfusion itself bad?

Anesthesiology 2008; 109:989–97

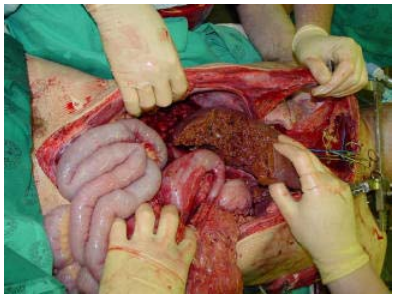
Blood Transfusion Promotes Cancer Progression: A Critical Role for Aged Erythrocytes

Shir Atzil, M.A., Michal Arad, M.A.,* Ariella Glasner, M.A.,* Noa Abiri, M.A.,* Roi Avraham, M.A.,* Keren Greenfeld, M.A.,* Ella Rosenne, M.A.,* Benzion Beilin, M.D.,† Shamgar Ben-Eliyahu, Ph.D.‡*

Anesthesiology:109(6)December 2008pp 989-997

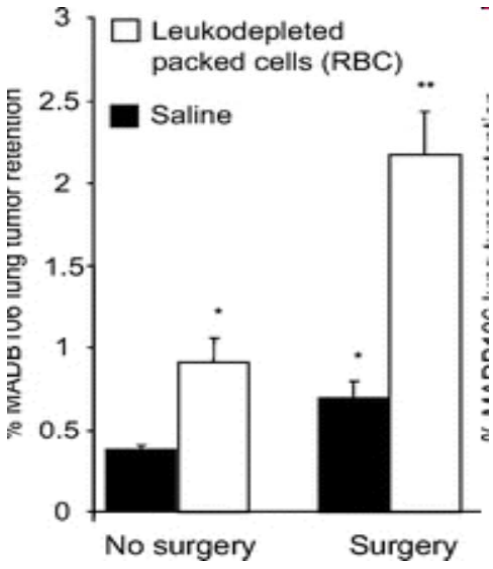


Anesthesiology:109(6)December 2008pp 989-997



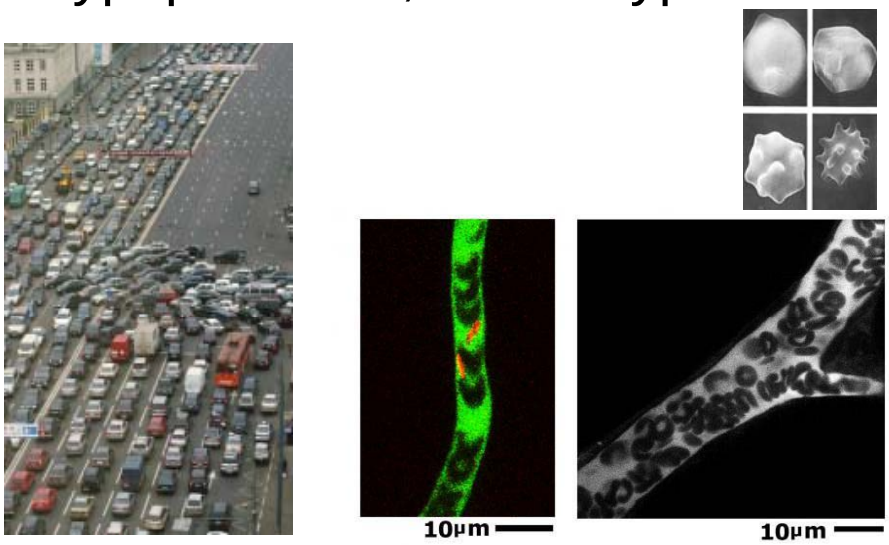
Surgery is bad, transfusion is bad

The combination is worse!



Anesthesiology:109(6)December 2008pp 989-997

Does old blood cause hypoperfusion, tissue hypoxia?



Bad old blood

- Exchange transfusion with RBC after 60% isovolemic hemodilution to Hct =18 %
- Stored RBCs (28 days in CPDA)
- Stored RBCs reduced microvascular flow by 63%
- Tissue oxygen levels:
  - 3.5 for the stored and
  - 14.4 mmHg for fresh RBCs.

Tsai AG, et al. Transfusion 2004; 44:1626-34

Goals of low CVP

- "Soften" the liver
- Precludes vena caval distention
- Facilitates mobilization of the liver and dissection of the retrohepatic and major hepatic veins.
- Minimizes hepatic venous bleeding during parenchymal transection
- Facilitates control of inadvertent venous injury
- Reduce EBL

Perioperative Outcomes of Major Hepatic Resections under Low Central Venous Pressure Anesthesia: Blood Loss, Blood Transfusion, and the Risk of Postoperative Renal Dysfunction

Jose A Melendez, MD, Vittoria Arslan, MD, Mary E Fischer, MD, David Wuest, MD, William R Jarnagin, MD, Yuman Fong, MD, and Leslie H Blumgart, MD, FRCS, FACS

- Fluid restriction
- Large bore IVs
- Isoflurane in oxygen, fentanyl
- prn morphine for vasodilation
- prn NTG to lower CVP < 5 mmHg
  - Why not just give everyone NTG??
- Does fluid restriction reduce organ perfusion??

Perioperative Outcomes of Major Hepatic Resections under Low Central Venous Pressure Anesthesia: Blood Loss, Blood Transfusion, and the Risk of Postoperative Renal Dysfunction

Jose A Melendez, MD, Vittoria Arslan, MD, Mary E Fischer, MD, David Wuest, MD, William R Jarnagin, MD, Yuman Fong, MD, and Leslie H Blumgart, MD, FRCS, FACS

- Air emboli well described during hepatectomy
- Risk is likely to increase with low CVP anesthesia.
- Therefore, no nitrous oxide used

Hepatic Resection by the Cavitron Ultrasonic Surgical Aspirator® Increases the Incidence and Severity of Venous Air Embolism

Bon N. Koo, MD*†, Hae K. Kil, MD*†, Jin-S. Choi, MD, PhD‡, Ji Y. Kim, MD*†, Duk H. Chun, MD*, and Yong W. Hong, MD, PhD*†

*Department of Anesthesia & Pain Medicine and †Anesthesia & Pain Research Institute, ‡Department of Surgery, Yonsei University College of Medicine, Seoul, Korea

Table 2. Staging of Gas Embolism by Two-Dimensional Transesophageal Echocardiography

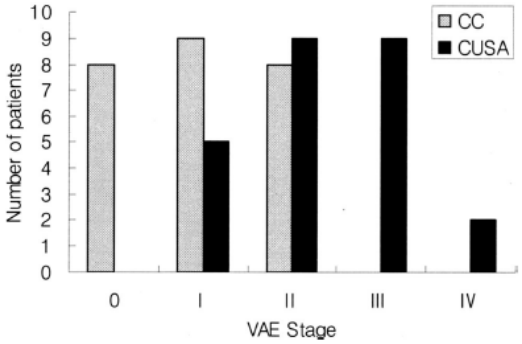
Stage	Transesophageal echocardiography
0	No emboli in RA, RV and RVOT
I	Several gas bubbles in RA, RV and RVOT
II	Gas emboli filling less than half the diameter of RA, RV and RVOT
III	Gas emboli filling more than half the diameter of RA, RV and RVOT
IV	Gas emboli completely filling the diameter of RA, RV and RVOT

RA = right atrium, RV = right ventricle, RVOT = right ventricular outflow tract.

Hepatic Resection by the Cavitron Ultrasonic Surgical Aspirator® Increases the Incidence and Severity of Venous Air Embolism

Bon N. Koo, MD*†, Hae K. Kil, MD*†, Jin-S. Choi, MD, PhD‡, Ji Y. Kim, MD*†, Duk H. Chun, MD*, and Yong W. Hong, MD, PhD*†

*Department of Anesthesia & Pain Medicine and †Anesthesia & Pain Research Institute, ‡Department of Surgery, Yonsei University College of Medicine, Seoul, Korea



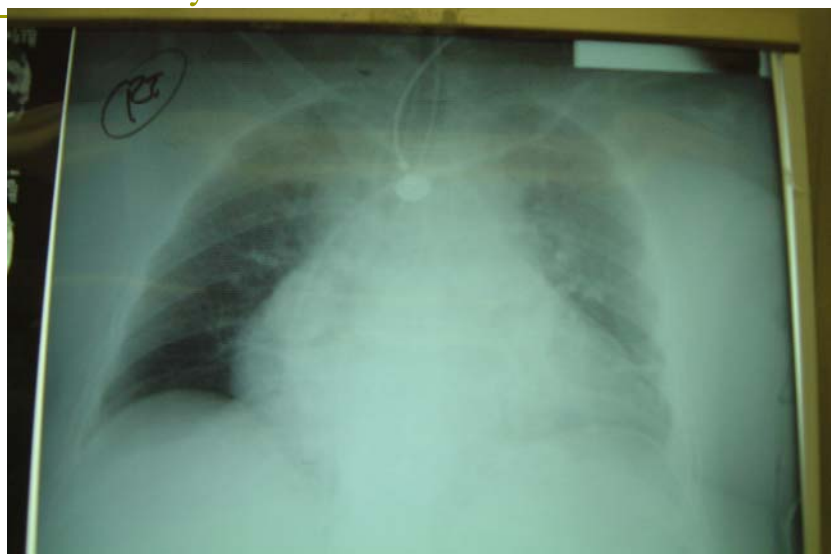
Perioperative Outcomes of Major Hepatic Resections under Low Central Venous Pressure Anesthesia: Blood Loss, Blood Transfusion, and the Risk of Postoperative Renal Dysfunction

Jose A Melendez, MD, Vittoria Arslan, MD, Mary E Fischer, MD, David Wuest, MD, William R Jarnagin, MD, Yuman Fong, MD, and Leslie H Blumgart, MD, FRCS, FACS

- Mean EBL 645 mL.
- Median units PRBC = 2
  - 67% of patients did not require transfusion during surgery and first 12 hours postop
- *"Only 3% of the patients experienced a persistent and clinically significant increase in serum creatinine possibly attributable to the anesthetic"*

Normovolemic hemodilution

Not everyone is a candidate



Hemodilution in the OR

- Whole blood collected
  - Cordis
  - Art Line
  - 14 G PIV
- How long to sit unrefrigerated?
- Blood banking paperwork etc…..

Renal effects of insufflation

1: Razvi HA, Fields D, Vargas JC, Vaughan ED Jr, Vukasin A, Sosa RE. Related Articles, Links
Oliguria during laparoscopic surgery: evidence for direct renal parenchymal compression as an etiologic factor.
J Endourol. 1996 Feb;10(1):1-4.
PMID: 8833721 [PubMed - indexed for MEDLINE]

2: Chiu AW, Chang LS, Birkett DH, Babayan RK. Related Articles, Links
Changes in urinary output and electrolytes during gaseous and gasless laparoscopy.
Urol Res. 1996;24(6):361-6.
PMID: 9008330 [PubMed - indexed for MEDLINE]

3: Chiu AW, Chang LS, Birkett DH, Babayan RK. Related Articles, Links
The impact of pneumoperitoneum, pneumoretroperitoneum, and gasless laparoscopy on the systemic and renal hemodynamics.
J Am Coll Surg. 1995 Nov;181(5):397-406.
PMID: 7582206 [PubMed - indexed for MEDLINE]

4: Nishio S, Takeda H, Yokoyama M. Related Articles, Links
Changes in urinary output during laparoscopic adrenalectomy.
BJU Int. 1999 Jun;83(9):944-7.
PMID: 10368233 [PubMed - indexed for MEDLINE]

5: Guler C, Sade M, Kirkali Z. Related Articles, Links
Renal effects of carbon dioxide insufflation in rabbit pneumoretroperitoneum model.
J Endourol. 1998 Aug;12(4):367-70.
PMID: 9726406 [PubMed - indexed for MEDLINE]

Does subtle hypovolemia cause harm?

Hypothesis: Vital organ hypoperfusion is common during major cancer resection, and may produce vital organ dysfunction

Goal-directed fluid therapy

Anesthesiology 2002; 97:820–6

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

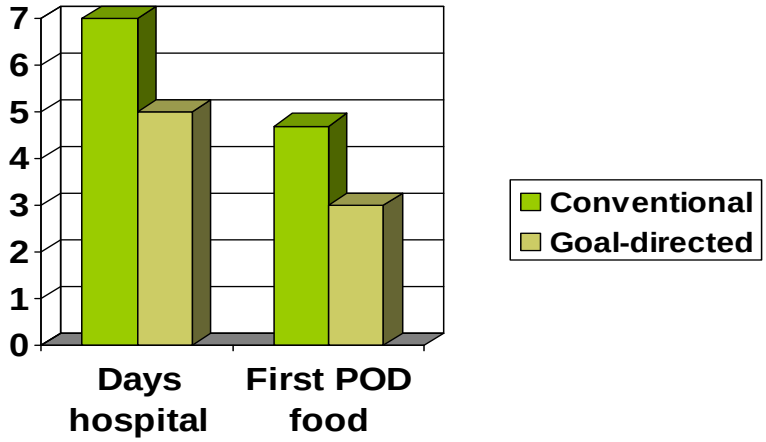
Tong J. Gan, M.B., B.S, F.R.C.A., Andrew Soppitt, B.Sc., M.B., B.S., F.R.C.A.,† Mohamed Maroof, M.D.,‡ Habib El-Moalem, Ph.D.,§ Kerri M. Robertson, M.D.,* Eugene Moretti, M.D.,† Peter Dwane, M.D.,‡ Peter S. A. Glass, M.B., F.F.A. (S.A.)‖*

- 100 major elective surgery patients
- Anticipated EBL > 500 ml randomized
  - control group (n = 50) that received standard care
  - protocol group (n = 50) received intraoperative plasma volume expansion guided by the esophageal Doppler monitor to maintain maximal stroke volume.

Anesthesiology 2002; 97:820–6

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.)‖*

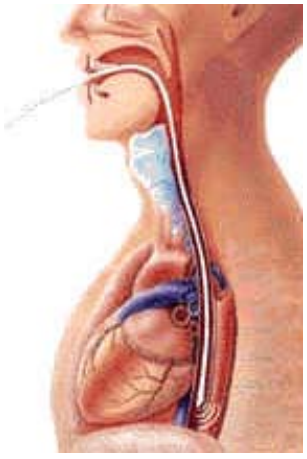


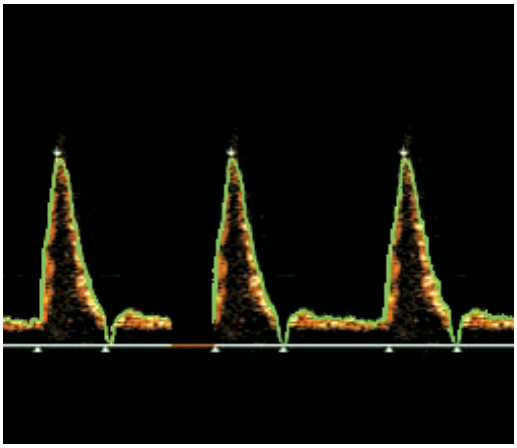
Anesthesiology 2002; 97:820–6

© 2002 American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

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.)‖*

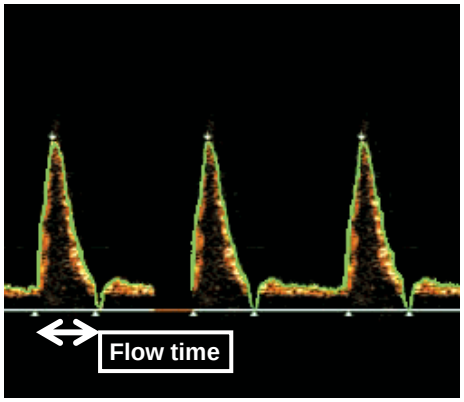


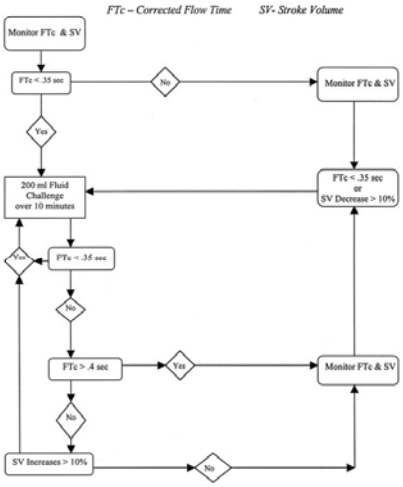


Anesthesiology 2002; 97:820–6

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.)‖





Anesthesiology 2002; 97:820–6
© 2002 American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.
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.)‖

Table 2. Intraoperative Fluid, Blood, and Blood Product Administration

	Protocol Group (n = 50)	Control Group (n = 50)
6% hetastarch in saline	847 ± 373*	282 ± 470
Lactated Ringer's solution	4405 ± 2030	4575 ± 2452
Erythrocytes	168 ± 386	118 ± 281
Estimated blood loss	703 ± 649	624 ± 632
Urinary output	544 ± 593	418 ± 380

Data are mean ± SD (volume in ml).
* $P < 0.01$.

Table 4. Incidence of Postoperative Complications

	Protocol Group (n = 50)	Control Group (n = 50)
Acute renal dysfunction (urine output <500 ml)	2 (4)	4 (8)
Respiratory support for > 24 h	1 (2)	3 (6)
Cardiovascular (hypotension, pulmonary edema, arrhythmia)	1 (2)	2 (4)
Chest infection (clinical diagnosis)	2 (4)	2 (4)
Severe PONV requiring rescue antiemetic	7 (14)	18 (36)*
Coagulopathy	4 (8)	4 (8)
Wound infection	4 (8)	5 (10)

Data presented as number of patients (%). Postoperative complications definition based on Bennett-Gurrerro *et al.*[13]
* $P < 0.05$ Fisher exact test.

Do we monitor vital organ perfusion?

- Renal
  - Urine output
- Gut
  - Gastric tonometry?
- Brain
  - EEG?
  - Cerebral oximetry?
- Heart
  - ST segments
  - TEE

Postoperative Ventilation

- Contributing factors
  - Underlying cardiopulmonary disease
  - Large fluid volumes
  - Airway edema / difficult ETT
  - Transfusion
  - Visceral edema
  - Systemic inflammatory response
  - Pain and splinting

Fluids to maintain BP?

Dangers of "excessive" IV fluids

FEATURE

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,¶ Else Hjortsø, MD,‖ Helle Ørding, MD, DMSc,** Karen Lindorff-Larsen, MD,†† Morten S. Rasmussen, MD,† Charlotte Lanng, MD,‡ Lene Wallin, MD, DMSc,§ and The Danish Study Group on Perioperative Fluid Therapy (Lene H. Iversen, MD, PhD,** Christina S. Gramkow, MD,‡ Mette Okholm, MD,‖ Tine Blemmer, MD,‖ Poul-Erik Svendsen, MD,† Henrik H. Rottensten, MD,¶ Birgit Thage, MD,‡ Jens Riis, MD,†† Inge S. Jeppesen, MD,§ Dorthe Teilum, MD,‡‡ Anne Mette Christensen, MD,** Ben Graungaard, MD,‖ and Frank Pott, MD‖*

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

A Randomized Assessor-Blinded Multicenter Trial

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.	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 dependent on hematocrit.	Blood component therapy started at approximate loss >1500 mL dependant on hematocrit.

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

A Randomized Assessor-Blinded Multicenter Trial

TABLE 1. Intraoperative Fluid Therapy

	Restricted Regimen	Standard Regimen
Preloading of epidural ana	Preloading of epidural analgesia — No preloading.	
Third space lo	Third space loss — No replacement	st hour; 5 mL/kg/h second ing hours.
Loss during fa (maintenanc		ependent of oral intake.
Blood loss		L of normal saline; Loss
	Blood component therapy started at approximate loss >1500 mL dependent on hematocrit.	Blood component therapy started at approximate loss >1500 mL dependant on hematocrit.

Problem Solving

- Ephedrine and/or dopamine were administered in both groups to achieve a mean arterial blood pressure above 60 mm Hg during operation.
- Cases of postoperative hypotension or low urinary output (<0.5 mL/kg/h) were always examined and the cause treated.
- Bleeding initiated administration of intravenous fluids as previously described.

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

A Randomized Assessor-Blinded Multicenter Trial

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

	Blinded Assessment		
	Restricted Group	Standard Group	*P* value
Overall complications	21	40	0.003
Major complications†	8	18	0.040
Minor complications†	15	36	0.000
Tissue-healing complications†	11	22	0.040
Cardiopulmonary complications†	5	17	0.007

Feasibility and Outcomes of an Early Extubation Policy After Esophagectomy

Michael Lanuti, MD, Pierre E. de Delva, MD, Abdulrahman Maher, MD, Cameron D. Wright, MD, Henning A. Gaissert, MD, John C. Wain, MD, Dean M. Donahue, MD, and Douglas J. Mathisen, MD

Division of General Thoracic Surgery, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts

Table 3. Postoperative Complications in the Study Patients

Pneumonia	14.7%
ARDS	2.9%
Effusion	15.7%
Myocardial infarction	1.0%
Intestinal leak	5.9%
Postoperative arrhythmia	15.1%
30-day mortality	1.9%

Feasibility and Outcomes of an Early Extubation Policy After Esophagectomy

Michael Lanuti, MD, Pierre E. de Delva, MD, Abdulrahman Maher, MD, Cameron D. Wright, MD, Henning A. Gaissert, MD, John C. Wain, MD, Dean M. Donahue, MD, and Douglas J. Mathisen, MD

Division of General Thoracic Surgery, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts

Table 2. Intraoperative Parameters for Study Patients in Mean ± Standard Error of the Mean or Percentage

Op time mean (minutes)	452 ± 10
Crystaloid mean (mL)	5962 ± 165
Colloid mean (mL)	211 ± 39
EBL mean (mL)	413 ± 24
Intraoperative blood transfusion	6.9%
Thoracic epidural	97.1%

Feasibility and Outcomes of an Early Extubation Policy After Esophagectomy

Michael Lanuti, MD, Pierre E. de Delva, MD, Abdulrahman Maher, MD, Cameron D. Wright, MD, Henning A. Gaissert, MD, John C. Wain, MD, Dean M. Donahue, MD, and Douglas J. Mathisen, MD

Division of General Thoracic Surgery, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts

- 102 patients
  - 92 extubated in OR
    - Only 3 required reintubation
  - 10 patients to ICU with ETT
    - 2 reintubated in OR for acute a/w obstruction
- Overall, ~5% require reintubation
  - Don't put the ETT in the esophagus!
  - Tube changer?

Continuous Positive Airway Pressure for Treatment of Postoperative Hypoxemia

A Randomized Controlled Trial

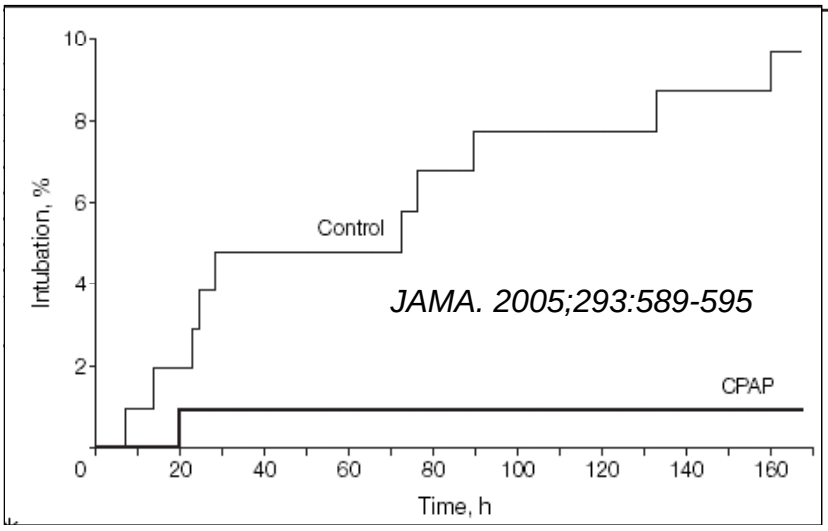
Vincenzo Squadrone, MD
Massimiliano Coha, MD
Elisabetta Cerutti, MD
Maria Maddalena Schellino, MD
Piera Biolino, MD
Paolo Occella, MD
Giuseppe Belloni, MD
Giuseppe Vilianis, MD
Gilberto Fiore, MD
Franco Cavallo, MD
V. Marco Ranieri, MD
for the Piedmont Intensive Care Units Network (PICUN)

17% of postop laparotomy patients were hypoxemic

JAMA. 2005;293:589-595

Continuous Positive Airway Pressure for Treatment of Postoperative Hypoxemia

A Randomized Controlled Trial



Continuous Positive Airway Pressure for Treatment of Postoperative Hypoxemia

A Randomized Controlled Trial

Table 2. Secondary Outcomes

	Control (n = 104)	CPAP (n = 105)	Difference of Means (95% CI)	*P* Value*
ICU length of stay, mean, d	2.6	1.4	−1.2 (−2.0 to −0.3)	.09
Median (95% CI), d	1 (1-11)	1 (1-4)		
Hospital length of stay, mean (SD), d	17 (15)	15 (13)	−2 (−6 to 2)	.10
Median (95% CI)	12 (7-47)	11 (6-35)		
			Relative Risk (95% CI)	
Pneumonia, No. (%)†	10 (10)	2 (2)	0.19 (0.04 to 0.88)	.02
Infection, No. (%)‡	11 (10)	3 (3)	0.27 (0.07 to 0.94)	.03
Sepsis, No. (%)§	9 (9)	2 (2)	0.22 (0.04 to 0.99)	.03
Anastomotic leakage, No.	6	1		
Pneumonia, No.	3	1		
Deaths, No. (%)	3 (3)	0 (0)		.12

JAMA. 2005;293:589-595

Good analgesia improves outcome?

Epidurals for abdominal surgery

Epidural anaesthesia and survival after intermediate-to-high risk non-cardiac surgery: a population-based cohort study

Duminda N Wijeysundera, W Scott Beattie, Peter C Austin, Janet E Hux, Andreas Laupacis

- From Ontario, Canada insurance data
- Retrospective analysis
- Matched cases with and without epidural
  - N = 44,000 in each group!

www.thelancet.com **Published online August 11, 2008**

Epidural anaesthesia and survival after intermediate-to-high risk non-cardiac surgery: a population-based cohort study

Duminda N Wijeysundera, W Scott Beattie, Peter C Austin, Janet E Hux, Andreas Laupacis

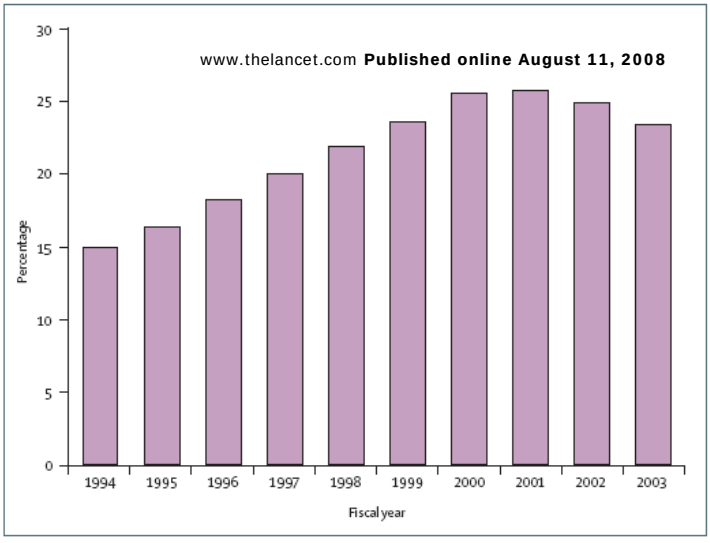


Figure 1: Proportion of patients who received perioperative epidural anaesthesia or analgesia

Epidural anaesthesia and survival after intermediate-to-high risk non-cardiac surgery: a population-based cohort study

www.thelancet.com **Published online August 11, 2008**

Dumindа N Wijeysundera, W Scott Beattie, Peter C Austin, Janet E Hux, Andreas Laupacis

	Epidural n=44 094	No epidural n=44 094	Absolute standardised difference (%)	
			Before matching	After matching
(Continued from previous page)				
Procedure				
Abdominal aortic aneurysm repair	2411 (5·5%)	2251 (5·1%)	35	1·6
Peripheral vascular bypass	3722 (8·4%)	3926 (8·9%)	9·7	1·6
Total hip replacement	6575 (15%)	6557 (15%)	43	0·1
Total knee replacement	10 539 (24%)	10 427 (24%)	42	0·6
Large bowel surgery	11 794 (27%)	12 154 (28%)	8·1	1·8
Liver resection	666 (1·5%)	642 (1·5%)	10	0·5
Whipple procedure	334 (0·8%)	339 (0·8%)	13	0·1
Pneumonectomy or lobectomy	2810 (6·4%)	2515 (5·7%)	46	2·8
Gastrectomy or oesophagectomy	1558 (3·5%)	1527 (3·5%)	19	0·4
Nephrectomy	2903 (6·6%)	2980 (6·8%)	15	0·7
Cystectomy	782 (1·8%)	776 (1·8%)	14	0·1

Epidural anaesthesia and survival after intermediate-to-high risk non-cardiac surgery: a population-based cohort study

www.thelancet.com **Published online August 11, 2008**

Dumindа N Wijeysundera, W Scott Beattie, Peter C Austin, Janet E Hux, Andreas Laupacis

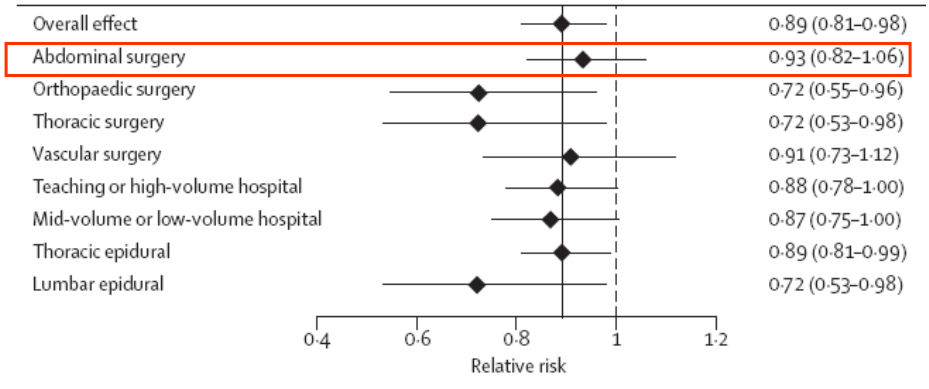


Figure 2: **Association of epidural anaesthesia or analgesia with 30-day mortality in the subgroup analyses**

Our institution

	All n=49	EPI n=32	PCA n-17	EPI+ n=25	EPI- n=7
LOS (mean)	3.98	3.979	4.00	3.72	4.86
Incision					
Transverse (n=29)	3.45*	3.19	3.77	2.93	5.00
Midline (n=20)	4.75*	4.75	4.75	4.73	4.80
Procedure					
Small bowel (n=25)	3.24+	3.13	3.44	2.85	4.33
R colon (n=11)	3.80+	4.50	3.33	4.5	4.50
L colon (n=7)	5.00+	4.60	6.00	3.67	6.00
Total colectomy (n=6)	5.50	6.00	5.00	6.00	–

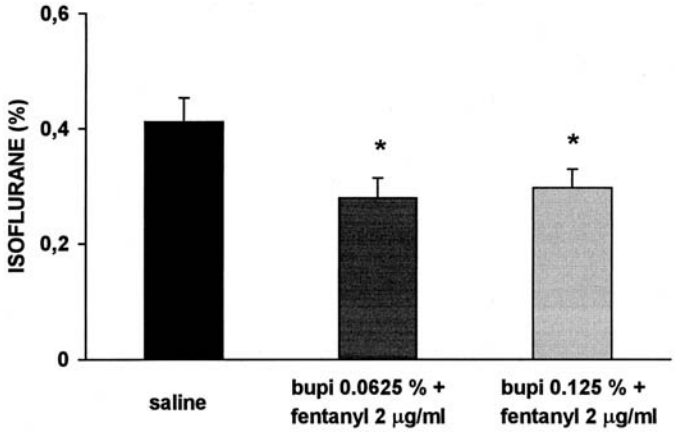
*T vs M p<0.01; + linear trend p<0.01

Much room for improvement!

Isoflurane Requirements During Combined General/Epidural Anesthesia for Major Abdominal Surgery

Luis Casati, MD, PhD, Susana Fernández-Galinski, MD, PhD, DEAA, Enriqueta Barrera, MD, Olga Pol, PhD, and Margarita M. Puig, MD, PhD, DABA

Department of Anesthesiology, Hospital Universitario del Mar, Universidad Autonóma de Barcelona, Barcelona, Spain



Conclusions

- High mortality, though not so apparent to anesthesia care providers
- Anesthetic technique, adequate fluid resuscitation may improve outcome
- Does early extubation reduce pulmonary complications?
- Multimodal analgesia and fast tracking?