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ANESTHESIOLOGICAL MANAGEMENT IN LIVER SURGERY

Dott.ssa Raffaella Reineke

UO Anestesia e Rianimazione

IRCCS Ospedale San Raffaele - Milano

OSPEDALE
SAN RAFFAELE

surgeon

anesthesist

patient

PERI-OPERATIVE MANAGEMENT

PRE-OPERATIVE>> RISK STRATIFICATION

INTRA-OPERATIVE>> MONITORING, GDT, FLUIDS, ERP

POST-OPERATIVE>> ANALGESIC PLAN

Risk stratification

European Heart Journal Advance Access published August 4, 2014

European Heart Journal
doi:10.1093/eurheartj/ehu282

ESC/ESA GUIDELINES

European Society of Anaesthesiology ESA

2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management

The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA)

ACCEPTED MANUSCRIPT

Fleisher LA, et al.
2014 ACC/AHA Perioperative Guideline

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, and Society of Cardiovascular Anesthesiologists,

FLUIDI ED EMODINAMICA PERIOPERATORIA NEL PAZIENTE AD ALTO RISCHIO

1 mL/Kg/h DI CRISTALLOIDI + MONITORAGGIO DELLA CO

SELECT	SELEZIONARE IL PAZIENTE AD ALTO RISCHIO
MONITOR	MONITORAGGIO DELLA GITTATA CARDIACA
ACTIVE	PROTOCOLLO PRO-ATTIVO O RE-ATTIVO
CORRECT	CORREGGERE I TARGET EMODINAMICI INTRAOPERATORI
KEEP	MANTIENI I TARGET NEL POSTOPERATORIO

IN CASO DI DUBBIO CONSIDERA SEMPRE TTE/TEE SE DISPONIBILE

NECESSARIO WARNING

European Society of Anaesthesiology ESA

SCORES

Recommendations on cardiac risk stratification

Recommendations	Class[a]	Level[b]	Ref.[c]
Clinical risk indices are recommended to be used for peri-operative risk stratification.	I	B	43,44
The NSQIP model or the Lee risk index are recommended for cardiac peri-operative risk stratification.	I	B	43,44,54
Assessment of cardiac troponins in high-risk patients, both before and 48–72 hours after major surgery, may be considered.	IIb	B	3,48,49
NT-proBNP and BNP measurements may be considered for obtaining independent prognostic information for peri-operative and late cardiac events in high-risk patients.	IIb	B	52,53,55
Universal pre-operative routine biomarker sampling for risk stratification and to prevent cardiac events is not recommended.	III	C	

BNP = B-type natriuretic peptide; NT-proBNP = N-terminal pro-brain natriuretic peptide.
NSQIP = National Surgical Quality Improvement Program.
[a]Class of recommendation.
[b]Level of evidence.
[c]Reference(s) supporting recommendations.

2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management

Table 4 Clinical risk factors according to the revised cardiac risk index[43]

1. Ischaemic heart disease (angina pectoris and/or previous myocardial infarction[a])
2. Heart failure
3. Stroke or transient ischaemic attack
4. Renal dysfunction (serum creatinine >170 μmol/L or 2 mg/dL or a creatinine clearance of <60 mL/min/1.73 m²)
5. Diabetes mellitus requiring insulin therapy

[a]According to the universal definition of myocardial infarction.[49]

6. High risk type surgery

Table 3 Surgical risk estimate according to type of surgery or intervention[a,b]

Low-risk: < 1%	Intermediate-risk: 1–5%	High-risk: > 5%
• Superficial surgery • Breast • Dental • Endocrine: thyroid • Eye • Reconstructive • Carotid asymptomatic (CEA or CAS) • Gynaecology: minor • Orthopaedic: minor (meniscectomy) • Urological: minor (transurethral resection of the prostate)	• Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy • Carotid symptomatic (CEA or CAS) • Peripheral arterial angioplasty • Endovascular aneurysm repair • Head and neck surgery • Neurological or orthopaedic: major (hip and spine surgery) • Urological or gynaecological: major • Renal transplant • Intra-thoracic: non-major	• Aortic and major vascular surgery amputation or thromboembolectomy • Duodeno-pancreatic surgery • Liver resection, bile duct surgery • Oesophagectomy • Adrenal resection • Total cystectomy • Pneumonectomy • Pulmonary or liver transplant

CAS = carotid artery stenting; CEA = carotid endarterectomy.
[a]Surgical risk estimate is a broad approximation of 30-day risk of cardiovascular death and myocardial infarction that takes into account only the specific surgical intervention, without considering the patient's comorbidities.
[b]Adapted from Glance et al.[11]

FACTORS	0	→	1	→	2	→ >3
MAJOR COMPL.	0,5 %	→	1,3%	→	4%	→ 9%

SCORES

Br. J. Surg. 1991, Vol. 78, March, 356-360

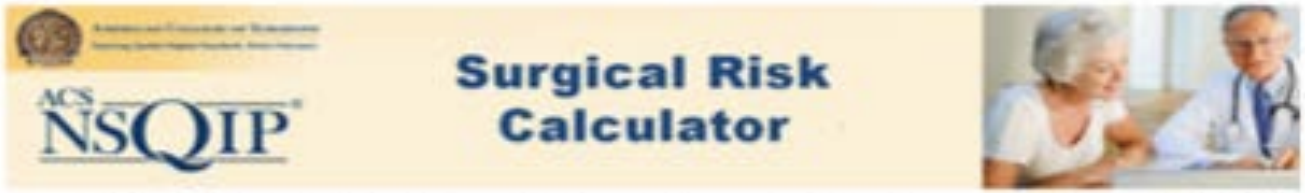
POSSUM: a scoring system for surgical audit

Preoperative Score to Predict Postoperative Mortality (POSPOM)

Derivation and Validation

(ANESTHESIOLOGY 2016; 124:570-9)

Yannick Le Manach, M.D., Ph.D., Gary Collins, Ph.D., Reitze Rodseth, M.B.Ch.B., Ph.D., Christine Le Bihan-Benjamin, M.D., M.Sc., Bruce Biccard, M.B.Ch.B., Ph.D., Bruno Riou, M.D., Ph.D., P.J. Devereaux, M.D., Ph.D., Paul Landais, M.D., Ph.D.

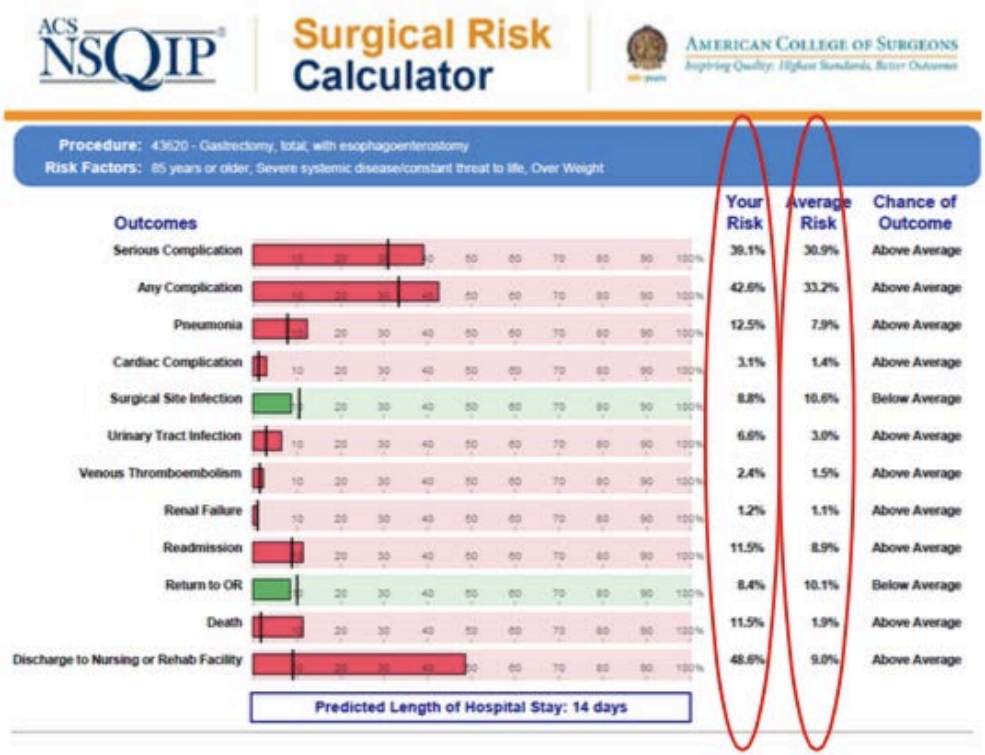


Cardiopulmonary Exercise Testing for Risk Prediction in Major Abdominal Surgery

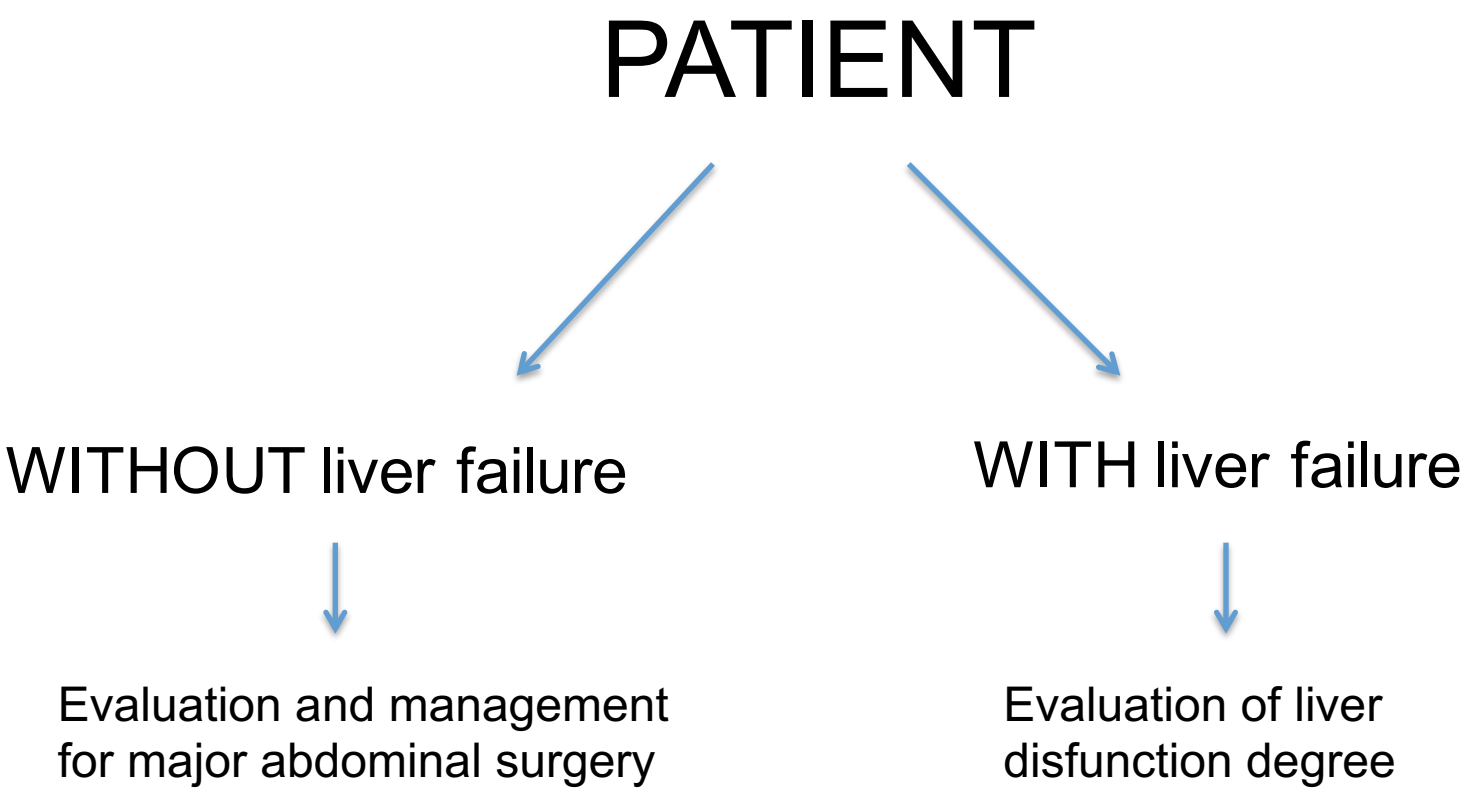
Anesthesiology Clin 33 (2015) 1–16

Denny Z.H. Levett,
Michael P.W. Grocott,


ACS NSQIP
Surgical Risk Calculator
Risk Calculator Homepage
About
FAQ
ACS Website
ACS NSQIP Website
Enter Patient and Surgical Information
Procedure
Clear
Begin by entering the procedure name or CPT code. One or more procedures will appear below the procedure box. You will need to click on the desired procedure to properly select it. You may also search using two words (or two partial words) by placing a "+" in between, for example: "cholecystectomy+cholangiography"
Reset All Selections
Are there other potential appropriate treatment options?
Other Surgical Options
Other Non-operative options
None
Please enter as much of the following information as you can to receive the best risk estimates. A rough estimate will still be generated if you cannot provide all of the information below.
Age Group
Under 65 years
Sex
Female
Functional status
Independent
Emergency case
No
ASA class
1 - Healthy patient
Wound class
Clean
Steroid use for chronic condition
No
Ascites within 30 days prior to surgery
No
Systemic sepsis within 48 hours prior to surgery
None
Ventilator dependent
No
Disseminated cancer
No
Diabetes
None
Hypertension requiring medication
No
Previous cardiac event
No
Congestive heart failure in 30 days prior to surgery
No
Dyspnea
None
Current smoker within 1 year
No
History of severe COPD
No
Dialysis
No
Acute Renal Failure
No
BMI Calculation:
Height (in)
Weight (lbs)


ACS NSQIP
Surgical Risk Calculator
American College of Surgeons
Inspiring Quality: Highest Standards, Better Outcomes
Procedure: 43620 - Gastrectomy, total, with esophagoenterostomy
Risk Factors: 85 years or older, Severe systemic disease/constant threat to life, Over Weight
Outcomes
Your Risk
Average Risk
Chance of Outcome
Serious Complication 39.1% 30.9% Above Average
Any Complication 42.6% 33.2% Above Average
Pneumonia 12.5% 7.9% Above Average
Cardiac Complication 3.1% 1.4% Above Average
Surgical Site Infection 8.8% 10.6% Below Average
Urinary Tract Infection 6.6% 3.0% Above Average
Venous Thromboembolism 2.4% 1.5% Above Average
Renal Failure 1.2% 1.1% Above Average
Readmission 11.5% 8.9% Above Average
Return to OR 8.4% 10.1% Below Average
Death 11.5% 1.9% Above Average
Discharge to Nursing or Rehab Facility 48.6% 9.0% Above Average
Predicted Length of Hospital Stay: 14 days

Risk stratification



CIRRHOSIS

- Portal hypertension>> oedema, ascitis, oesophageal varices, splenomegaly, encefalopathy
- Hypoalbuminemia
- Coagulopathy
- Renal disfunction

CIRRHOSIS

HAEMODINAMICS

Peripheric vasodilatation
A-v Shunt
} ↓ SVRI

↑ preload
} ↑ CO e CI

Hematic flow redistribution
} ↑ Pulmonary flow
} = ↓ Renal flow

Dilatative cardiomiopathy

↓ Δ Ca-v O2

PERI-OPERATIVE MANAGEMENT

PRE-OPERATIVE>> RISK STRATIFICATION

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POST-OPERATIVE>> ANALGESIC PLAN

Monitoring

WHAT?

HOW?

CHEST 2013; 143(5):1480-1488 Hemodynamic Monitoring

Monitoring: WHAT

Hemodynamic parameters

Heart rate — ECG 

BP — ABP 

Vascular pressure (CVP, PAP)

Cardiac Output

Ventricular performance — TOE 

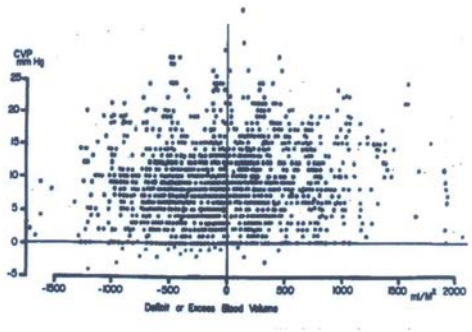
CHEST 2013; 143(5):1480-1488 Hemodynamic Monitoring

DOES CVP PREDICT FLUID RESPONSIVENESS?

24 studies > 803 patients

CVP should not be used to make clinical decision on fluid management

CHEST 2008 Jul; 134(1): 172-8



43 studies > 20 on OR patients

NO data support using CVP to guide fluid therapy. This approach should be abandoned.

Crit Care Med. 2013 Jul;41(7):1774-81

Monitoring: WHAT

Hemodynamic parameters

Heart rate — ECG 

BP — ABP 

Vascular pressure (CVP, PAP)

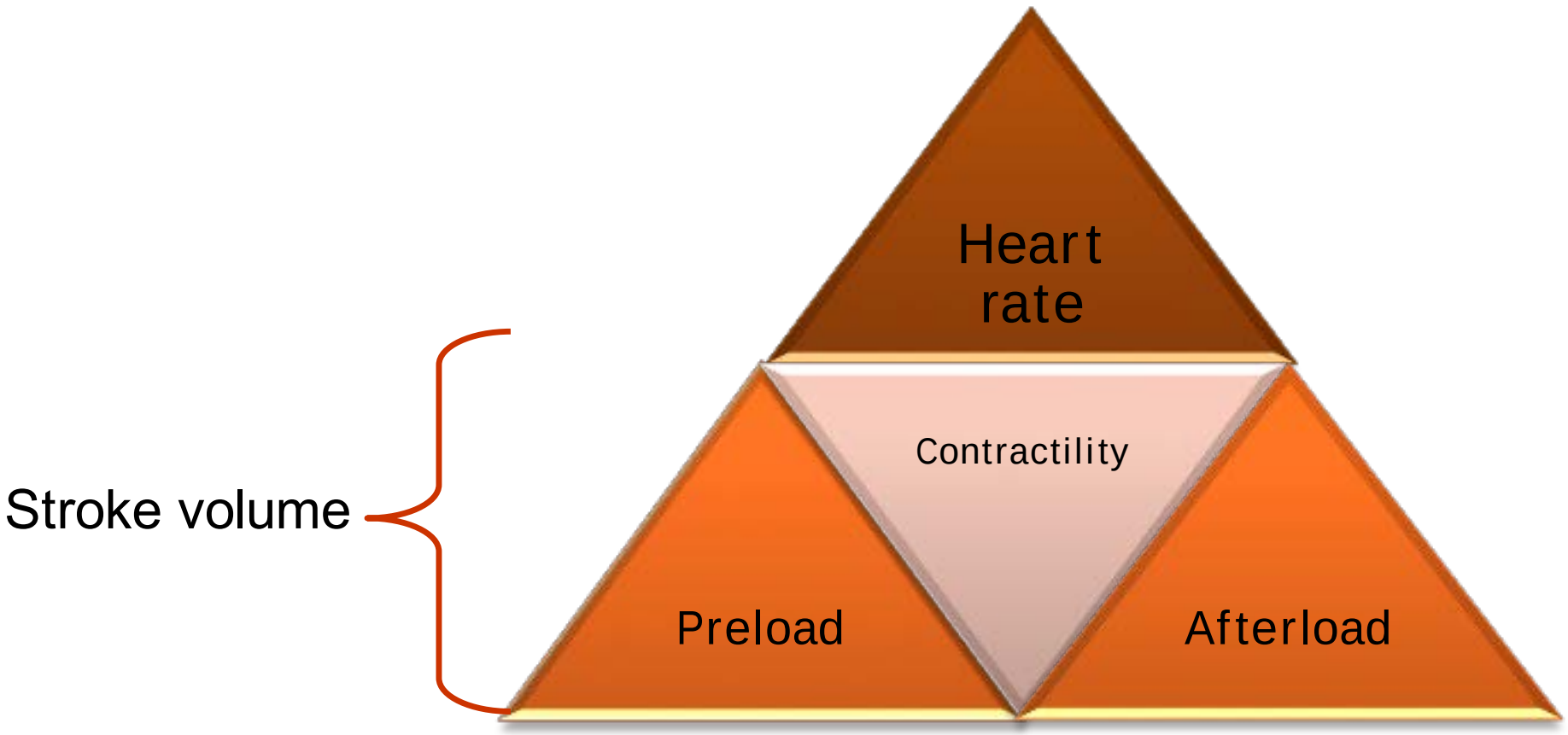
Cardiac Output

Ventricular performance — TOE 

CHEST 2013; 143(5):1480-1488 Hemodynamic Monitoring

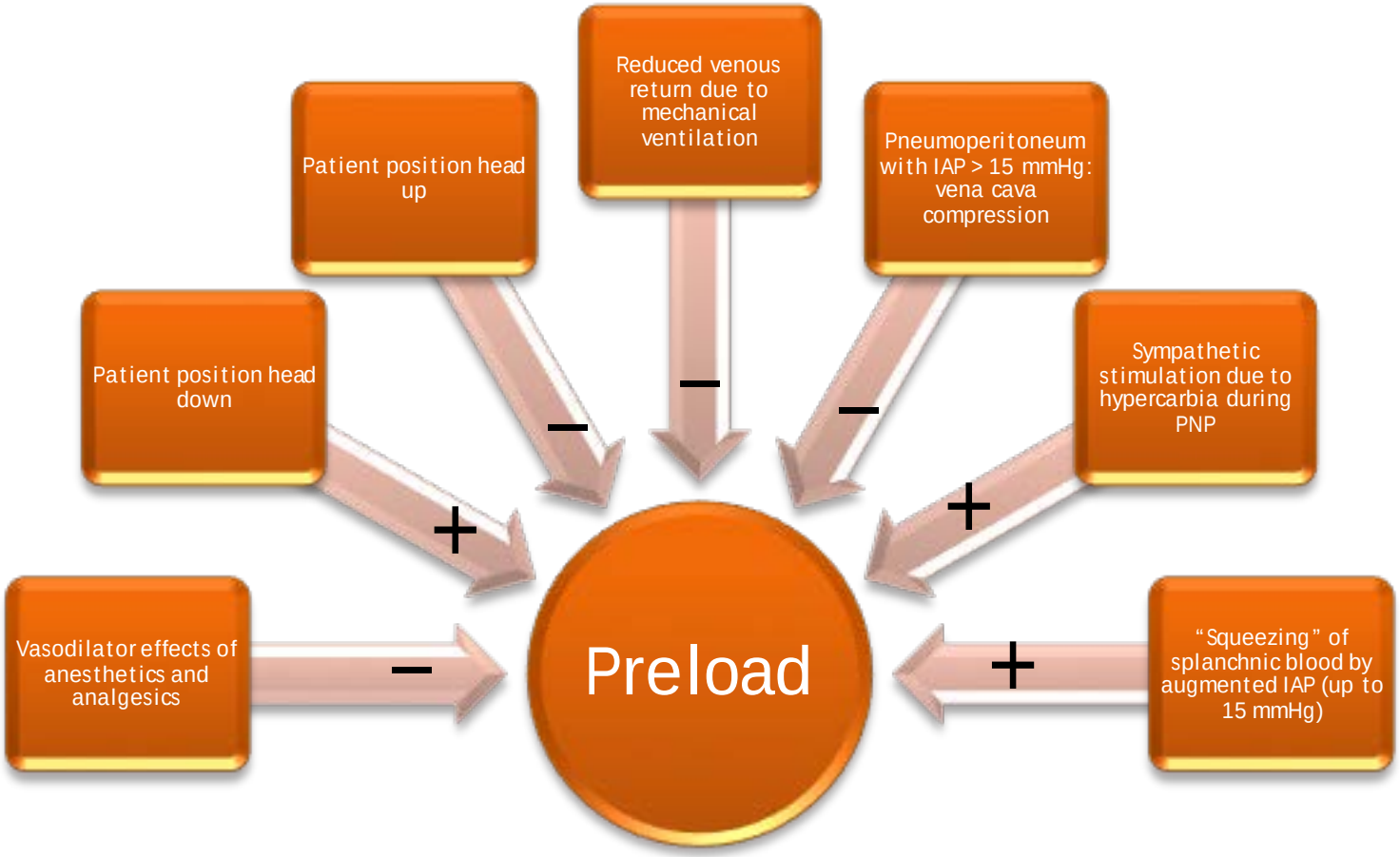
CARDIAC OUTPUT

CO = Stroke Volume (SV) x Heart Rate (HR)



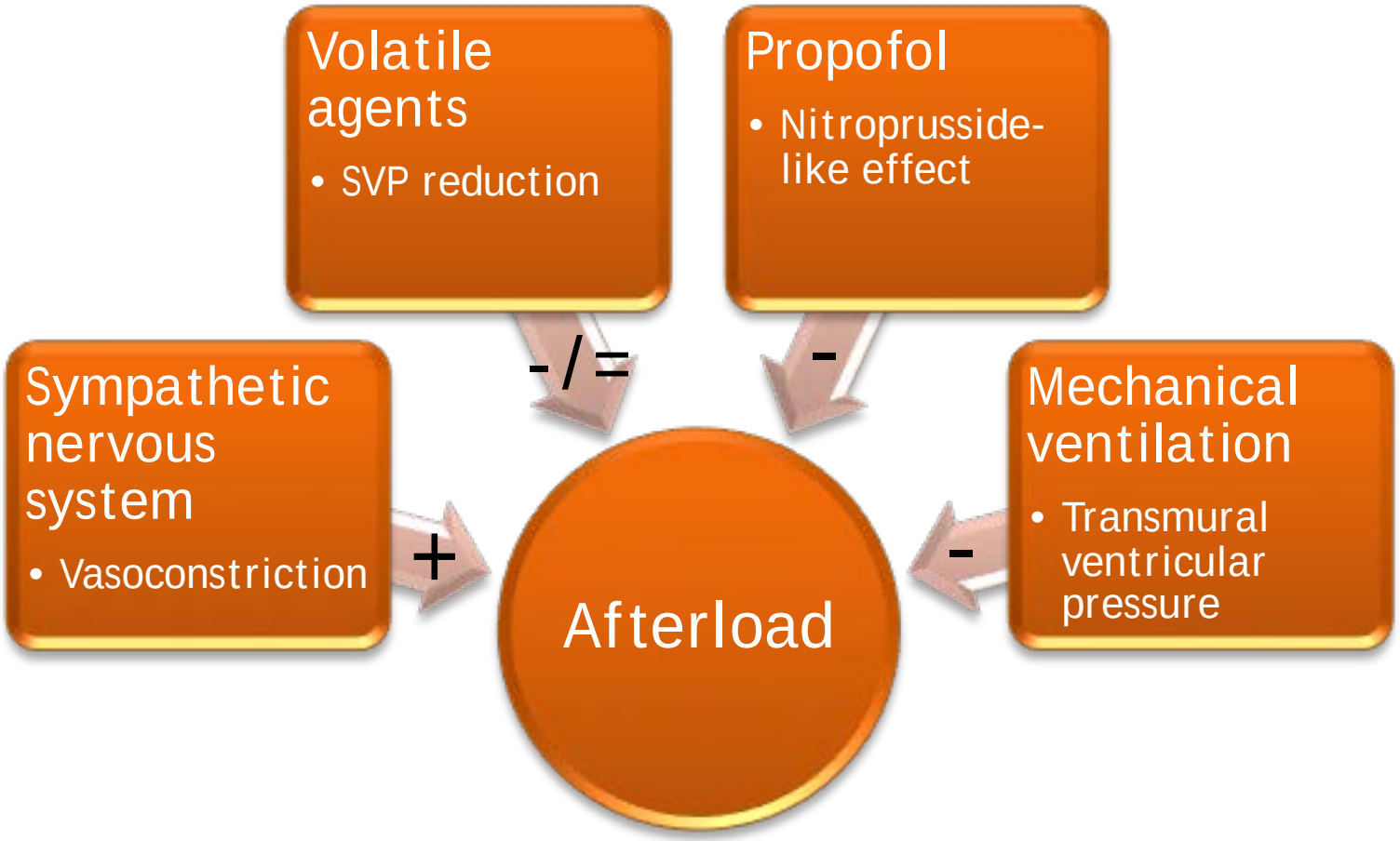
PRELOAD

FACTORS AFFECTING PRELOAD IN OR



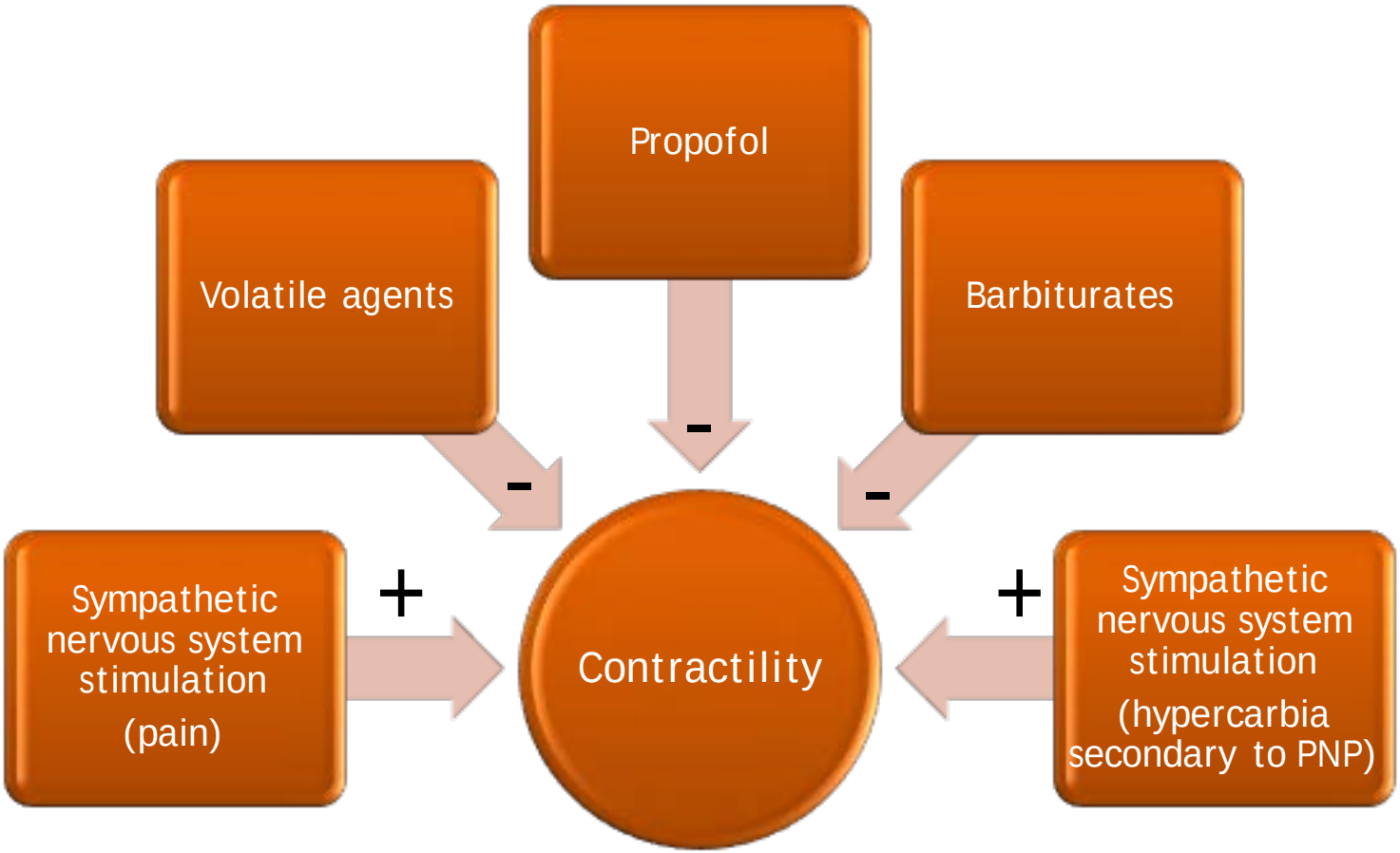
AFTERLOAD

FACTORS AFFECTING AFTERLOAD IN OR



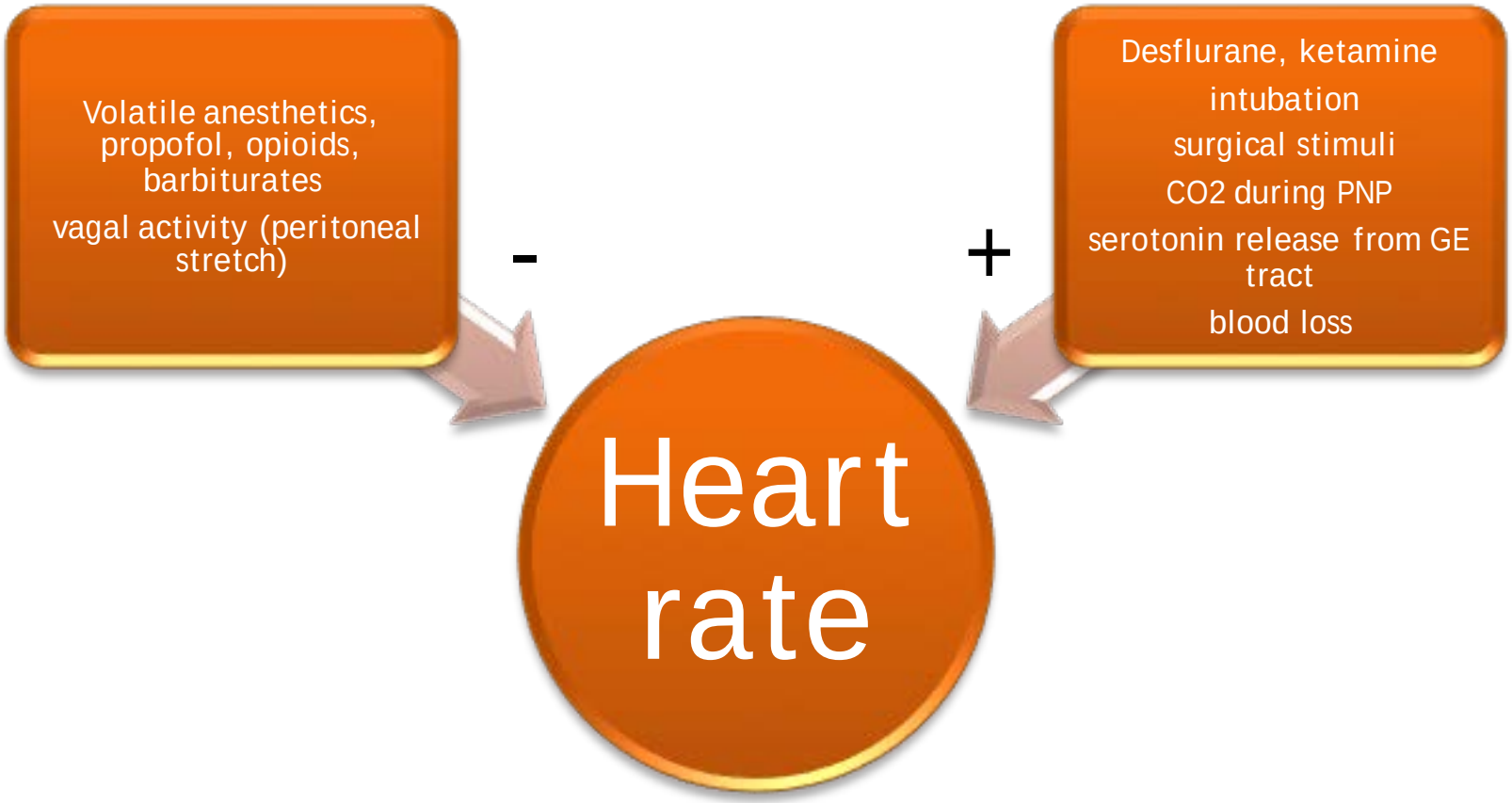
CONTRACTILITY

FACTORS AFFECTING CONTRACTILITY IN OR



HEART RATE

FACTORS AFFECTING HEART RATE IN OR



Ideal Monitoring

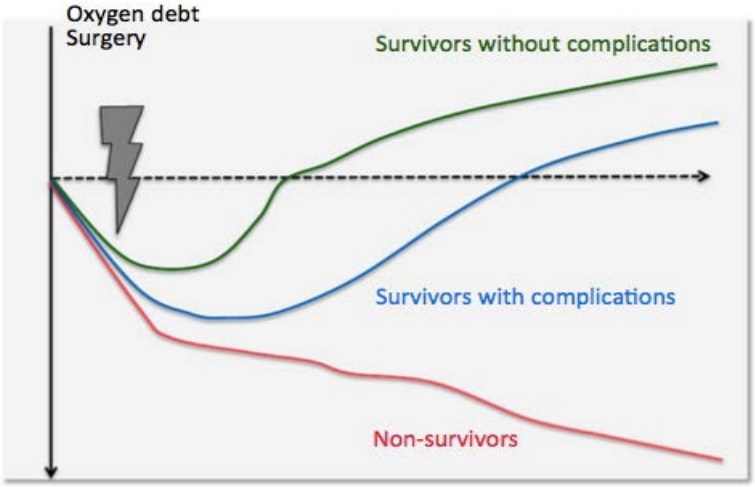
Cardiac Output

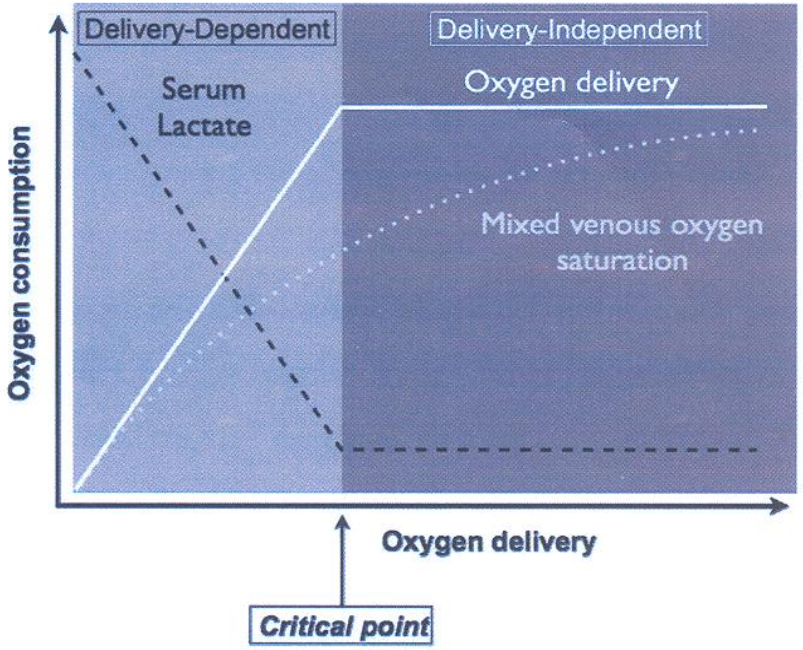
Tissue Oxygenation (DO2)

Monitoring: WHY?

CO is related to the oxygen debt concept (AVOID!)

$DO_2 = CO \times CaO_2 \times 10$





CHEST 2013; 143(5):1480-1488 Hemodynamic Monitoring

Haemodynamic and oxygen transport patterns in surviving and nonsurviving patients.

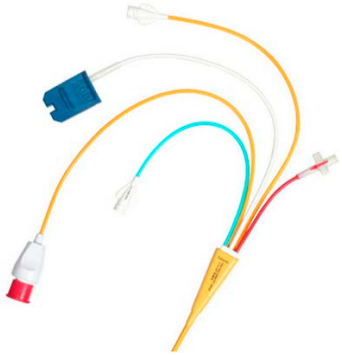
Bland RD, Shoemaker WC,Abraham E, Cobo JC

Critical Care Medicine

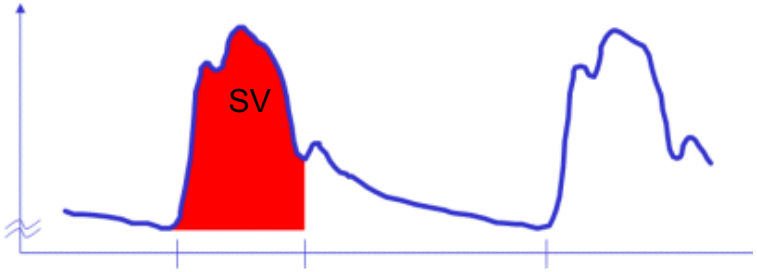
Crit Care Med 1985;13:85–90

Monitoring CO: HOW?

Thermodilution



Pulse contour analysis >> SVV



Ultrasound - Doppler

SV- SVV- CO

Fluid responsiveness can be predicted during positive pressure breathing by SVV variations

Curr Opin Crit Care 2014
Jun;20(3):288-93
J Anesth 2015 Feb;29(1):40-6

Vigileo system recalibrates itself;
Arterial compliance is costant;
CO measured is comparable to values with SG

Chest 2013; 143(5):1480-1488

World J Surg (2016) 40:2425–2440
DOI 10.1007/s00268-016-3700-1

SCIENTIFIC REVIEW

Guidelines for Perioperative Care for Liver Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations

Emmanuel Melloul[1,2] · Martin Hübner[1] · Michael Scott[3] · Chris Snowden[4,5] · James Prentis[6] · Cornelis H. C. Dejong[7] · O. James Garden[8] · Olivier Farges[9] · Norihiro Kokudo[10] · Jean-Nicolas Vauthey[11] · Pierre-Alain Clavien[12] · Nicolas Demartines[1]

Monitoring

plan, excess crystalloid and blood loss should be avoided in all patients. Although the measure of stroke volume variation (SVV) has been proposed as appropriate replacement for CVP monitoring [122], it is more likely that a synergistic combination of CVP monitoring and SVV methods will become the standard form of hemodynamic monitoring in liver surgery.

One recent study has demonstrated that goal-directed

quality and level of evidence of the studies remain low. The highest level of evidence (level 1 or 2) was available for only 5 items. Though the value of enhanced recovery pathways has now been demonstrated in colorectal surgery, with a significant reduction in morbidity, cost and hospital stay, there is a need to perform high-quality studies to confirm the benefit of ERAS pathways in liver surgery. In conclusion, the proposed ERAS pathway for liver surgery

Anaesthesia 2015, 70, 1250–1258 doi:10.1111/anae.13155

Original Article

Effect of stroke volume variation-directed fluid management on blood loss during living-donor right hepatectomy: a randomised controlled study

S.-S. Choi,[1] I.-G. Jun,[2] S.-S. Cho,[3,4] S.-K. Kim,[5] G.-S. Hwang[6] and Y.-K. Kim[6]

ORIGINAL ARTICLE

Intraoperative monitoring of stroke volume variation versus central venous pressure in laparoscopic liver surgery: a randomized prospective comparative trial

HPB, 2016

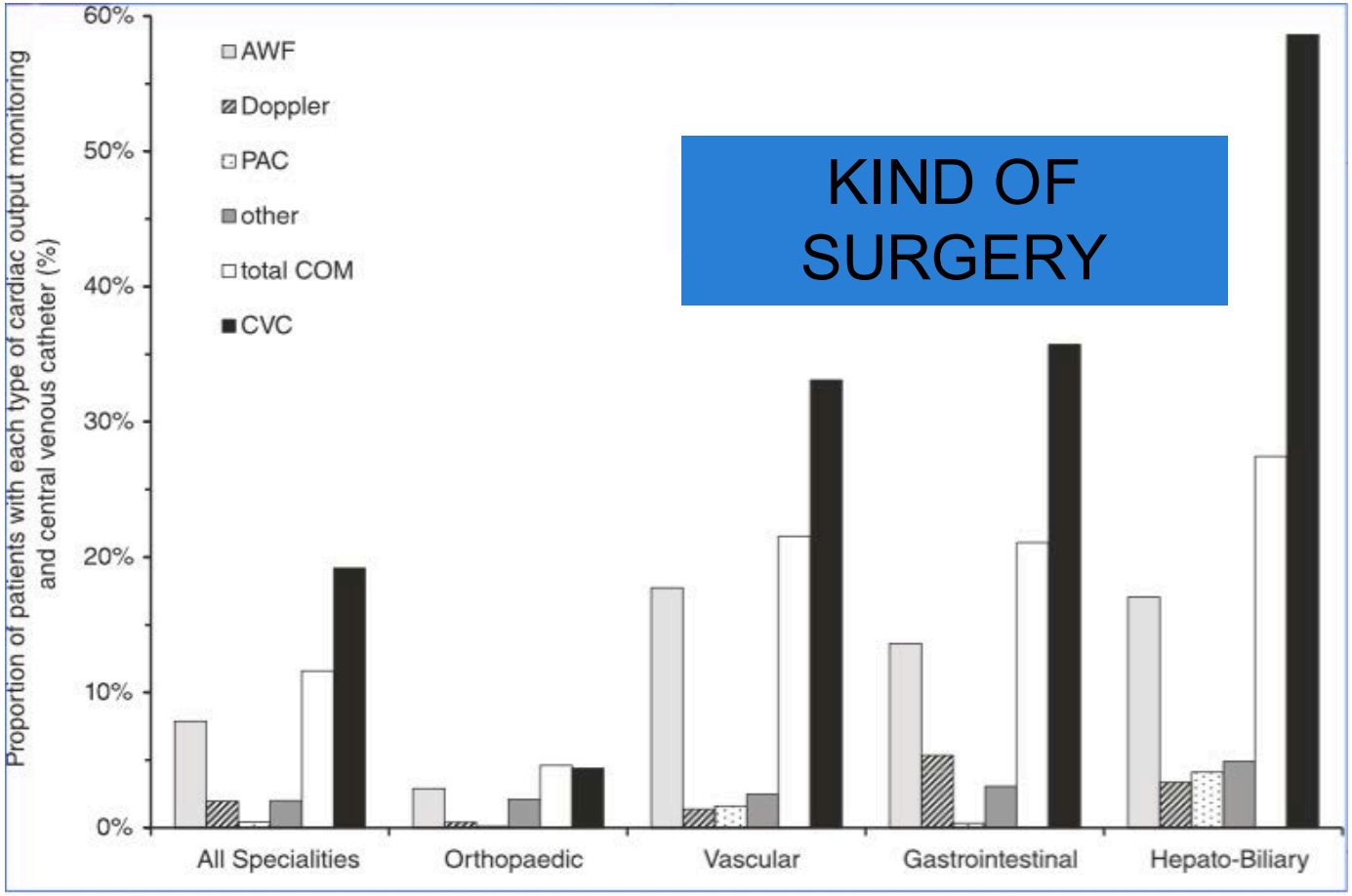
Francesca Ratti[1], Federica Cipriani[1], Raffaella Reineke[2], Marco Catena[1], Michele Paganelli[1], Laura Comotti[2], Luigi Beretta[2] & Luca Aldrighetti[1]

[1]Division of Hepatobiliary Surgery, and [2]Department of Anaesthesiology and Intensive Care, IRCCS San Raffaele Hospital, Milano, Italy

		SVV group (n = 45)	CVP group (n = 45)	p
Conversion, n (%)		3 (6.7)	8 (17.8)	0.02
Reason for conversion, n (%)				
	Haemorrhage	0 (0)	4 (8.9)	0.05
	Oncologic inadequacy	1 (2.2)	2 (4.4)	ns
	Anaesthesiological problems	0 (0)	1 (2.2)	ns
	Damage to the liver	1 (2.2)	0 (0)	ns
	Inadequate biliostasis	1 (2.2)	0 (0)	ns

		SVV group (n = 45)	CVP group (n = 45)	p
Pringle manoeuvre, n (%)				ns
	Not performed	19 (42.2)	24 (53.3)	
	Performed	26 (57.8)	21 (46.7)	
Length of surgery (min)	Mean ± SD	220 ± 50	210 ± 60	ns
Blood Loss (mL)	Mean ± SD	150 ± 100	300 ± 250	0.04
Associated procedures, n (%)				ns
	None	39 (86.7)	41 (91.1)	
	Colecistectomy	6 (13.3)	4 (8.9)	
Surgical margin, n (%)				ns
	R0	44 (97.8)	45 (100)	
	R1	1 (2.2)	0 (0)	
Surgical margin (mm)	Mean ± SD	8 ± 4	9 ± 6	ns
Intraoperative blood transfusions, n (%)				ns
	No	43 (95.6)	43 (95.6)	
	Yes	2 (4.4)	2 (4.4)	
Total blood transfusions, n (%)				ns
	No	43 (95.6)	41 (91.1)	
	Yes	2 (4.4)	4 (8.9)	
Morbidity, n (%)		5 (11.1)	6 (13.3)	ns
Grade of complications, n (%)				
Minor	I grade	1 (2.2)	1 (2.2)	ns
	II grade	2 (4.4)	3 (6.7)	ns
Major	IIIa grade	1 (2.2)	1 (2.2)	ns
Mortality, n (%)		0 (0)	0 (0)	ns
Functional recovery (days)	Median (range)	3 (1–6)	3 (1–7)	ns
Length of stay (days)	Median (range)	4 (2–10)	5 (3–13)	ns

Variation in haemodynamic monitoring for major surgery in European nations: secondary analysis of the EuSOS dataset



Potenziali Target nei passi Active e Control
INTRAOPERATORIO:

Stroke volume indicizzato >35 mL/min/m2
Gittata cardiaca indicizzata > 2.5 L/min/m2
DO2I > 600 mL/min/m2

Potenziali Target nel passo Keep
POSTOPERATORIO:
DO2I > 600 mL/min/m2
ScvO2/SvO2≥ 70%
Considerare ulteriore ottimizzazione se:
Diuresi < 1 mL/kg/h
Lattati > 2 mmol/L
ScvO2 < 65%

European Society of Anaesthesiology ESA

Evidence-based, perioperative Goal-Directed Therapy (GDT) protocols.

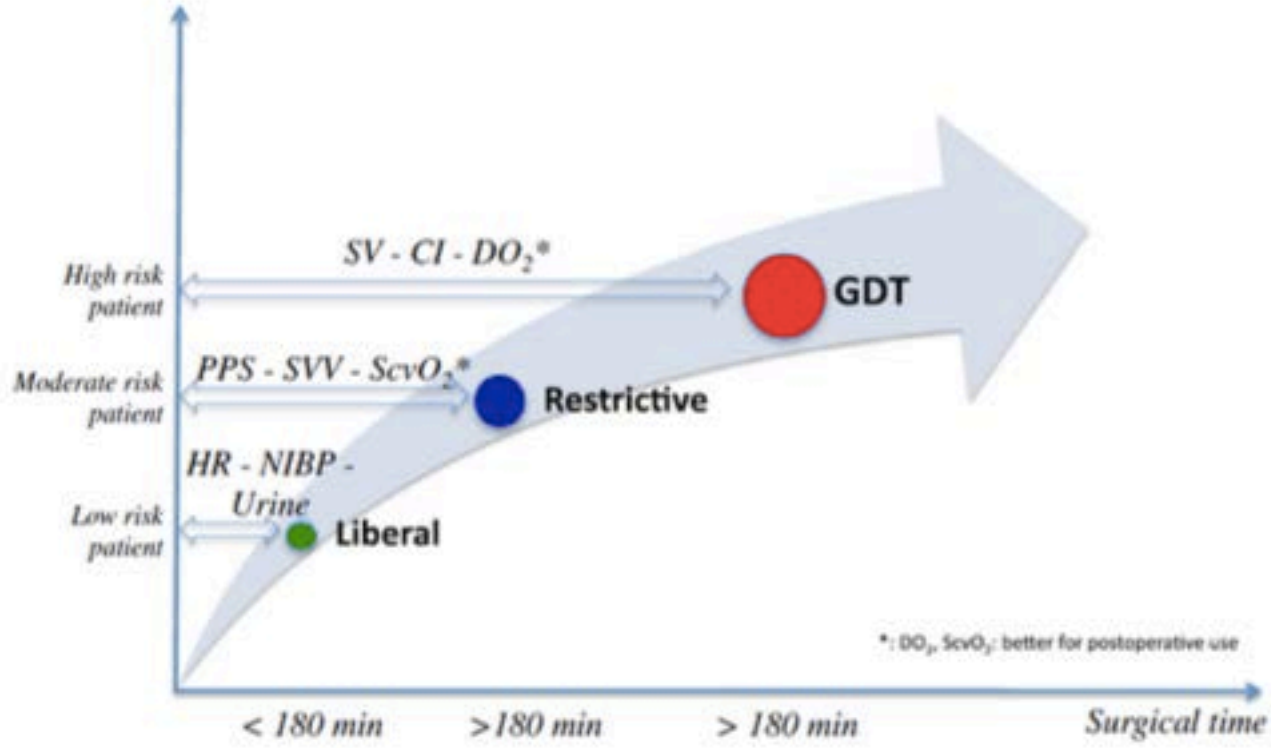
Several single centre randomized controlled trials, meta-analysis and quality improvement programs have shown that perioperative GDT decreases postoperative complications and hospital length of stay when compared to standard fluid management.[1-5]

This summary describes the three main perioperative GDT strategies which have been successfully used to decrease postoperative morbidity and length of stay:

- Stroke Volume (SV) optimization with fluid
- Oxygen Delivery Index (iDO_2) optimization with fluid and inotropes
- Pulse Pressure Variation (PPV) or Stroke Volume Variation (SVV) optimization with fluid

This summary does not recommend the use of any specific medical device, and the choice of the treatment protocol is left at the discretion of the anesthesiologist in charge.

Patient risk, monitoring, fluid goal and surgical time



Della Rocca *et al. BMC Anesthesiology* 2014, **14**:62

PERI-OPERATIVE MANAGEMENT

PRE-OPERATIVE>> RISK STRATIFICATION

INTRA-OPERATIVE>> MONITORING, GDT, FLUIDS, ERP

POST-OPERATIVE>> ANALGESIC PLAN

ANALGESIC PLAN

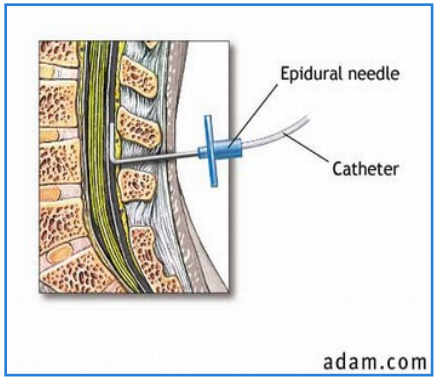
GENERAL ANAESTHESIA

CENTRAL BLOCKS

PERIPHERAL BLOCKS

CENTRAL BLOCKS

- EPIDURAL



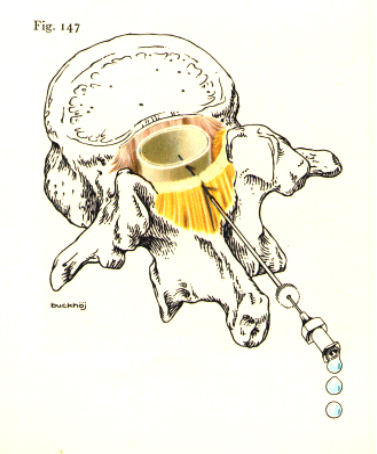
Thoracic
(T7-T8)

Grade A Evidence
(SIAARTI)

CP LA+ oppioid

Matot I, Anesth Analg 2002;

- SPINAL



Lombar

Morphine 0,2 mg

Sparing effect

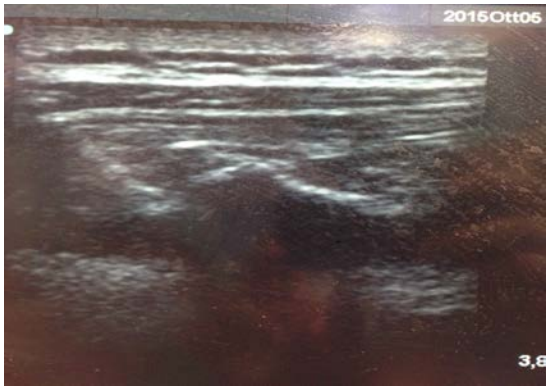
Sangwook Ko J, Liver Transplantation 2009

PERIPHERAL BLOCKS

- PARAVERTEBRAL THORACIC (PVB)

US guide (8-18 MHz)

Continuous block (catheter in T7) with c.p. of LA



Luyet, Br J Anaesth 2011

Luyet, Anaesthesiology 2012

Ho, Br J Rad 2008

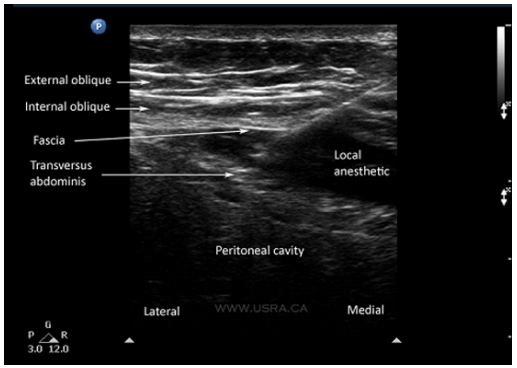
Culp WC, Br J Radiol 2011;

- TAP (Trasversus Abdominal Plane)

US guide (8-18 MHz) - bilateral

Classic / Subcostal

LA– sparing effect



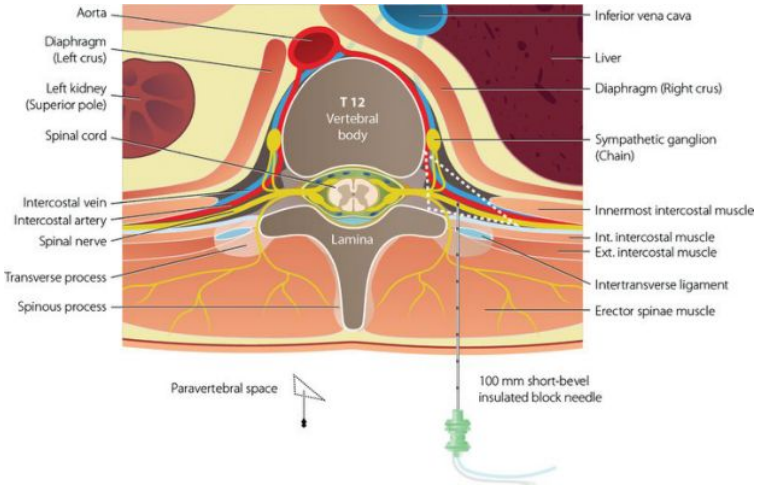
Br J Anesth 2011 e 2012

Clorectal Dis 2010;

Surg Endosc 2010;

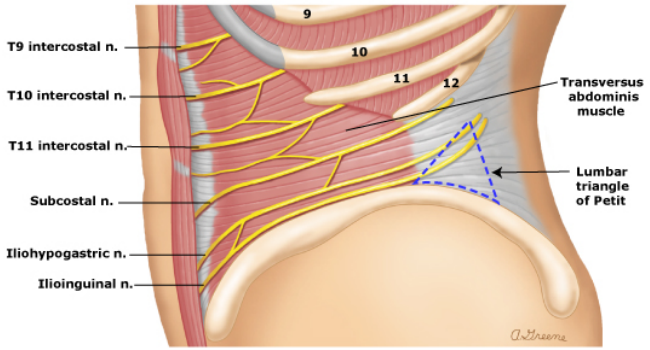
Borglum J et al., Acta Anaesth Scand 2011

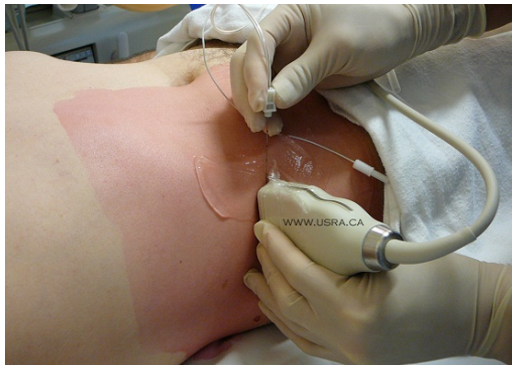
PVB



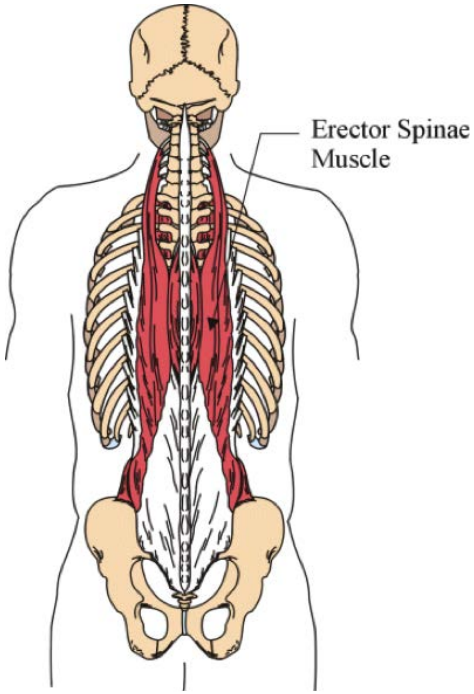
Reg Anesth and Pain Med – Vol 35, No. 2, 2010

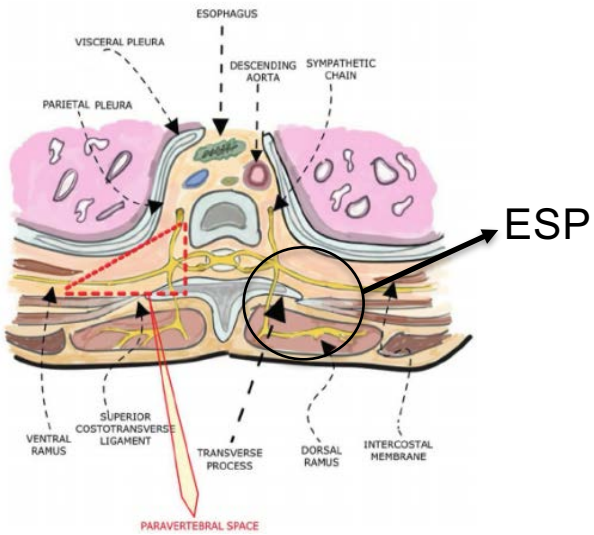
TAP BLOCK





PERIPHERAL BLOCKS:
ERECTOR SPINAE BLOCK





OSPEDALE SAN RAFFAELE

HEPATIC RESECTION: OUR PROTOCOL

ERAS

	Minor Open	Major Open	Laparoscopic	Perihilar
CVC	NO (note 2)	NO (note 2)	NO (note 2)	NO (note 2)
EV1000	YES	YES	YES	YES
ANESTHETIC PLAN	GEN. + PERIDURAL	GEN. + PVB	GEN. + SPINAL (+ TAP) Or GEN + ESP	GEN. + PVB
PARACETAMOL	1g x 3	1g x 2	1g x 3	1g x 2
TAPENTHADOL	NO	AS RESCUE	50 mg x 2	NO
NSAIDs	Ketorolac 30 mg ab (max 90 mg die) AS RESCUE	Ketorolac 30 mg ab (max 90 mg die) AS RESCUE	Ketorolac 30 mg ab (max 90 mg die) AS RESCUE	Ketorolac 30 mg ab (max 90 mg die) AS RESCUE
NGTube	NO	NO	NO	NO/YES
JEJUNOSTOMY	NO	YES (if MUST low)	NO	YES (if MUST low)

NOTE 2

CVC POSITIONING

Difficult peripheral venous finding:
obesity
oedema
Previuous chemotherapy

Severe comorbidities:
severe cardiomiopathy (ischaemic, dilatative, hypertrophic) to administer vasopressors (dopamine, norepinephrine, epinephrine)

Severe cirrhosis or patients with high risk to develop postoperative liver (in case of low platlet count it is advisable to insert CVC with US guide)

Intensive Care Med
DOI 10.1007/s00134-017-4814-0

Kahan BC, Koulenti D, Arvaniti K et al (2017) Relationship between critical care provision and mortality following elective surgery: prospective analysis of data from 27 countries. Intensive Care Med. doi:10.1007/s00134-016-4633-8

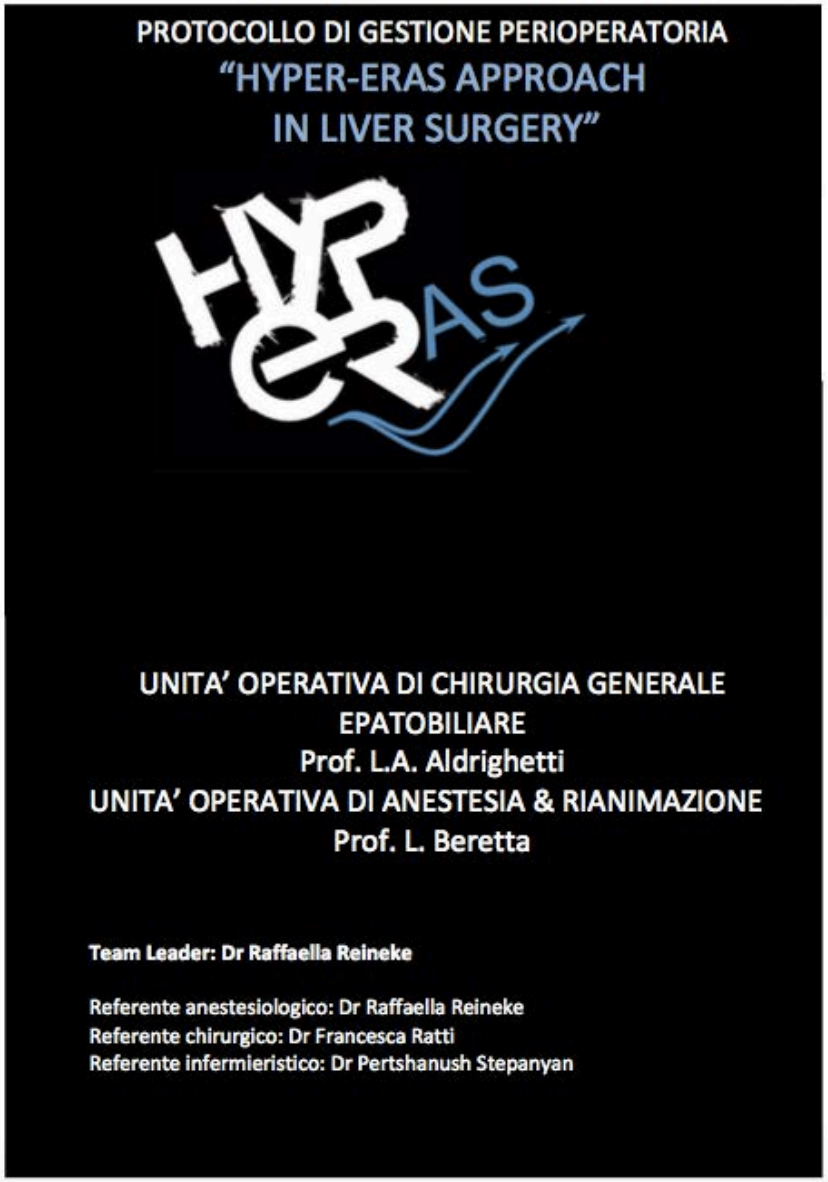
EDITORIAL

Do we really need postoperative ICU management after elective surgery? No, not any more!

Paolo Taccone[1]*, Thomas Langer[2] and Giacomo Grasselli[1]

efficient assistance to surgical patients. A postoperative "intermediate care" ward may represent a sufficiently safe environment for the majority of surgical patients, with a significant reduction in costs and ICU-related side effects. The resource-savings benefits of such a model may allow us to guarantee appropriate assistance to a larger number of patients, avoiding the selection biases related to unreliable preoperative risk assessment and unstandardized patient triage. Moreover, patient monitoring could be prolonged beyond the first postoperative days, when late complications (e.g., infections) are more likely to occur and are frequently under-recognized and undertreated.

What's next?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IN LIVER SURGERY"
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