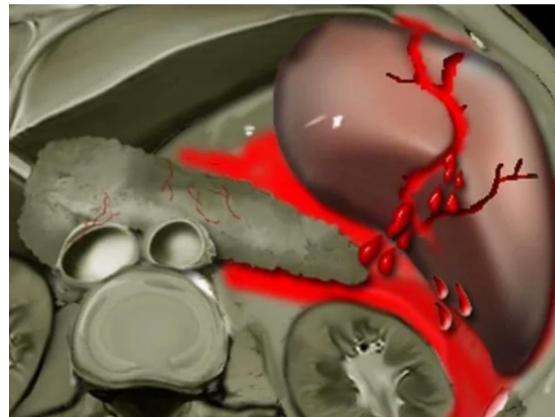




SURGICAL MANAGEMENT OF SPLENIC TRAUMA

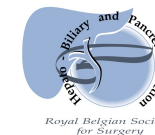


Alexandra Dili
CHU-UCL Namur, site Godinne



SURGICAL MANAGEMENT OF SPLENIC TRAUMA

PENETRATING *The Rule of 30%*



EXPLORATORY LAPAROTOMY

Negative 9-14%

Unnecessary 23-53% (stab wounds)

NOM in highly selected patients (Stab>gunshots)

Systematic review of PSI and NOM

608p with PSI, 20% of NOM

fNOM: 18%

Overall mortality 11% (NOM: 0%)

INDICATIONS FOR EXPLORATION

Signs of peritonitis/evisceration/impalement

Hemodynamic instability

Blood in NGT/rectum

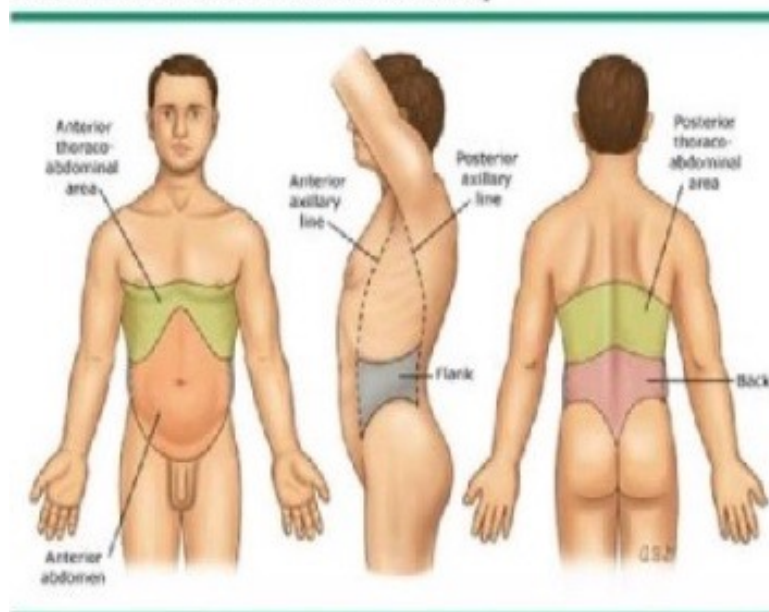
Spinal Injuries

Impaired mental status

Laparoscopic exploration

Pancreatic/colic/diaphragmatic injuries increase OM and mortality

Anatomic zones of the abdominal cavity



Coccolini et al WJ Emergency Surgery 2017

Teuben et al, Eur J Tr Em Surgery 2018

Demetriades et al, Ann Surg 1987

Velmahos et al, Ann Surg 2001

Renz et al, J Trauma 1994

Inaba et al, J Trauma 2010

Zafar et al, Br J Surg 2012

SURGICAL MANAGEMENT OF SPLENIC TRAUMA

BLUNT

Shift from OM to NOM

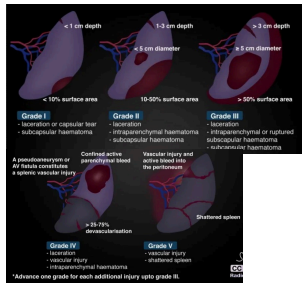
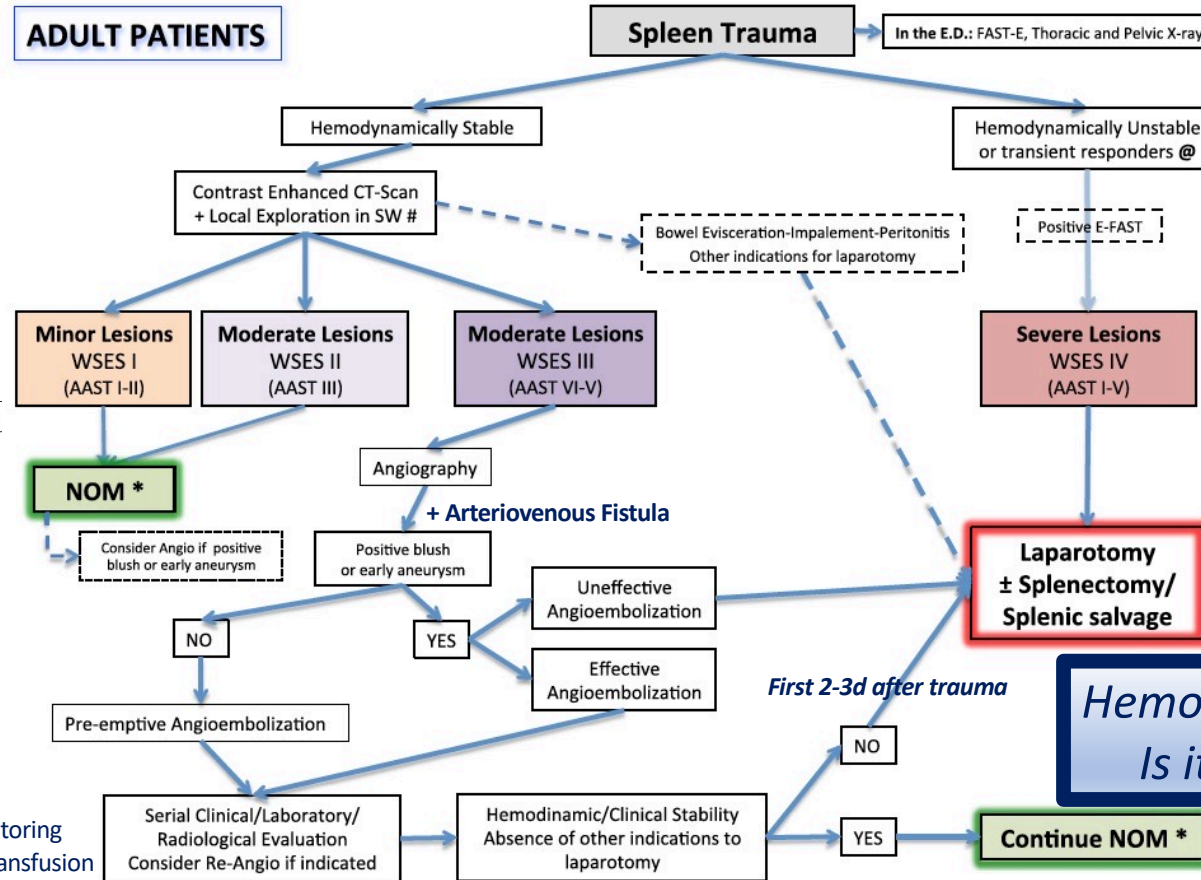


Table 1 AAST Spleen Trauma Classification

Grade	Injury description
I	Hematoma Laceration Subcapsular, < 10% surface area Capsular tear, < 1 cm parenchymal depth
II	Hematoma Laceration Subcapsular, 10-50% surface area Intraparenchymal, < 5 cm diameter 1-3 cm parenchymal depth not involving a parenchymal vessel
III	Hematoma Laceration Subcapsular, > 50% surface area or expanding Ruptured subcapsular or parenchymal hematoma Intraparenchymal hematoma > 5 cm > 3 cm parenchymal depth or involving trabecular vessels
IV	Laceration Laceration of segmental or hilar vessels producing major devascularization (> 25% of spleen)
V	Laceration Vascular Completely shatters spleen Hilar vascular injury which devascularized spleen

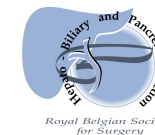
Table 3 WSES Spleen Trauma Classification for adult and pediatric patients

	WSES class	Mechanism of injury	AAST	Hemodynamic status ^a
Minor	WSES I	Blunt/penetrating	I-II	Stable
Moderate	WSES II	Blunt/penetrating	III	Stable
	WSES III	Blunt/penetrating	IV-V	Stable
Severe	WSES IV	Blunt/penetrating	I-V	Unstable



NOM
Facility for monitoring
Possibility for transfusion
Manpower

SURGICAL MANAGEMENT OF SPLENIC TRAUMA SPLENIC TRAUMA



HEMODYNAMIC INSTABILITY (ATLS)

SBP < 90 mmHg
 SBP > 90 mmHg but bolus infusions/transfusions/vasopressive drugs
 HR > 120 bpm
 Skin vasoconstriction (cool, clammy, decreased capillary refill)
 Altered level of consciousness
 Shortness of breath

+/- BE > -5 mmol/l
 +/- Shock Index (HR/SBP) > 1
 +/- transfusion requirements > 4-6 units PRBC in the first 24h
 Transient responders

Keep algorithms simple

Shock Index = Heart Rate / Systolic Blood Pressure

SI > 0,9 → Critical bleeding (Start MTP)

Evolution of SI > 0,3 ⇒ Mortality 5x

< 0,6: no shock → MT 3% / Mortality 10%
 > 0,6 - < 1: mild shock → MT 10% / Mortality 10%
 > 1 - < 1,4: moderate shock → MT 30% / Mortality 23%
 > 1,4: severe shock → MT 60% / Mortality 40%

Definition of hemodynamic stability in blunt trauma patients: a systematic review and assessment amongst Dutch trauma team members

S. A. I. Loggers¹ · T. W. A. Koedam¹ · G. F. Giannakopoulos¹ · E. Vandewalle² · M. Erwteman³ · W. P. Zuidema¹

Table 1 Top 5 used definitions of hemodynamic instability with corresponding cut-off points

	Parameters	Cut-off points	Freq.	% of studies
1	Only SBP	< 80–100 mmHg at admission	13	27.6
2	SBP and Response to Fluid resuscitation PRBC	< 90 mmHg or a PRBC > 1–2–6 PRBC	12	25.5
3	SBP and HR	< 90 mmHg at admission > 100–130 bpm at admission	10	21.3
4	SBP and HR and	< 90 mmHg at admission or > 100–120 bpm at admission or	4	8.5
5	Res Fluid SB SI Tot			

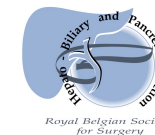
TIMING?

Dutch Trauma Center Study
Lack of consensus

Parameter(s) ?
 Cut-offs (SBP/HR/RR/Hb)?
 Timing?

*Emergency Surgery 2017
 Journal of Emergency Surgery 2017
 Critical Care 2013
 Critical Care 2013
 Mutschler et al, Resuscitation 2013
 Koch et al, Emergency Medicine 2019*

SURGICAL MANAGEMENT OF SPLENIC TRAUMA



NOM Failure rate 4-15%

PROGNOSTIC FACTORS fNOM

Grade of Splenic injury > IV (III for AE) **debated**

Age > 55yo **debated**

Large hemoperitoneum

Hypotension before resuscitation

GCS < 12 **debated**

Low Hc level at admission

Blood clotting disorders (Anticoagulation drugs)

Blush (location/size matters: intraperitoneal) **debated**
(only if AG/AE not available)

Drug addiction

Cirrhosis (MELD > 17)

High ISS (> 25 or?)

Arteriovenous fistula (fNOM 60%)

Pseudoaneurysm

Need for RBC transfusion in the ED

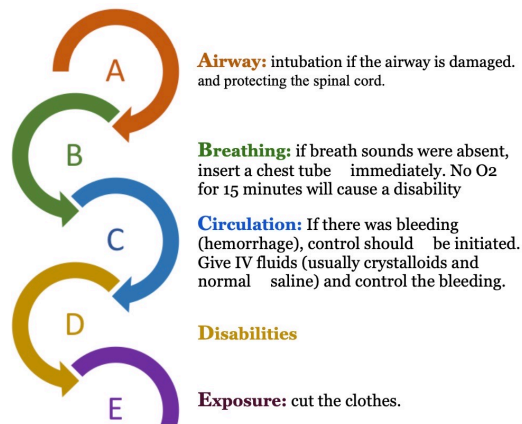
OPERATIVE MANAGEMENT

- **Hemodynamic instability +/- associated lesions (GoR2A)**
Peritonitis, Bowel evisceration, Impalement
- **Stable patients if intensive monitoring (+/-AG/AE) not available (GoR 2A)**
- **fNOM (+AG/AE) + hemodynamic instability/drop Hc/Transfusion (GoR2A)**
- **Severe spinal or brain injury? *Debated* if AE available**

Injury Severity Score (ISS)

Body Region	Score	Abbreviated Injury Scale (AIS)
Head	1	Minor
Face	1	Minor
Neck	2	Moderate
Thorax	3	Serious
Abdomen	3	Serious
Spine	4	Severe
Upper Extremity	5	Critical
Lower Extremity	5	Critical
External and other	6	Unsurvivable

SURGICAL MANAGEMENT OF SPLENIC TRAUMA EXAMINATION



➤ Primary Survey: ABCDE

➤ Secondary Survey: History (Blunt/penetrating) Physical examination

Left lower rib tenderness

LUQ bruising or abrasion

Kehri's sign

Ballance's sign: LUQ mass/dull percussion (hematoma)

Abdominal generalized tenderness

General status

Confusion/dizziness/ anxiety

Paleness/ Fainting

Shock



SURGICAL MANAGEMENT OF SPLENIC TRAUMA

CATASTROPHIC SCENARIO

High hemodynamic instability

EMERGENCY ROOM

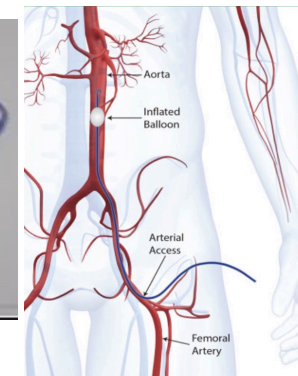
G-suit (pneumatic device for external compression)

IV access: femoral vein catheter/artery lines

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA)

Activation of Massive Transfusion Protocols

Aggressive Hemostatic Resuscitation



OPERATIVE ROOM = DAMAGE CONTROL LAPAROTOMY

Do not take out the anti-G device

Limit heat loss

(OR > 25°C), warm fluids, forced air convective heating blanket,...

Midline incision

No REBOA => CLAMP of the Aorta

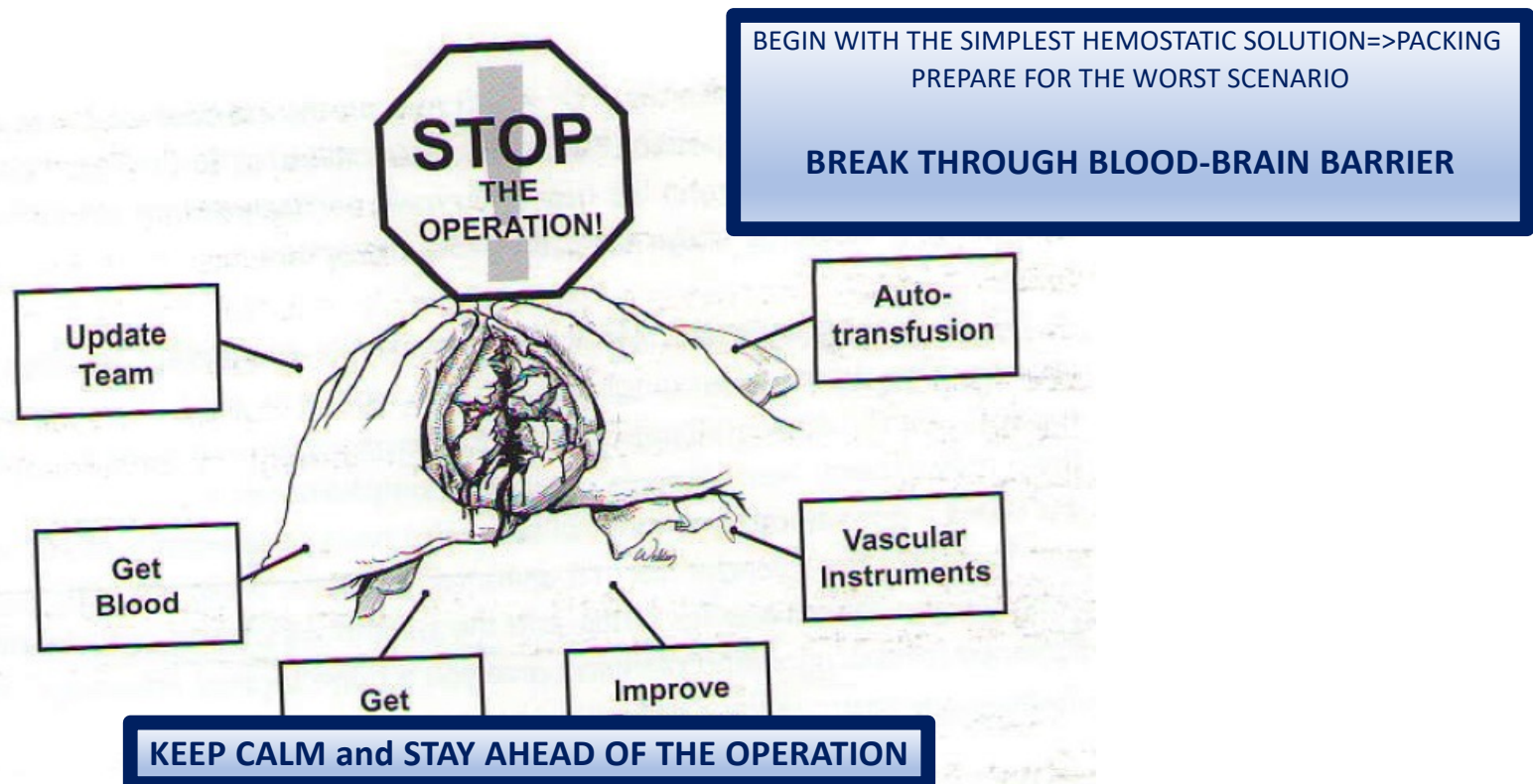
Control Bleeding/contamination



Weber et al, BJS 2014
Cirrochi et al, Cochrane 2013
Thraiklill et al, Scan J Trauma 2021
Seerna et al, Colombia Medica 2021

SURGICAL MANAGEMENT OF SPLENIC TRAUMA

CATASTROPHIC SCENARIO

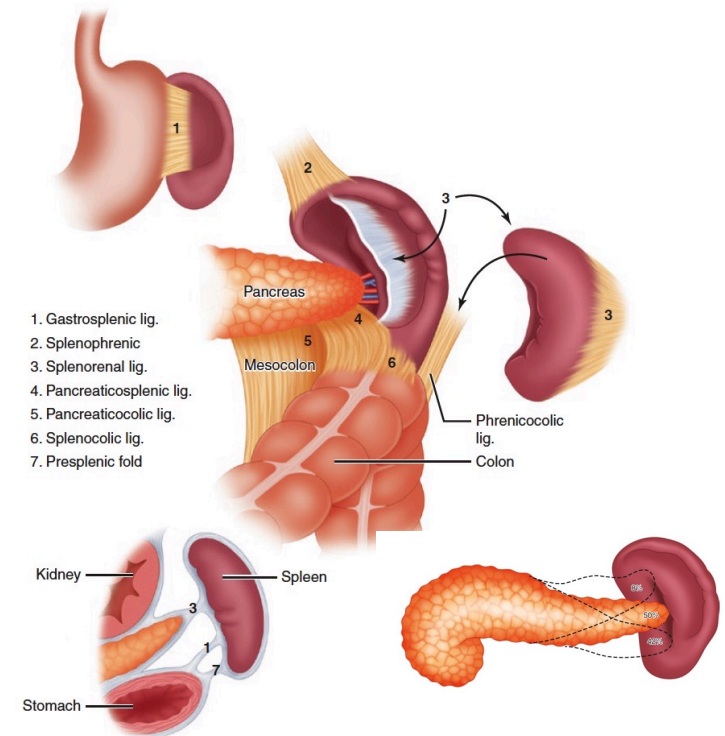
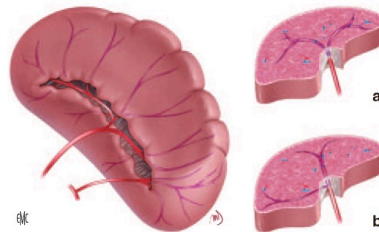
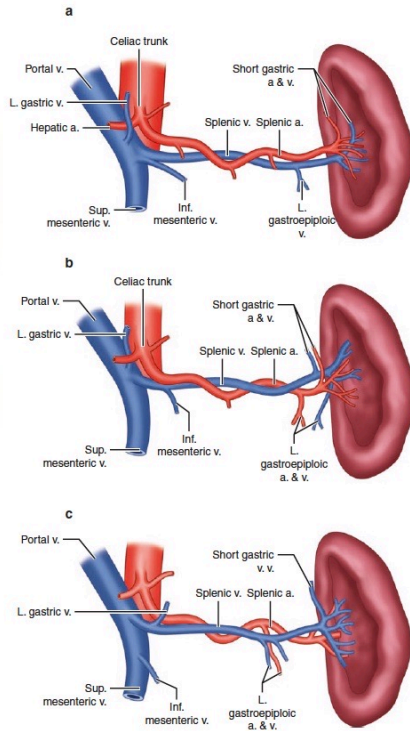


Whenever you encounter massive bleeding, the first thing to remember is: it's not your blood.

~ Raphael Adar, MD, FACS

Hirshberg and Mattox, TOP KNIFE textebok

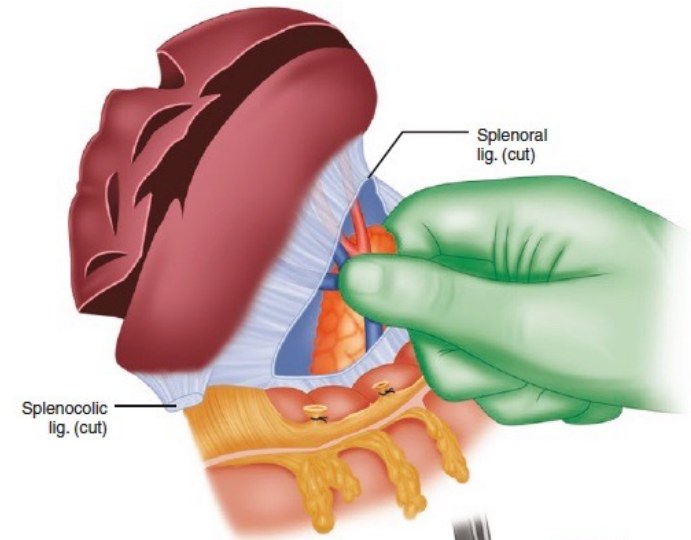
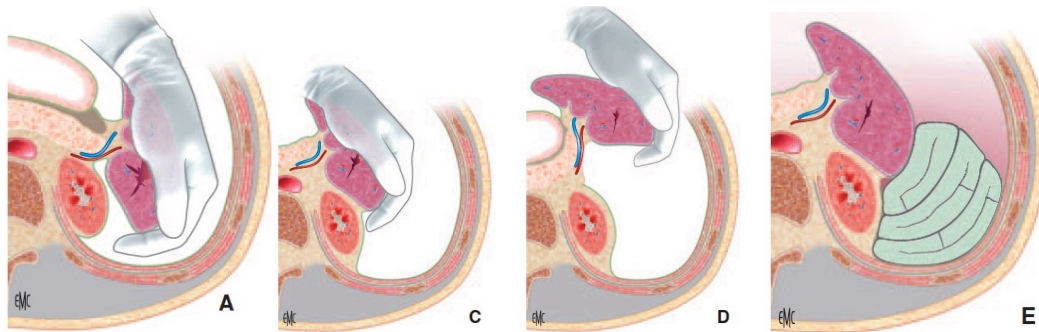
SURGICAL MANAGEMENT OF SPLENIC TRAUMA THE ANATOMY



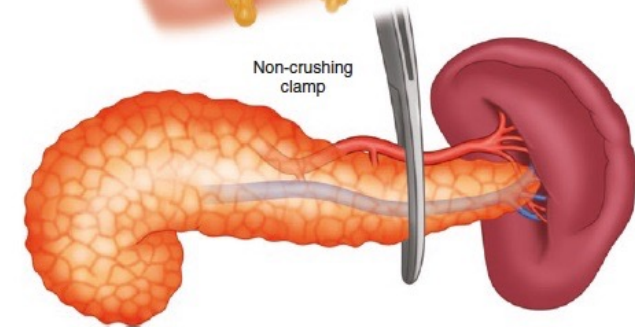
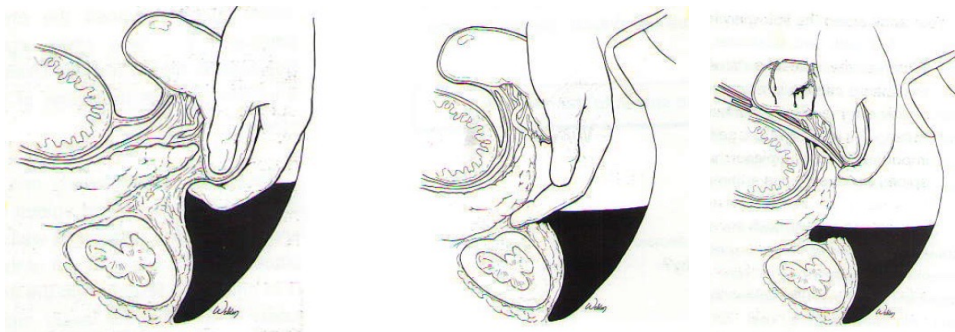
The peritoneum covers the spleen, except in the hilum

SURGICAL MANAGEMENT OF SPLENIC TRAUMA SURGICAL TECHNIQUE

The mobile spleen



The stuck spleen



Skandalakis, *Surgical anatomy and technique*
EMC
Hirshberg and Mattox, *TOP KNIFE* textebok

**SURGICAL MANAGEMENT OF SPLENIC TRAUMA
SURGICAL TECHNIQUE**



**REMOVE or REPAIR?
PRESERVE AN ORGAN=PRESERVE A LIFE**

FOUR QUESTIONS

Trauma burden

Age

Injury

Experience

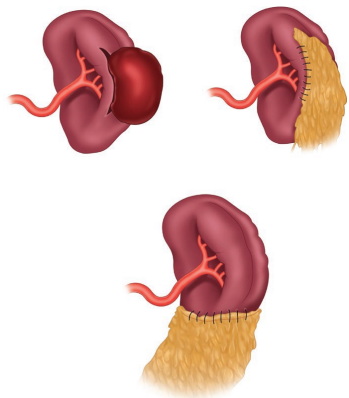
**Never make the decision with the spleen in situ
Repair should not entail additional blood loss**

Completing the splenectomy is not a crime!

SURGICAL MANAGEMENT OF SPLENIC TRAUMA
SURGICAL TECHNIQUE
PARENCHYMAL SAVING TECHNIQUES
THE LOST ART IN THE MODERN ERA

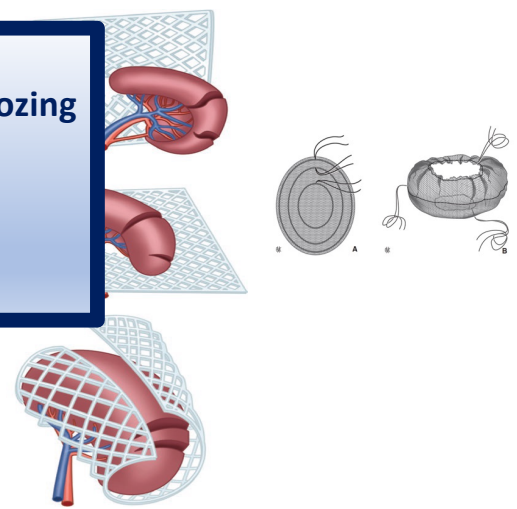
INDICATIONS

- Hemodynamic stability
- Laparotomy due to other associated injuries (penetrating trauma)
- No acidosis, coagulopathy, hypothermia
- No candidates for damage control laparotomy



Don't persist if your repair doesn't work
Don't rely on patient's clotting mechanism to stop ongoing oozing
« if it ain't dry, it's not working! »

One attempt should work, if not....a second????
A third attempt is playing with fire!



SPLENORRHAPHY

PARTIAL SPLENECTOMY

SPLENIC MESH WRAP

Ako et al, The American Surgeon 2021
Skandalakis Handbook
Hirshberg and Mattox, Top Knife Handbook

SURGICAL MANAGEMENT OF SPLENIC TRAUMA SPLENIC AUTOTRANSPLANTATION

REVIEW ARTICLE



ANZJSurg.com

Splenic autotransplantation: a systematic review

Arthavan Surendran[□],* Marty Smith,[†] Nezor Houli,[†] Val Usatoff,^{††} Denis Spelman[§] and Julian Choit

*Department of Surgery, Western Health, Melbourne, Victoria, Australia

[†]Department of Upper Gastrointestinal/Hepatobiliary Surgery, Western Health, Melbourne, Victoria, Australia

^{††}Department of Surgery, The University of Melbourne, Melbourne, Victoria, Australia and

[§]Department of Infectious Diseases, The Alfred, Melbourne, Victoria, Australia

SAFE , SIMPLE, and minimal complications

NO CONSENSUS

- location of implantation (Omentum>retroperitoneum)
- how to prepare the harvested splenic tissue (spleen slices?)
- critical mass to transplant (animal studies: 25% of the initial volume?)

Splenic Function?

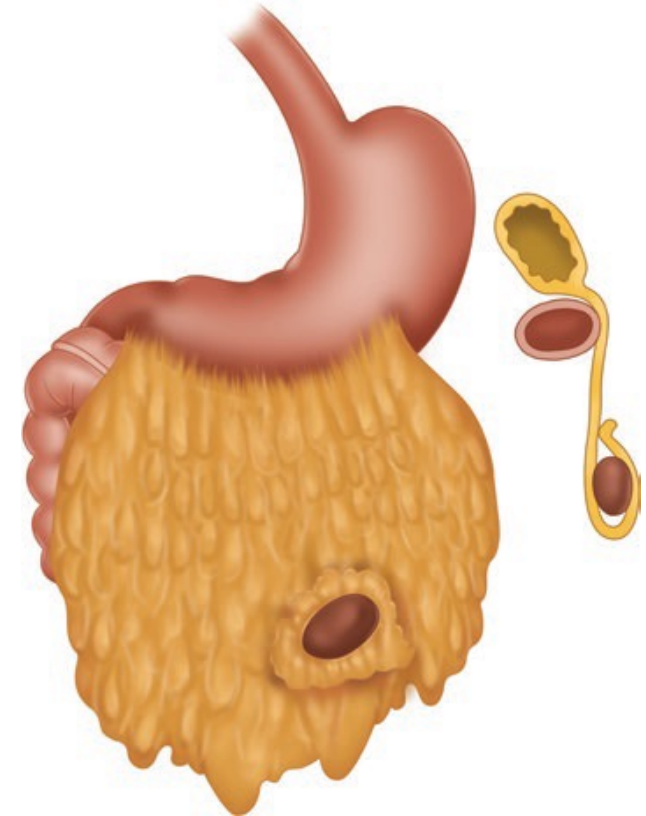
Viable splenic tissue: **YES**

Parafollicular lymphoid cells (Immunological function? : Ig (M, G): **NO**

BUT

Case reports with Humans with splenosis and OPSI

Protection against OPSI: no evidence



SURGICAL MANAGEMENT OF SPLENIC TRAUMA LAPAROSCOPIC EXPLORATION



Surgery Today (2021) 51:1075–1084
<https://doi.org/10.1007/s00595-020-02177-2>

REVIEW ARTICLE

CASE SERIES or Comparative Retrospective Studies

INDICATIONS:

reduced surgical trauma and better cosmetic effect
 Complete exploration of the abdomen

Hemodynamically stable patients
 fNOM

Suspicion of hollow viscus injury or diaphragmatic rupture
 Mostly >24h after trauma

WSES 2018:

Laparoscopic splenectomy in early trauma scenario in bleeding patients is not recommended (GoR2A)

Laparoscopic surgery for splenic injuries in the era of non-operative management: current status and future perspectives

Table 2 Summary of relevant data extracted from published studies

Authors	Year	Type of article	Total cases	Cases treated with laparoscopy	Type of performed intervention (laparoscopic)	Mean operative time in laparoscopy (min)	Conversion rate	Mean in hospital LOS (days)	Complications rate	Mortality	Embolization
Nasr et al.	2004	Comparative retrospective study	4	4	Splenectomy: 4; Partial splenectomy: 0; others: 0	175	0%	5.5	25%	0%	0
Huscher et al.	2006	Case series	111	11	Splenectomy: 6; partial splenectomy: 1; others: 4	177	9%	15.2	18.2%	0%	0
Ranson et al.	2009	Comparative retrospective study	11	4	Splenectomy: 4; partial splenectomy: 0; others: 0	140	0%	4.5	0%	0%	11
Carobbi et al.	2010	Case series	12	12	Splenectomy: 10; partial splenectomy: 0; others: 2	115	0%	5.6	8.3%	0%	0
Yahya et al.	2013	Case series	18	18	Splenectomy: 4; partial splenectomy: 0; others: 14	Not reported	5.5%	3.8	0%	0%	0
Huang et al.	2013	Case series	52	11	Splenectomy: 11; partial splenectomy: 0; others: 0	Not reported	Not reported	9.64	9.1%	0%	Not reported
Li et al.	2017	Comparative retrospective study	41	41	Splenectomy: 20; partial splenectomy: 21; others: 0	116	0%	5	19.5%	0%	Not reported
Shamim et al.	2018	Comparative retrospective study	25,521	113	Splenectomy: 113; partial splenectomy: 0; others: 0	Not reported	Not reported	9	19.5%	14.2%	Not reported

LOS length of stay

Fransvea et al, J Min Access Surgery 2019
Romeo et al, Surgery Today 2021

SURGICAL MANAGEMENT OF SPLENIC TRAUMA POST-OPERATIVE COURSE

IMMEDIATE POSTOPERATIVE COURSE

THROMBOPROPHYLAXIS

Mechanical prophylaxis is safe

Spleen trauma without ongoing bleeding is not CI to LMWH-based prophylactic anticoagulation (POD2-4)

FOLLOW UP

Bed rest 48-72h

COMPLICATIONS

EARLY:

Bleeding (3%)

Visceral fistula (colic <0,5%, pancreatic 7%)

Thrombocytosis

Abscess

Thrombotic complications

LATE:

Overwhelming post-splenectomy infection (OPSI)

Incidence: 0,5-2%

Mortality 30-70%



OPSI even in the presence of accessory spleen

SURGICAL MANAGEMENT OF SPLENIC TRAUMA INFECTION PROPHYLAXIS



Table 5 Vaccinations and antibiotic prophylaxis after splenectomy or hyposplenic status

Vaccination after splenectomy or in hyposplenic status	Pneumococcal	Meningococcal	<i>H. influenzae</i> B	Seasonal flu						
Vaccination in adults and children > 24 months (unless they have already been fully vaccinated earlier in life for the bacteria considered).	1 dose of PCV13 and 1 dose of PPSV23 after at least 8 weeks. Some authors recommend a second PPSV23 dose, after 5 years from the first	1 dose of Meningococcal ACWY conjugated vaccine. A series of 2 doses of Meningococcal B vaccine at least 1 month apart.	1 dose	1 dose annually						
Antibiotic prophylaxis after splenectomy or in hyposplenic status	<p>Lifelong prophylactic antibiotics should be offered to patients considered at continued high risk: aged less than 6 years or greater than 50 years, or</p> <ol style="list-style-type: none"> 1) Having inadequate serological response to pneumococcal vaccination, or 2) With a history of previous invasive pneumococcal disease, or 3) Splenectomized for underlying haematological malignancy particularly in the context of on-going immunosuppression <p>Suggested regimens:</p> <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td>Birth to 3rd month</td> <td>AMX/CLA or AMX 10 mg/Kg BID</td> </tr> <tr> <td>3rd month–5 years</td> <td>AMX 10 mg/Kg BID</td> </tr> <tr> <td>> 5 years and adults</td> <td>AMX 250 mg BID</td> </tr> </tbody> </table> <p>For penicillin allergic patients, probably TMP/SMX is the best option, but this should be discussed case-by-case, according also to the type of allergy in cause.</p>				Birth to 3rd month	AMX/CLA or AMX 10 mg/Kg BID	3rd month–5 years	AMX 10 mg/Kg BID	> 5 years and adults	AMX 250 mg BID
Birth to 3rd month	AMX/CLA or AMX 10 mg/Kg BID									
3rd month–5 years	AMX 10 mg/Kg BID									
> 5 years and adults	AMX 250 mg BID									

PCV13 is a tridecavalent conjugated pneumococcal vaccine, and *PPSV23* is a 23-valent polysaccharide pneumococcal vaccine. *AMX* Amoxicillin, *AMX/CLA* Amoxicillin/clavulanic, *TMP/SMX* cotrimoxazole

INFORM YOUR PATIENT!

TAKE HOME MESSAGE

OM in hemodynamically instable patients+/-associated injuries

Time is a luxury

Simplify complexe situations

Be technically flexible

Consider age, trauma burden, injury, experience

Don't persiste if spleen preservation doe not work

The spleen is a usefull but « take-outable » organ

Inform you patient



THANK YOU FOR YOUR ATTENTION