

# **Guidelines for the Performance of Minimally Invasive Splenectomy Supplementary Materials**

## **Appendix A- List of contributors**

### **Panelists**

Vamsi V. Alli  
Joseph Broucek

Andre Campbell  
Michael Cripps  
Rebecca Dirks (non-voting)  
Stephen Haggerty  
Celeste Hollands  
Tammy Kindel  
Robert Lim  
Aurora Pryor  
Kim Ritchey  
Amelia Collings (non-voting)  
Stefan Scholz  
Dimitrios Stefanidis  
Danielle Walsh  
Bradley Zagol

### **Methodologists**

Ahmed M. Abou-Setta  
Mohammed T. Ansari

### **Additional splenectomy working group members**

Ziad Awad  
Francisco Quinteros  
Jake Whiteside

## **Appendix B- full declarations of conflicts of interest**

**Conflicts of Interest and disclosures.** All conflicts of interest and disclosures were assessed as not having influenced the construction of these Guidelines.

Ahmed M. Abou-Setta- Nothing to disclose

Vamsi V. Alli- Nothing to disclose

Mohammed T. Ansari- Nothing to disclose

Ziad Awad- Nothing to disclose

Joseph Broucek-Nothing to disclose

Andre Campbell- Nothing to disclose

Amelia Collings- partial salary support by SAGES

Michael Cripps- Nothing to disclose

Rebecca Dirks- Equity in Johnson & Johnson

Stephen Haggerty- Nothing to disclose

Celeste Hollands- Nothing to disclose

Tammy Kindel- Nothing to disclose

Robert Lim- Consultant for UpToDate, Inc.

Aurora Pryor- Speaker for Ethicon, Gore, Merck, Stryker; Scientific advisory board for Obalon

Francisco Quinteros- Consultant for Applied Medical, Medtronic, and THD America

Kim Ritchey- Nothing to disclose

Stefan Scholz- Nothing to disclose

Dimitrios Stefanidis- Nothing to disclose

Danielle Walsh- Nothing to disclose

Jake Whiteside- Nothing to disclose

Bradley Zagol- Nothing to disclose

## Appendix C Evidence Table Framework

### Question 1

Should preoperative imaging vs. no imaging be used for ITP patients getting laparoscopic splenectomy?	
<b>POPULATION:</b>	Patients with ITP undergoing laparoscopic splenectomy
<b>INTERVENTION:</b>	Preoperative imaging
<b>COMPARISON:</b>	No preoperative imaging
<b>MAIN OUTCOMES:</b>	Without evidence: Length of hospital stay/return to work, transfusion requirements, estimated blood loss, operative time, 30d mortality, 30d disease remission, cost difference/effectiveness to patients.
<b>PERSPECTIVE:</b>	Patient/surgeon

### Assessment

Desirable Effects (for preoperative imaging) How substantial are the desirable anticipated effects?		
Judgement	Research evidence	Additional considerations
<ul style="list-style-type: none"> <li>○ Trivial</li> <li>● Small</li> <li>○ Moderate</li> <li>○ Large</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<p>Multiple non-randomized studies addressed the question of preoperative imaging versus laparoscopy (intraoperative identification) in laparoscopic splenectomy for either mixed diseases, hematologic diseases, or ITP alone [1-4], but none addressed the question of imaging versus no imaging as all patients underwent preoperative CT scan and the surgeon was either explicitly [1-3] or implicitly [4] aware of the imaging results. A systematic review on the prevalence of accessory spleen using different investigative studies also does not answer this question given an unknown and likely varying population prevalence of accessory spleen [5].</p>	<p>The original key question had multiple outcomes that would address the efficacy of preoperative imaging, however, no evidence appropriately addressed any of the outcomes, and judgements were based on expert opinion. The panel opined that there was expected desirable effects of preoperative imaging for patients with ITP. A small proportion of accessory spleens may be found by imaging which would otherwise not have been found during laparoscopy [1]. The sensitivity is expected to be low given preoperative imaging has shown either worse sensitivity [1,2,4] or at best similar sensitivity [3] as laparoscopy. However, preoperative imaging likely prompts further intraoperative exploration and results in some degree of additional accessory spleen discovery. The degree of benefit of pre-operative imaging for additional spleen discovery is unknown. Any increase in the ability to detect accessory spleens pre-operatively is beneficial considering that laparoscopy does not find all accessory spleens and missing accessory spleens can lead to inferior clinical outcomes in ITP. Additionally, preoperative imaging may give important information about the anatomy of the spleen in select cases to aid operative planning and increase safety of the operation [3]. The potential clinical benefits of preoperative imaging were deemed small in magnitude by the panel.</p>

<b>Undesirable Effects (for preoperative imaging)</b> How substantial are the undesirable anticipated effects?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ Large</li> <li>○ Moderate</li> <li>● Small</li> <li>○ Trivial</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	As above, there is no research evidence available that directly addresses this key question.	Panel expert opinion was that the expected undesirable effects from preoperative imaging would be small for patients with ITP. Undesirable effects include greater cost and additional radiation exposure from the preoperative imaging. The dose of radiation from a CT scan can vary greatly as can its risk. In a 2009 study on associated lifetime attributable risk of cancer from common CT scans, a range of approximately 400-1400 people getting a CT abdomen and pelvis were needed to incur 1 radiation induced cancer [6]. In pediatric populations, the risk from radiation exposure was greater than adults per scan. These risks can become trivial if ultrasound or MRI is used. Children CT scans should be done using pediatric settings/packages (ALARA) [7].
<b>Certainty of evidence</b> What is the overall certainty of the evidence of effects?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ Very low</li> <li>○ Low</li> <li>○ Moderate</li> <li>○ High</li> <li>● No included studies</li> </ul>	Given the above critical flaws, no studies were included for decision-making for this key question.	Expert opinion informed decision-making.
<b>Values</b> Is there important uncertainty about or variability in how much people value the main outcomes?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ Important uncertainty or variability</li> <li>● Possibly important uncertainty or variability</li> <li>○ Probably no important uncertainty or variability</li> <li>○ No important uncertainty or variability</li> </ul>		The panel used their own experiences with patients to gauge the true variation in how much people value the main outcomes that could be influenced by preoperative imaging before laparoscopic splenectomy.
<b>Balance of effects</b> Does the balance between desirable and undesirable effects favor the intervention or the comparison?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>

<ul style="list-style-type: none"> <li>○ Favors the comparison (no imaging)</li> <li>○ Probably favors the comparison</li> <li>○ Does not favor either the intervention or the comparison</li> <li>● <b>Probably favors the intervention</b></li> <li>○ Favors the intervention</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		Expert opinion was that the desirable and undesirable effects would both be small for preoperative imaging before splenectomy in patients with ITP, but that the desirable effects would slightly outweigh the undesirable effects.
<b>Acceptability</b>		
Is the option from balance of effects acceptable to key stakeholders?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ No</li> <li>○ Probably no</li> <li>● <b>Probably yes</b></li> <li>○ Yes</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		Both options favored in the balance of effects were deemed probably acceptable by the panel. Preoperative imaging is already common and accepted by many surgeons, as is performing splenectomy for ITP without preoperative imaging.
<b>Feasibility</b>		
Is the option from balance of effects feasible to implement?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ No</li> <li>○ Probably no</li> <li>○ Probably yes</li> <li>● <b>Yes</b></li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		Both options are feasible. Preoperative imaging is almost universally available and is easy to implement.

## Summary of judgements

	JUDGEMENT						
DESIRABLE EFFECTS	Trivial	<b>Small</b>	Moderate	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	<b>Small</b>	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	Very low	Low	Moderate	High			<b>No included studies</b>
VALUES	Important uncertainty or variability	<b>Possibly important uncertainty or variability</b>	Probably no important uncertainty or variability	No important uncertainty or variability			

	JUDGEMENT						
BALANCE OF EFFECTS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	<b>Probably favors the intervention</b>	Favors the intervention	Varies	Don't know
ACCEPTABILITY	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know
FEASIBILITY	No	Probably no	Probably yes	<b>Yes</b>		Varies	Don't know

### Type of recommendation

Strong recommendation against the intervention ○	Conditional recommendation against the intervention ○	Conditional recommendation for either the intervention or the comparison ○	<b>Conditional recommendation for the intervention</b> ●	Strong recommendation for the intervention ○
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### Conclusions

#### Recommendation

The panel suggests that preoperative imaging may be beneficial for patients with ITP scheduled for laparoscopic

#### Justification

There are both small but present desirable and undesirable effects according to expert opinion, though the desirable effects were felt to outweigh the undesirable effects. Preoperative imaging can be helpful in surgical management of ITP if an accessory spleen is identified and may yield important information about splenic anatomy to aid operative planning. However, the absence of accessory spleen(s) on preoperative imaging does not abdicate the need for exploration for accessory spleens intraoperatively. Given that there is no acceptable evidence informing the effectiveness of preoperative imaging vs no imaging in this context, the panel provided their expert opinion.

splenectomy. (expert opinion in the absence

#### Subgroup considerations

In pediatric populations, the concerns for additional radiation exposure are greater. Modern imaging techniques may mitigate these negative effects and should be discussed with the patient and/or caregivers.

#### Implementation considerations

None. The intervention is already readily and easily available.

#### Monitoring and evaluation

Regardless of intervention or comparison, patients with ITP should be monitored for recurrence of disease suggesting missed accessory spleen.

## Research priorities

The panel made two recommendations for future studies on preoperative imaging in ITP patients undergoing splenectomy.

1. A truly comparative design should be used, such that post-surgical outcomes in a cohort of patient with preoperative imaging are compared with outcomes in a similar cohort of patients without preoperative imaging. Ideally, this design would also involve randomization and evaluate cost-effectiveness of these alternative management strategies.
2. Ultrasound, including contrast enhanced ultrasound, and other alternatives to CT should be investigated, especially in children.

### References:

1. Koshenkov VP, Pahuja AK, Németh ZH, Abkin A, Carter MS (2012) Identification of accessory spleens during laparoscopic splenectomy is superior to preoperative computed tomography for detection of accessory spleens. *JSL* 16:387-391.
2. Quah C, Ayiomamitis GD, Shah A, Ammori BJ (2011) Computed tomography to detect accessory spleens before laparoscopic splenectomy: is it necessary? *Surg Endosc* 25:261-265.
3. Napoli A, Catalano C, Silecchia G, Fabiano P, Fraioli F, Pediconi F, Venditti F, Basso N, Passariello R (2004) Laparoscopic splenectomy: multi-detector row CT for preoperative evaluation. *Radiology* 232:361-367.
4. Stanek A, Stefaniak T, Makarewicz W, Kaska L, Podgórczyk H, Hellman A, Lachinski A (2005) Accessory spleens: preoperative diagnostics limitations and operational strategy in laparoscopic approach to splenectomy in idiopathic thrombocytopenic purpura patients. *Langenbecks Arch Surg*. 390:47-51.
5. Vikse J, Sanna B, Henry BM, Tattera D, Sanna S, Pękala PA, Walocha JA, Tomaszewski KA (2017) The prevalence and morphometry of an accessory spleen: A meta-analysis and systematic review of 22,487 patients. *Int J Surg* 45:18-28.
6. Smith-Bindman R, Lipson J, Marcus R, Kim KP, Mahesh M, Gould R, Berrington de González A, Miglioretti DL (2009) Radiation dose associated with common computed tomography examinations and the associated lifetime attributable risk of cancer. *Arch Intern Med* 169:2078-2086.
7. Furlow B (2011) Radiation protection in pediatric imaging. *Radiol Technol* 82:421-439.

## Question 2

Should splenic artery embolization (SAE) vs. no SAE be used for laparoscopic splenectomy?	
<b>POPULATION:</b>	Patients undergoing laparoscopic splenectomy
<b>INTERVENTION:</b>	Splenic artery embolization (SAE)
<b>COMPARISON:</b>	No SAE
<b>MAIN OUTCOMES:</b>	Length of hospital stay/return to work, transfusion requirements, estimated blood loss, surgical site infection, mesenteric venous thromboembolism, conversion to open rate, organ injury, 30d mortality; Post hoc: 30d splenic related disease remission, mean surgery time, out of pocket cost.
<b>PERSPECTIVE:</b>	Patient/surgeon

## Assessment

Desirable Effects (for SAE) How substantial are the desirable anticipated effects?						
Judgement	Research evidence			Additional considerations		
<ul style="list-style-type: none"> <li>○ Trivial</li> <li>○ Small</li> <li>○ Moderate</li> <li>○ Large</li> <li>● Varies</li> <li>○ Don't know</li> </ul>	Evidence from two observational studies of high quality but small sample size informed this key question [1,2].			<p>The panel felt that different populations may experience a different degree of effect. In pediatric or anemic patients, diminished blood loss/avoidance of transfusion is clinically important, and the desirable effect may be moderate, while in adults the effect might be trivial.</p> <p>Additionally, the size of the spleen and skill of the surgeon are important. Based on panel opinion, the desirable effects with a small spleen and a skilled surgeon are likely trivial.</p> <p>Conversion to open is associated with additional risks that may be important to</p>		
	Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)		Certainty of the evidence (GRADE)	
			SAE		Without SAE	Difference
	Transfusion № of participants: 36 (1 observational study)	<b>OR 0.24</b> (0.06 to 0.99)	Study population <b>27.4%</b> (8.6 to 60.9)		61.1%	<b>33.7% fewer</b> (52.5 fewer to 0.2 fewer)
Mean estimated blood loss № of participants: 86 (2 observational studies)	-	-	-	<b>MD 146.1 mL lower</b> (290.94 lower to 1.26 lower)	⊕○○○ VERY LOW <sup>a,b</sup>	
Conversion to open approach № of participants: 86 (2 observational studies)	<b>OR 0.30</b> (0.03 to 2.78)	Study population <b>2.0%</b> (0.2 to 15.6)	6.3%	<b>4.3% fewer</b> (6.1 fewer to 9.4 more)	⊕○○○ VERY LOW <sup>a</sup>	



SSI (Superficial wound infection) № of participants: 86 (2 observational studies)	<b>OR 0.32</b> (0.01 to 8.27)	Study population			⊕○○○ VERY LOW <sup>a</sup>
		<b>0.7%</b> (0 to 15)	2.1%	<b>1.4% fewer</b> (2.1 fewer to 12.9 more)	

patients, such as length of stay and return to work.

- a. There is very serious imprecision as a small sample size and/or wide confidence interval suggest both the potential for harm and benefit.
- b. There is significant heterogeneity between the included studies with  $I^2 = 99\%$ , however, both agree in direction of estimate and the difference in estimate is clinically negligible.  
\*0.01 events for the control arm was used to calculate a non-zero absolute effect range

A third small observational study addressed this question in the population of patients with cirrhotic portal hypertension and splenomegaly [3]. This study included both conventional and modified SAE compared to no SAE prior to laparoscopic splenectomy and was also limited by small sample size.

Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)			Certainty of the evidence (GRADE)
		With SAE	Without SAE	Difference	
Transfusion - № of participants: 56 (1 observational study)	<b>OR 0.24</b> (0.07 to 0.85)	Study population			⊕○○○ VERY LOW <sup>a</sup>
		<b>16.4%</b> (5.4 to 41)	45.0%	<b>28.6% fewer</b> (39.6 fewer to 4 fewer)	
Mean EBL - № of participants: 56 (1 observational studies)	-		The mean without splenic artery embolization (SAE) was 328 mL	<b>MD 114 mL lower</b> (184.6 lower to 43.5 lower)	⊕○○○ VERY LOW <sup>a</sup>
Conversion - № of participants: 56 (1 observational study)	<b>OR 0.14</b> (0.02 to 0.76)	Study population			⊕○○○ VERY LOW <sup>a</sup>
		<b>5.7%</b> (0.8 to 24.6)	30.0%	<b>24.3% fewer</b> (29.2 fewer to 5.4 fewer)	
Massive Bleeding - № of participants: 56 (1	<b>OR 0.27</b> (0.06 to 1.29)	Study population			⊕○○○ VERY LOW <sup>b</sup>
		<b>8.3%</b> (2 to 30.1)	25.0%	<b>16.7% fewer</b> (23 fewer to 5.1 more)	

	observational study)						
<p>a. There is imprecision due to small sample size.  b. Small sample size and a wide confidence interval support both benefit and no difference.</p>							

**Undesirable Effects (for SAE)**  
How substantial are the undesirable anticipated effects?

Judgement	Research evidence	Additional considerations
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- Large
- Moderate
- Small
- Trivial
- Varies
- Don't know

Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)			Certainty of the evidence (GRADE)
		Without SAE	SAE	Difference	
Mesenteric venous thromboembolism № of participants: 50 (1 observational study)	<b>OR 8.24</b> (0.37 to 181.31)	Study population			⊕○○○ VERY LOW <sup>d</sup>
		0.0%	<b>0.3%</b> (0 to 5.7)	<b>0.2% more</b> (0 fewer to 5.7 more)*	

d. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.  
\*0.01 events for the control arm was used to calculate a non-zero absolute effect range

Increased mesenteric venous thrombosis may be present but whether actually greater or to what extent is not known due to imprecise research evidence. This outcome can lead to lifelong increased risk of varices and need for further medical management or intervention.

Additional undesirable effects not captured by research evidence are increased time required to include embolization and increased cost. Together, the added cost, time delay, and the unknown potential for increased MVTE were deemed a small undesirable effect by the panel.

There are additionally low but real risks that can occur during embolization, including contrast-induced renal insufficiency, coil migration, left sided pleural

		effusion and groin pseudoaneurysm [4,5].
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### Certainty of evidence

What is the overall certainty of the evidence of effects?

Judgement	Research evidence	Additional considerations
<ul style="list-style-type: none"> <li>● Very low</li> <li>○ Low</li> <li>○ Moderate</li> <li>○ High</li> <li>○ No included studies</li> </ul>	All evidence for individual outcomes, including critical outcomes, was very low certainty.	Only comparative evidence addressing the key question was used and was already very low certainty. Evidence from single cohort studies was deemed inappropriate for inclusion given the presence of comparative data and was not included. No large, randomized studies addressing this question were found. Transfusion and mean EBL were considered important outcomes in adults, and critical outcomes in pediatric patients, for decision-making on SAE versus no SAE.

### Values

Is there important uncertainty about or variability in how much people value the main outcomes?

Judgement	Research evidence	Additional considerations
<ul style="list-style-type: none"> <li>○ Important uncertainty or variability</li> <li>● Possibly important uncertainty or variability</li> <li>○ Probably no important uncertainty or variability</li> </ul>		The population to whom this is applied, such as pediatric vs adult, may impact the value for different outcomes. Long term sequelae of MVTE and transfusions may make these

<input type="radio"/> No important uncertainty or variability		outcomes higher value to younger patient populations.
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**Balance of effects**  
Does the balance between desirable and undesirable effects favor the intervention or the comparison?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> Favors the comparison <input type="radio"/> Probably favors the comparison <input type="radio"/> Does not favor either the intervention or the comparison <input type="radio"/> Probably favors the intervention <input type="radio"/> Favors the intervention <input checked="" type="radio"/> Varies <input type="radio"/> Don't know	The balance of effects varies based on the degree of anticipated desirable effects which is based on patient population and surgeon experience.	In large spleens, where bleeding is a concern, embolization may be favored. In small spleens, with surgeons with greater experience, embolization is probably not beneficial.

**Acceptability**  
Is the option favored in the balance of effects above acceptable to key stakeholders?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> No <input type="radio"/> Probably no <input checked="" type="radio"/> Probably yes <input type="radio"/> Yes <input type="radio"/> Varies <input type="radio"/> Don't know		This is an established and medically acceptable procedure. However, some places will not perform this procedure in pediatric populations. Additionally, for those who want to avoid an extra procedure and don't mind the risk of transfusion or conversion to open, then SAE may not be acceptable.

**Feasibility**

Is the option favored in the balance of effects above feasible to implement?		
Judgement	Research evidence	Additional considerations
<input type="radio"/> No <input type="radio"/> Probably no <input type="radio"/> Probably yes <input type="radio"/> Yes <input checked="" type="radio"/> <b>Varies</b> <input type="radio"/> Don't know		Not all hospitals have access to interventional radiology or interventional vascular capabilities, precluding the intervention.

### Summary of judgements

	JUDGEMENT						
DESIRABLE EFFECTS	Trivial	Small	Moderate	Large		<b>Varies</b>	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	<b>Small</b>	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	<b>Very low</b>	Low	Moderate	High			No included studies
VALUES	Important uncertainty or variability	<b>Possibly important uncertainty or variability</b>	Probably no important uncertainty or variability	No important uncertainty or variability			
BALANCE OF EFFECTS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	<b>Probably favors the intervention</b>	Favors the intervention	Varies	Don't know
ACCEPTABILITY	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know
FEASIBILITY	No	Probably no	Probably yes	Yes		<b>Varies</b>	Don't know

### Type of recommendation

Strong recommendation against the intervention <input type="radio"/>	Conditional recommendation against the intervention <input type="radio"/>	<b>Conditional recommendation for either the intervention or the comparison</b> <input checked="" type="radio"/>	Conditional recommendation for the intervention <input type="radio"/>	Strong recommendation for the intervention <input type="radio"/>
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## Conclusions

### Recommendation

The panel suggests that patients scheduled for laparoscopic splenectomy may be managed with either preoperative splenic artery embolization or no embolization. This decision should be based on surgeon and patient's shared decision-making and take into consideration the value and clinical sequelae of critical outcomes as well as the local feasibility and acceptability of SAE. In certain populations, such as cirrhotic patients with portal hypertension, the panel suggest that splenic artery embolization be considered before laparoscopic splenectomy.

### Justification

When performed for laparoscopic splenectomy, splenic artery embolization is associated with less blood loss, transfusion, superficial wound infection, and conversion to open procedure based on evidence with very low certainty. Evidence is too imprecise to establish whether there is no risk or greater risk of mesenteric VTE. For high risk patients like those with portal hypertension and splenomegaly, this increased safety of splenectomy may outweigh the unknown risk of MVTE and any increase in cost and time needed to perform the intervention. In low risk patients, the long-term health implications of mesenteric VTE and added cost/time may outweigh the short-term benefits of SAE. SAE may not be feasible in some hospitals.

### Subgroup considerations

Multiple patient populations influence the value of different outcomes as well as the feasibility and acceptability of SAE. Long term sequelae may influence decision making more in pediatric populations. Children may benefit more from decreased transfusions and experience greater long-term detriment from MVTE. Additionally, children may have less access to SAE based on local acceptability and based on decreased feasibility due to small size and technical considerations. Patients with splenomegaly and arborized splenic arteries likely experience different outcomes from embolization that increase and decrease, respectively, both the desired and undesired effects. Patients with splenomegaly especially may value decreased conversion to open and decreased blood loss given a higher baseline risk for this outcome.

### Implementation considerations

To implement the intervention, there must be access to trained interventional radiologists or vascular surgeons. The procedure increases ultimately the costs of the splenectomy and such resources must be available.

### Monitoring and evaluation

While the wide variation in mesenteric VTE events lacks significance, patients may need to be screened for mesenteric venous thromboembolism after the intervention.

### Research priorities

The panel suggests multiple areas for future research priority:

- Higher certainty evidence on transfusion, blood loss, conversion, and MVT in the setting of splenectomy with and without embolization will strengthen future recommendations. Randomized, multicenter trials studying this comparison would be ideal.
- If not possible with randomized trials, large prospective studies should be sought to establish the risk of mesenteric VTE rate with SAE vs no SAE.
- Size-matched patients and size matched spleens would better elucidate the increased safety of laparoscopic splenectomy after SAE.
- More accurate and consistent measures of blood loss are needed for this outcome to have greater value in decision making.

## References

1. Naoum JJ, Silberfein EJ, Zhou W, Sweeney JF, Albo D, Brunicardi FC, Kougias P, El Sayed HF, Lin PH (2007) Concomitant intraoperative splenic artery embolization and laparoscopic splenectomy versus laparoscopic splenectomy: comparison of treatment outcome. *Am J Surg* 193:713-718.
2. Wu Z, Zhou J, Pankaj P, Peng B (2012) Comparative treatment and literature review for laparoscopic splenectomy alone versus preoperative splenic artery embolization splenectomy. *Surg Endosc* 26:2758-2766.
3. Li J, You N, Deng C, Wu K, Wang L, Huang X, Wang W, Fan J, Zheng L (2018) Use of iodized oil and gelatin sponge embolization in splenic artery coiling reduces bleeding from laparoscopic splenectomy for cirrhotic portal hypertension patients with complicating hypersplenic splenomegaly: A comparative study. *J Laparoendosc Adv Surg Tech A* 28:713-720.
4. Ekeh AP, Khalaf S, Ilyas S, Kauffman S, Walusimbi M, McCarthy MC (2013) Complications arising from splenic artery embolization: a review of an 11-year experience. *Am J Surg* 205: 250-254.
5. Gaba RC, Katz JR, Parvinian A, Reich S, Omene BO, Yap FY, Owens CA, Knuttinen MG, Bui JT (2013) Splenic artery embolization: a single center experience on the safety, efficacy, and clinical outcomes. *Diagn Interv Radiol* 19:49-55.

### Question 3

Should routine drain placement vs. no drain placement be used for laparoscopic splenectomy?	
<b>POPULATION:</b>	Patients undergoing laparoscopic splenectomy
<b>INTERVENTION:</b>	Routine drain placement
<b>COMPARISON:</b>	No routine drain placement
<b>MAIN OUTCOMES:</b>	Postoperative pain, length of hospital stay/return to work, transfusion requirements, estimated blood loss, surgical site infection, organ injury, 30d mortality, and cost to the patient. Post hoc: length of surgery
<b>PERSPECTIVE:</b>	Patient/surgeon

### Assessment

Desirable Effects (for routine drain placement)							
How substantial are the desirable anticipated effects?							
Judgement	Research evidence					Additional considerations	
<ul style="list-style-type: none"> <li>● Trivial</li> <li>○ Small</li> <li>○ Moderate</li> <li>○ Large</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	A single, small observational study yielded this research evidence [1].					<p>Reasons for placing a drain were not described in the papers. The panel felt that patients with clear indications for drain placement, such as infected fields or obvious injuries to the pancreas, experience greater desirable effects. For routine placement of drains, the effect was deemed small.</p> <p>A benefit not present in the research evidence was the ability of a drain to detect any postoperative bleeding faster and thus potentially increase postoperative safety.</p>	
	<b>Outcomes</b>	<b>Relative effect (95% CI)</b>	<b>Anticipated absolute effects* (95% CI)</b>				<b>Certainty of the evidence (GRADE)</b>
			<b>WITH drain placement</b>	<b>Without drain placement</b>	<b>Difference</b>		
Surgery time mean (minutes) № of participants: 54 (1 observational study)	-	-	-	MD <b>41.75 lower</b> (72.77 lower to 10.73 lower)	⊕○○○ VERY LOW <sup>a,b</sup>		
30d mortality № of participants: 54 (1 observational study)	not estimable	Study population			⊕○○○ VERY LOW <sup>a,b</sup>		
		<b>0.0%</b> (0 events)	0.0% (0 events)	<b>0.0% fewer</b> (0 fewer to 0 fewer)			
		<p>a. This study had high risk of selection bias due to missing data (113 of 296 patients excluded without statement on why they were excluded or if they were similar to the included set of patients) and unclear follow up length; also risk of confounding due to unclear between group differences.</p> <p>b. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.</p>					



## Undesirable Effects (for routine drain placement)

How substantial are the undesirable anticipated effects?

Judgement	Research evidence	Additional considerations																																	
<ul style="list-style-type: none"> <li>○ Large</li> <li>○ Moderate</li> <li>● Small</li> <li>○ Trivial</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<p>A single, small observational study yielded this research evidence [1].</p> <table border="1"> <thead> <tr> <th rowspan="2">Outcomes</th> <th rowspan="2">Relative effect (95% CI)</th> <th colspan="3">Anticipated absolute effects* (95% CI)</th> <th rowspan="2">Certainty of the evidence (GRADE)</th> </tr> <tr> <th>WITH drain placement</th> <th>Without drain placement</th> <th>Difference</th> </tr> </thead> <tbody> <tr> <td rowspan="2"> <b>SSI (deep or intraabdominal)</b>                      № of participants: 54 (1 observational study)                 </td> <td rowspan="2"> <b>OR 2.97</b>                      (0.14 to 61.05)                 </td> <td colspan="3">Study population</td> <td rowspan="2">                     ⊕○○○                      VERY LOW<sup>a,b</sup> </td> </tr> <tr> <td>study population 7.7%</td> <td>study population 0.0%</td> <td><b>1.2% fewer</b> (0.6 fewer to 335 more)</td> </tr> <tr> <td> <b>LOS mean</b>                      (days)                      № of participants: 54 (1 observational study)                 </td> <td>-</td> <td>-</td> <td>-</td> <td> <b>MD 1.46 higher</b>                      (0.32 lower to 3.24 higher)                 </td> <td>                     ⊕○○○                      VERY LOW<sup>a,b</sup> </td> </tr> <tr> <td rowspan="2"> <b>30d mortality</b>                      № of participants: 54 (1 observational study)                 </td> <td rowspan="2">not estimable</td> <td colspan="3">Study population</td> <td rowspan="2">                     ⊕○○○                      VERY LOW<sup>a,b</sup> </td> </tr> <tr> <td><b>0.0%</b> (0 events)</td> <td>0.0% (0 events)</td> <td><b>0.0% fewer</b> (0 fewer to 0 fewer)</td> </tr> </tbody> </table> <p>a. This study had high risk of selection bias due to missing data (113 of 296 patients excluded without statement on why they were excluded or if they were similar to the included set of patients) and unclear follow up length; also risk of confounding due to unclear between group differences.</p> <p>b. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.</p>	Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)			Certainty of the evidence (GRADE)	WITH drain placement	Without drain placement	Difference	<b>SSI (deep or intraabdominal)</b> № of participants: 54 (1 observational study)	<b>OR 2.97</b> (0.14 to 61.05)	Study population			⊕○○○ VERY LOW <sup>a,b</sup>	study population 7.7%	study population 0.0%	<b>1.2% fewer</b> (0.6 fewer to 335 more)	<b>LOS mean</b> (days) № of participants: 54 (1 observational study)	-	-	-	<b>MD 1.46 higher</b> (0.32 lower to 3.24 higher)	⊕○○○ VERY LOW <sup>a,b</sup>	<b>30d mortality</b> № of participants: 54 (1 observational study)	not estimable	Study population			⊕○○○ VERY LOW <sup>a,b</sup>	<b>0.0%</b> (0 events)	0.0% (0 events)	<b>0.0% fewer</b> (0 fewer to 0 fewer)	<p>Increased length of stay may additionally increase costs to patients without insurance coverage.</p> <p>There is a high risk of bias in these observational studies given that drains are often placed in more complex or difficult cases (selective use), based on panel experience.</p>
Outcomes	Relative effect (95% CI)			Anticipated absolute effects* (95% CI)				Certainty of the evidence (GRADE)																											
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## Certainty of evidence

What is the overall certainty of the evidence of effects?

Judgement	Research evidence	Additional considerations
<ul style="list-style-type: none"> <li>● Very low</li> <li>○ Low</li> <li>○ Moderate</li> <li>○ High</li> <li>○ No included studies</li> </ul>	<p>All evidence for individual outcomes was very low certainty.</p>	<p>Some studies, such as Degrade et al, highlight the difficulty in studying this question [2]. While this observational study addressed drain versus no</p>

		<p>drain, the drain placement was clearly not routine based on statistically older patients with statistically higher ASA, higher rate of malignancy at baseline for those receiving drains.</p>
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**Values**  
Is there important uncertainty about or variability in how much people value the main outcomes?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ Important uncertainty or variability</li> <li>● Possibly important uncertainty or variability</li> <li>○ Probably no important uncertainty or variability</li> <li>○ No important uncertainty or variability</li> </ul>		<p>Based on panel expert opinion, the value of operative length on decision-making may vary.</p>

**Balance of effects**  
Does the balance between desirable and undesirable effects favor the intervention or the comparison?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ Favors the comparison</li> <li>● Probably favors the comparison</li> <li>○ Does not favor either the intervention or the comparison</li> <li>○ Probably favors the intervention</li> <li>○ Favors the intervention</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<p>The trivial benefit from decreased operative time is outweighed by small undesirable effects from increased risk for infection and increased length of stay.</p>	<p>There was some distrust from the panel in any conclusions based on the evidence given the poor quality and limited nature of the available data, greatly tempering any judgement on overall balance.</p>

<b>Acceptability</b> Is the option favored in the balance of effects above acceptable to key stakeholders?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> No <input type="radio"/> Probably no <input checked="" type="radio"/> Probably yes <input type="radio"/> Yes <input type="radio"/> Varies <input type="radio"/> Don't know		Most would accept not placing a drain, but not all.

  

<b>Feasibility</b> Is the option favored in the balance of effects above feasible to implement?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> No <input type="radio"/> Probably no <input type="radio"/> Probably yes <input checked="" type="radio"/> Yes <input type="radio"/> Varies <input type="radio"/> Don't know		

### Summary of judgements

	<b>JUDGEMENT</b>						
<b>DESIRABLE EFFECTS</b>	Trivial	Small	Moderate	Large		Varies	Don't know
<b>UNDESIRABLE EFFECTS</b>	Large	Moderate	<b>Small</b>	Trivial		Varies	Don't know
<b>CERTAINTY OF EVIDENCE</b>	<b>Very low</b>	Low	Moderate	High			No included studies
<b>VALUES</b>	Important uncertainty or variability	<b>Possibly important uncertainty or variability</b>	Probably no important uncertainty or variability	No important uncertainty or variability			
<b>BALANCE OF EFFECTS</b>	Favors the comparison	<b>Probably favors the comparison</b>	Does not favor either the intervention or the comparison	Probably favors the intervention	Favors the intervention	Varies	Don't know
<b>ACCEPTABILITY</b>	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know

		JUDGEMENT					
FEASIBILITY	No	Probably no	Probably yes	Yes		Varies	Don't know

## Type of recommendation

Strong recommendation against the intervention  ○	<b>Conditional recommendation against the intervention</b>  ●	Conditional recommendation for either the intervention or the comparison  ○	Conditional recommendation for the intervention  ○	Strong recommendation for the intervention  ○
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## Conclusions

### Recommendation

The panel suggests that drain placement not be used routinely during laparoscopic splenectomy. Individual patient and operative considerations may warrant drain placement such as infected fields, difficult dissection, or obvious injuries to the pancreas. In these situations, the desirable effects of drain placement such as control of pancreatic leak, or source control for an infection, may outweigh the undesirable effects associated with drain placement. Additionally, in patients with intraoperative bleeding or higher risk for bleeding such as patients with portal hypertension, leaving a drain to detect postoperative bleeding is likely more effective option.

### Justification

Based on the limited and very low certainty evidence available, the panel judged there is not much benefit to routine placement of a drain, and there may be a detriment. The undesirable effects of increased SSI and increased length of stay outweigh any small benefit in operative time. A small proportion of the panel felt the evidence was limited such that no recommendation should be made.

### Subgroup considerations

In patients with intraoperative bleeding or higher risk for bleeding such as patients with portal hypertension, leaving a drain to detect postoperative bleeding early may have a higher yield.

### Implementation considerations

None

### Monitoring and evaluation

None

### Research priorities

Given the paucity of data available, the panel recommends additional research which address the following:

- Randomized studies, ideally large and multicenter, would yield much more robust evidence.
- The indication for drain placement, and specification of whether it is routine, is needed in future studies.

## References

1. Major P, Matlok M, Pedziwiatr M, Budzynski A (2012) Do we really need routine drainage after laparoscopic adrenalectomy and splenectomy? *Wideochir Inne Tech Maloinwazyjne* 8:33-39.
2. Degrate L, Zanframundo C, Bernasconi DP, Real G, Garancini M, Uggeri F, Romano F, Braga M (2020) Futility of abdominal drain in elective laparoscopic splenectomy. *Langenbecks Arch Surg* 405:665-672.

## Question 4

Should patients be positioned supine vs. lateral for laparoscopic splenectomy?	
<b>POPULATION:</b>	Patients undergoing elective laparoscopic splenectomy
<b>INTERVENTION:</b>	Supine positioning
<b>COMPARISON:</b>	Lateral positioning
<b>MAIN OUTCOMES:</b>	Operative Time, Conversion to Open, Transfusion, Organ Injury, Pain, 30d Mortality, 30d related readmit, LOS, PMVT, Estimated blood loss, surgical site infection,
<b>PERSPECTIVE:</b>	Patient/Surgeon

## Assessment

Desirable Effects (for supine position) How substantial are the desirable anticipated effects?																													
Judgement	Research evidence	Additional considerations																											
<ul style="list-style-type: none"> <li>○ Trivial</li> <li>○ Small</li> <li>○ Moderate</li> <li>○ Large</li> <li>● Varies</li> <li>○ Don't know</li> </ul>	<p>A randomized controlled trial which included adults with hematological disorders (65%) and malignant disorders (35%), addressed this question and was used for decision-making [1]</p> <table border="1"> <thead> <tr> <th rowspan="2">Outcomes</th> <th rowspan="2">Relative effect (95% CI)</th> <th colspan="3">Anticipated absolute effects* (95% CI)</th> <th rowspan="2">Certainty of the evidence (GRADE)</th> </tr> <tr> <th>With supine positioning</th> <th>With lateral positioning</th> <th>Difference</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Mesenteric VTE - No of participants: 80 (1 RCT)</td> <td rowspan="2"><b>OR 0.19</b> (0.01 to 4.09)</td> <td colspan="3">Study population</td> <td rowspan="2">⊕○○○ VERY LOW<sup>a,b</sup></td> </tr> <tr> <td><b>1.0%</b> (0.1 to 17.7)</td> <td>5.0%</td> <td><b>4.0% fewer</b> (50 fewer to 152 more)</td> </tr> <tr> <td rowspan="2">Organ injury * No of participants: 80 (1 RCT)</td> <td rowspan="2"><b>OR 0.19</b> (0.01 to 4.09)</td> <td colspan="3">Study population</td> <td rowspan="2">⊕○○○ VERY LOW<sup>a,b</sup></td> </tr> <tr> <td><b>1.0%</b> (0.1 to 17.7)</td> <td>5.0%</td> <td><b>4.0% fewer</b> (50 fewer to 152 more)</td> </tr> </tbody> </table> <p>a. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit. Statistical non-significance was judged more a reflection of equivalence rather than lack of power in the study.</p> <p>b. A single study had unclear risk of bias due to open label design (no blinding) and no mention of follow-up length besides at least one postoperative visit at undesignated time.</p> <p><i>*organ injury was defined in this study as intraoperative minor injury to the stomach.</i></p>	Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)			Certainty of the evidence (GRADE)	With supine positioning	With lateral positioning	Difference	Mesenteric VTE - No of participants: 80 (1 RCT)	<b>OR 0.19</b> (0.01 to 4.09)	Study population			⊕○○○ VERY LOW <sup>a,b</sup>	<b>1.0%</b> (0.1 to 17.7)	5.0%	<b>4.0% fewer</b> (50 fewer to 152 more)	Organ injury * No of participants: 80 (1 RCT)	<b>OR 0.19</b> (0.01 to 4.09)	Study population			⊕○○○ VERY LOW <sup>a,b</sup>	<b>1.0%</b> (0.1 to 17.7)	5.0%	<b>4.0% fewer</b> (50 fewer to 152 more)	
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## Undesirable Effects (for supine position)

How substantial are the undesirable anticipated effects?

Judgement	Research evidence	Additional considerations																																					
<ul style="list-style-type: none"> <li>○ Large</li> <li>● Moderate</li> <li>○ Small</li> <li>○ Trivial</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<table border="1"> <thead> <tr> <th rowspan="2">Outcomes</th> <th rowspan="2">Relative effect (95% CI)</th> <th colspan="3">Anticipated absolute effects* (95% CI)</th> <th rowspan="2">Certainty of the evidence (GRADE)</th> </tr> <tr> <th>With supine positioning</th> <th>With lateral positioning</th> <th>Difference</th> </tr> </thead> <tbody> <tr> <td>Conversion - RCT No of participants: 80 (1 RCT)</td> <td><b>OR 2.25</b> (0.62 to 8.18)</td> <td colspan="3">Study population</td> <td>⊕○○○ VERY LOW<sup>a,b</sup></td> </tr> <tr> <td></td> <td><b>20.0%</b> (6.4 to 47.6)</td> <td>10.0%</td> <td><b>10.0% more</b> (35 fewer to 511 more)</td> <td></td> </tr> <tr> <td>Mean EBL - RCT No of participants: 80 (1 RCT)</td> <td>-</td> <td></td> <td>The mean EBL with lateral positioning was <b>179.5 mL</b></td> <td><b>MD 103.5 mL higher</b> (30.46 higher to 176.54 higher)</td> <td>⊕⊕○○ LOW<sup>a,c</sup></td> </tr> <tr> <td>Transfusion requirement - RCT No of participants: 80 (1 RCT)</td> <td><b>OR 2.25</b> (0.62 to 8.18)</td> <td colspan="3">Study population</td> <td>⊕○○○ VERY LOW<sup>a,b</sup></td> </tr> <tr> <td></td> <td><b>20.0%</b> (6.4 to 47.6)</td> <td>10.0%</td> <td><b>10.0% more</b> (35 fewer to 511 more)</td> <td></td> </tr> </tbody> </table> <p>a. A single study had unclear risk of bias due to open label design (no blinding) and no mention of follow-up length besides at least one postoperative visit at undesignated time.</p> <p>b. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.</p> <p>c. There is severe imprecision due to small sample size</p>	Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)			Certainty of the evidence (GRADE)	With supine positioning	With lateral positioning	Difference	Conversion - RCT No of participants: 80 (1 RCT)	<b>OR 2.25</b> (0.62 to 8.18)	Study population			⊕○○○ VERY LOW <sup>a,b</sup>		<b>20.0%</b> (6.4 to 47.6)	10.0%	<b>10.0% more</b> (35 fewer to 511 more)		Mean EBL - RCT No of participants: 80 (1 RCT)	-		The mean EBL with lateral positioning was <b>179.5 mL</b>	<b>MD 103.5 mL higher</b> (30.46 higher to 176.54 higher)	⊕⊕○○ LOW <sup>a,c</sup>	Transfusion requirement - RCT No of participants: 80 (1 RCT)	<b>OR 2.25</b> (0.62 to 8.18)	Study population			⊕○○○ VERY LOW <sup>a,b</sup>		<b>20.0%</b> (6.4 to 47.6)	10.0%	<b>10.0% more</b> (35 fewer to 511 more)		
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## Certainty of evidence

What is the overall certainty of the evidence of effects?

Judgement	Research evidence	Additional considerations									
<ul style="list-style-type: none"> <li>● Very low</li> <li>○ Low</li> <li>○ Moderate</li> <li>○ High</li> <li>○ No included studies</li> </ul>	<table border="1"> <thead> <tr> <th>Outcomes</th> <th>Importance</th> <th>Certainty of the evidence (GRADE)</th> </tr> </thead> <tbody> <tr> <td>Mesenteric VTE - RCT</td> <td>IMPORTANT</td> <td>⊕○○○ VERY LOW<sup>a,b</sup></td> </tr> <tr> <td>Organ injury - RCT</td> <td>IMPORTANT</td> <td>⊕○○○ VERY LOW<sup>a,b</sup></td> </tr> </tbody> </table>	Outcomes	Importance	Certainty of the evidence (GRADE)	Mesenteric VTE - RCT	IMPORTANT	⊕○○○ VERY LOW <sup>a,b</sup>	Organ injury - RCT	IMPORTANT	⊕○○○ VERY LOW <sup>a,b</sup>	
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	Mesenteric VTE - RCT	IMPORTANT	⊕○○○ VERY LOW <sup>a,b</sup>								
Organ injury - RCT	IMPORTANT	⊕○○○ VERY LOW <sup>a,b</sup>									

Conversion - RCT	CRITICAL	⊕○○○ VERY LOW <sup>a,b</sup>
Mean EBL - RCT	IMPORTANT	⊕⊕○○ LOW <sup>b,c</sup>
Transfusion requirement - RCT	IMPORTANT	⊕○○○ VERY LOW <sup>a,b</sup>

a. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.

b. A single study had unclear risk of bias due to open label design (no blinding) and no mention of follow-up length besides at least one postoperative visit at undesignated time.

c. There is severe imprecision due to small sample size.

### Values

Is there important uncertainty about or variability in how much people value the main outcomes?

Judgement	Research evidence	Additional considerations
<input type="radio"/> Important uncertainty or variability <input checked="" type="radio"/> Possibly important uncertainty or variability <input type="radio"/> Probably no important uncertainty or variability <input type="radio"/> No important uncertainty or variability		<p>Jehovah's witness may value transfusion more.</p> <p>The panel believes populations getting a splenectomy for hematologic disease would likely favor remission over the other outcomes, however no current data exists to support one approach over the other in this population.</p>

### Balance of effects

Does the balance between desirable and undesirable effects favor the intervention or the comparison?

Judgement	Research evidence	Additional considerations
<input type="radio"/> Favors the comparison <input type="radio"/> Probably favors the comparison <input type="radio"/> Does not favor either the intervention or the comparison <input type="radio"/> Probably favors the intervention		<p>Confounders may include training of surgeon and learning curve.</p> <p>Lateral approach may apply to a broader range of patients</p> <p>In a low BMI group, there were no differences found between approaches</p>

<ul style="list-style-type: none"> <li>○ Favors the intervention</li> <li>● Varies</li> <li>○ Don't know</li> </ul>		across multiple outcomes.
<b>Acceptability</b>		
Is the option from balance of effects acceptable to key stakeholders?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ No</li> <li>○ Probably no</li> <li>● Probably yes</li> <li>○ Yes</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		
<b>Feasibility</b>		
Is the option from balance of effects feasible to implement?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ No</li> <li>○ Probably no</li> <li>● Probably yes</li> <li>○ Yes</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		The panel felt that surgeon training and degree of comfort with one procedure might influence feasibility. The lateral approach appears easier technically.

### Summary of judgements

	JUDGEMENT						
<b>DESIRABLE EFFECTS</b>	Trivial	Small	Moderate	Large		<b>Varies</b>	Don't know
<b>UNDESIRABLE EFFECTS</b>	Large	<b>Moderate</b>	Small	Trivial		Varies	Don't know
<b>CERTAINTY OF EVIDENCE</b>	<b>Very low</b>	Low	Moderate	High			No included studies
<b>VALUES</b>	Important uncertainty or variability	<b>Possibly important uncertainty or variability</b>	Probably no important uncertainty or variability	No important uncertainty or variability			
<b>BALANCE OF EFFECTS</b>	Favors the comparison	Probably favors the comparison	Does not favor either the intervention	Probably favors the intervention	Favors the intervention	<b>Varies</b>	Don't know



JUDGEMENT							
			or the comparison				
<b>ACCEPTABILITY</b>	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know
<b>FEASIBILITY</b>	No	Probably no	<b>Probably yes</b>	Yes		Varies	Don't know

### Type of recommendation

Strong recommendation against the intervention of supine positioning ○	<b>Conditional recommendation against the intervention of supine positioning</b> ●	Conditional recommendation for either the intervention or the comparison ○	<b>Conditional recommendation for the intervention of supine positioning</b> ●	Strong recommendation for the intervention of supine positioning ○
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*Conditional recommendation against the intervention (supine), favoring the lateral approach.*

### Conclusions

#### Recommendation

The panel suggests that lateral positioning be considered over supine positioning for laparoscopic splenectomy.

#### Justification

The evidence suggests that the lateral approach is preferred for patients undergoing laparoscopic splenectomy, based on the findings within a single randomized control trial.

#### Subgroup considerations

In certain situations/subgroups the choice of approach should be shared decision-making:

- Low BMI patients may have more equivalent outcomes with either approach.
- There is currently limited data, based on pediatric patients. The only pediatric article that demonstrated this outcome, however, suggested overall that lateral-ligamentous approach was better due to less EBL, less conversion to open, and less operative complications [2].

#### Implementation considerations

None

#### Monitoring and evaluation

None

#### Research priorities

The panel felt the following research areas needed further evidence, especially in the format of further randomized controlled trials:

1. Studies that ask surgeons to rate technical difficulty and evaluate learning curve.
2. Studies with more homogenous populations or subpopulations, such as patients with obesity, pediatric and adult populations, etc.
3. Studies specifically looking at disease remission and identification rate of accessory spleens with one approach or the other.

## **References**

1. Fathi A, Eldamshety O, Bahy O, Denewer A, Fady T, Shehatto F, Khater A, Elnahas W, Roshdy S, Farouk O, Senbel A, Hamed EE, Setit A (2016) Lateral versus anterior approach laparoscopic splenectomy: A Randomized-controlled Study. *Surg Laparosc Endosc Percutan Tech* 26:465-469.
2. Podevin G, Victor A, De Napoli S, Heloury Y, Leclair MD (2011) Laparoscopic splenectomy: comparison between anterior and lateral approaches. *J Laparoendosc Adv Surg Tech A* 21:865-868.

## Question 5

Should pre-operative vs. intra-operative administration of platelets be used for elective, minimally invasive splenectomy?	
<b>POPULATION:</b>	Splenectomy
<b>INTERVENTION:</b>	pre-operative
<b>COMPARISON:</b>	intra-operative administration of platelets
<b>MAIN OUTCOMES:</b>	Mean estimated blood loss; Transfusion (yes/no); Conversion to open approach; Mean surgery time (minutes); LOS mean (days); 30d remission
<b>PERSPECTIVE:</b>	Patient/Surgeon

## Assessment

Desirable Effects (for pre-operative administration) How substantial are the desirable anticipated effects?		
Judgement	Research evidence	Additional considerations
<ul style="list-style-type: none"> <li>● Trivial</li> <li>○ Small</li> <li>○ Moderate</li> <li>○ Large</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<p>A single small observational study in adult patients with ITP and thrombocytopenia undergoing laparoscopic splenectomy yielded the relevant evidence [1]. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.</p>	<p>No desirable effects seen for the intervention. There were no other desirable effects the panel knew of based on experience.</p> <p>The panel felt that this evidence could not be generalized to other indications for splenectomy with any modicum of certainty.</p>
Undesirable Effects (for pre-operative administration) How substantial are the undesirable anticipated effects?		
Judgement	Research evidence	Additional considerations
<ul style="list-style-type: none"> <li>○ Large</li> <li>● Moderate</li> <li>○ Small</li> <li>○ Trivial</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<p>A single small observational study yielded this research evidence [1]. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.</p>	

Outcomes	Relative effect (95% CI)	Anticipated absolute effects* (95% CI)			Certainty of the evidence (GRADE)
		With pre-operative	With intra-operative	Difference	
<b>Mean estimated blood loss</b> № of participants: 30 (1 observational study)	-	-	The mean estimated blood loss (mL) with intraoperative administration of platelets was 95.5 mL	MD 150.5 higher (56.59 higher to 244.41 higher)	⊕○○○ VERY LOW <sup>a</sup>
<b>Transfusion (yes/no)</b> № of participants: 30 (1 observational study)	<b>OR 1.50</b> (0.32 to 6.99)	Study population			⊕○○○ VERY LOW <sup>b</sup>
		60.0% (24.2 to 87.5)	50.0%	10.0% more (25.8 fewer to 37.5 more)	
<b>Conversion to open approach</b> № of participants: 30 (1 observational study)	<b>OR 2.11</b> (0.12 to 37.72)	Study population			⊕○○○ VERY LOW <sup>b</sup>
		10.0% (0.6 to 66.5)	5.0%	5.0% more (4.4 fewer to 61.5 more)	
<b>Mean surgery time (minutes)</b> № of participants: 30 (1 observational study)	-	-	The mean surgery time with intraoperative administration of platelets was 181 min	MD 38 higher (22.77 lower to 98.77 higher)	⊕○○○ VERY LOW <sup>b</sup>
<b>LOS mean (days)</b> № of participants: 30 (1 observational study)	-	-	The mean length of stay with intraoperative administration of platelets was 7.4 days	MD 1.1 higher (0.58 lower to 2.78 higher)	⊕○○○ VERY LOW <sup>b</sup>
<b>30d remission</b> № of participants:	<b>OR 0.47</b> (0.03 to 8.46)	Study population			⊕○○○ VERY LOW <sup>b</sup>
		89.9% (36.3 to 99.4)	95.0%	5.1% fewer (58.7	

	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; text-align: center;">30 (1 observational study)</td> <td style="width: 15%;"></td> <td style="width: 15%;"></td> <td style="width: 15%;"></td> <td style="width: 15%;"></td> <td style="width: 15%; text-align: center;">fewer to 4.4 more)</td> <td style="width: 15%;"></td> </tr> </table> <p>a. There is imprecision due to small sample size. b. There is very serious imprecision as a small sample size and wide confidence interval suggest both the potential for harm and benefit.</p>	30 (1 observational study)					fewer to 4.4 more)		
30 (1 observational study)					fewer to 4.4 more)				
<b>Certainty of evidence</b> What is the overall certainty of the evidence of effects?									
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>							
<ul style="list-style-type: none"> <li>● Very low</li> <li>○ Low</li> <li>○ Moderate</li> <li>○ High</li> <li>○ No included studies</li> </ul>	All evidence for individual outcomes was very low certainty due to small sample size and usually wide confidence intervals suggesting both the potential for harm and benefit.								
<b>Values</b> Is there important uncertainty about or variability in how much people value the main outcomes?									
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>							
<ul style="list-style-type: none"> <li>○ Important uncertainty or variability</li> <li>○ Possibly important uncertainty or variability</li> <li>● Probably no important uncertainty or variability</li> <li>○ No important uncertainty or variability</li> </ul>									
<b>Balance of effects</b> Does the balance between desirable and undesirable effects favor the intervention or the comparison?									
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>							
<ul style="list-style-type: none"> <li>○ Favors the comparison</li> <li>● Probably favors the comparison</li> <li>○ Does not favor either the intervention or the comparison</li> </ul>	All outcomes slightly favor the comparison but there is serious imprecision of the single study addressing this question due to small sample size and wide confidence intervals	Having platelets “on board” prior to incision may appear to have benefit.							

<ul style="list-style-type: none"> <li>○ Probably favors the intervention</li> <li>○ Favors the intervention</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		
<b>Acceptability</b>		
Is the option from the balance of effects acceptable to key stakeholders? (is INTRA-op transfusion acceptable)		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ No</li> <li>○ Probably no</li> <li>○ Probably yes</li> <li>● Yes</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		Jehovah's witnesses may not want either the comparison or the intervention.
<b>Feasibility</b>		
Is the option from the balance of effects feasible to implement? (is INTRA-op transfusion feasible)		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>○ No</li> <li>○ Probably no</li> <li>○ Probably yes</li> <li>● Yes</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>		There may be logistical concerns getting intra-op platelets. The intervention would be feasible to surgeons who use platelet transfusions to improve safety for surgery.

### Summary of judgements

	JUDGEMENT						
<b>DESIRABLE EFFECTS</b>	<b>Trivial</b>	Small	Moderate	Large		Varies	Don't know
<b>UNDESIRABLE EFFECTS</b>	Large	<b>Moderate</b>	Small	Trivial		Varies	Don't know
<b>CERTAINTY OF EVIDENCE</b>	<b>Very low</b>	Low	Moderate	High			No included studies
<b>VALUES</b>	Important uncertainty or variability	Possibly important uncertainty or variability	<b>Probably no important uncertainty or variability</b>	No important uncertainty or variability			

	JUDGEMENT						
BALANCE OF EFFECTS	Favors the comparison	<b>Probably favors the comparison</b>	Does not favor either the intervention or the comparison	Probably favors the intervention	Favors the intervention	Varies	Don't know
ACCEPTABILITY	No	Probably no	Probably yes	<b>Yes</b>		Varies	Don't know
FEASIBILITY	No	Probably no	Probably yes	<b>Yes</b>		Varies	Don't know

### Type of recommendation

Strong recommendation against the intervention ○	<b>Conditional recommendation against the intervention (against preop, for intraop)</b> ●	Conditional recommendation for either the intervention or the comparison ○	Conditional recommendation for the intervention ○	Strong recommendation for the intervention ○
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### Conclusions

#### Recommendation

The panel suggests the use of intra-operative platelet transfusion during laparoscopic splenectomy *for ITP* as opposed to pre-operative administration. No recommendations could be made for other splenectomy indications because of absence of

#### Justification

The intervention does not appear to have a benefit over the comparison according to the reviewed data. All outcomes slightly favor intra-operative administration of platelets but there is serious imprecision of the single study addressing this question due to small sample size and wide confidence intervals limiting a strong recommendation because of absence of evidence.

#### Subgroup considerations

The single subgroup addressed by the data, a single study, are adult patients with ITP and thrombocytopenia undergoing laparoscopic splenectomy. It remains unclear if there is a benefit for the intervention for pediatric patients with and without ITP or for adult patients without ITP who have preoperative thrombocytopenia. It also remains unclear if there is benefit for the intervention, pre-operative platelet transfusion, for patients with higher risk of intraoperative bleeding such as patients with portal hypertension or other reasons for splenomegaly where there may be a heightened bleeding risk.

#### Implementation considerations

No

#### Monitoring and evaluation

Timing of platelet counts need to be standardized before and during surgery

#### Research priorities

Given the paucity of data available, additional research which address the following would be useful

- Larger, prospective, possibly multi-center or randomized studies to increase the certainty of evidence.
- Identification of a minimum platelet count preoperatively for major or minor surgical procedures to maximize surgical safety.

## **References**

1. Wu Z, Zhou J, Li J, Zhu Y, Peng B (2012) The feasibility of laparoscopic splenectomy for ITP patients without preoperative platelet transfusion. *Hepatogastroenterology* 59:81-85.



## Question 6

Should mechanical vs. energy device be used for control of hilum	
<b>POPULATION:</b>	Patients undergoing laparoscopic Splenectomy
<b>INTERVENTION:</b>	Mechanical device to control Hilum of spleen
<b>COMPARISON:</b>	Energy device to control hilum of spleen
<b>MAIN OUTCOMES:</b>	Transfusion requirements/estimated blood loss, surgical site infection, mesenteric venous thromboembolism, organ injury, conversion to open surgery rate, 30d mortality Post hoc addition: LOS, operative time
<b>PERSPECTIVE:</b>	PATIENT/SURGEON

## Assessment

Desirable Effects (for Mechanical device)						
How substantial are the desirable anticipated effects?						
Judgement	Research evidence				Additional considerations	
<ul style="list-style-type: none"> <li>○ Trivial</li> <li>○ Small</li> <li>● Moderate</li> <li>○ Large</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	Two RCTs were used to inform decision-making. Fathi 2020 was an RCT comparing Ligasure versus stapler and Shabahang 2012 was an RCT comparing Ligasure versus clip ligation [1,2]. Both studied adults age 17 years of age and older.					
	<b>Outcomes</b>	<b>Relative effect (95% CI)</b>	<b>Anticipated absolute effects* (95% CI)</b>			<b>Certainty of the evidence (GRADE)</b>
			<b>With mechanical (stapling/ligation)</b>	<b>With energy</b>	<b>Difference</b>	
	Mean estimated blood loss (mL) № of participants: 91 (2 RCTs)	-	-	The mean estimated blood loss (mL) with energy was 159.9 mL	<b>MD 2.48 mL lower</b> (66.35 lower to 61.38 higher)	⊕○○○ VERY LOW <sup>a,b</sup>
Transfusion (yes/no) № of participants: 91 (2 RCTs)	<b>OR 0.21</b> (0.02 to 2.03)	Moderate <b>1.8%</b> (0.2 to 15)	8.0% *	<b>6.2% fewer</b> (7.8 fewer to 7 more)	⊕○○○ VERY LOW <sup>a,b</sup>	
Conversion open № of participants: 91 (2 RCTs)	<b>OR 0.090</b> (0.0 ** to 1.770)	Moderate <b>0.8%</b> (0 to 13.3)	8.0% *	<b>7.2% fewer</b> (8 fewer to 5.3 more)	⊕○○○ VERY LOW <sup>a,b</sup>	
<p>Limited operative technique description in the two studies leaves uncertainty about whether the effect was due to the intervention or comparator or a confounder such as dissection technique. The size of the vessel can play an important role in choice of device. Larger vessels may be better taken via mechanical devices. For example, the manufacturer recommendations for some energy devices also do not recommend use above a certain size. Importance of transfusion ranged from important to critical, likely</p>						

	<p>a. Two studies have high risk of bias from lack or unclear sequence generation, allocation concealment, blinding of participants and blinding of assessors. One study had unclear follow-up.</p> <p>b. There is severe imprecision due to small sample size and confidence interval suggesting potential for both harm and benefit.</p> <p>*The median control event rate across the included studies was used</p> <p>**A lower bound of 0.001 was used to calculate a non-zero absolute effect range</p>	<p>based on patient population – e.g. cancer patients, Jehovah’s witness</p>
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**Undesirable Effects (for Mechanical device)**  
How substantial are the undesirable anticipated effects?

<b>Judgement</b>	<b>Research evidence</b>				<b>Additional considerations</b>													
<ul style="list-style-type: none"> <li>○ Large</li> <li>○ Moderate</li> <li>● Small</li> <li>○ Trivial</li> <li>○ Varies</li> <li>○ Don't know</li> </ul>	<table border="1"> <thead> <tr> <th data-bbox="316 598 544 808"><b>Outcomes</b></th> <th data-bbox="544 598 657 808"><b>Relative effect (95% CI)</b></th> <th colspan="3" data-bbox="657 598 1112 661"><b>Anticipated absolute effects* (95% CI)</b></th> <th data-bbox="1112 598 1258 808"><b>Certainty of the evidence (GRADE)</b></th> </tr> <tr> <td></td> <td></td> <th data-bbox="657 661 836 808"><b>With mechanical (stapling/ligation)</b></th> <th data-bbox="836 661 982 808"><b>With energy</b></th> <th data-bbox="982 661 1112 808"><b>Difference</b></th> <td></td> </tr> </thead> </table>	<b>Outcomes</b>	<b>Relative effect (95% CI)</b>	<b>Anticipated absolute effects* (95% CI)</b>			<b>Certainty of the evidence (GRADE)</b>			<b>With mechanical (stapling/ligation)</b>	<b>With energy</b>	<b>Difference</b>						
<b>Outcomes</b>	<b>Relative effect (95% CI)</b>	<b>Anticipated absolute effects* (95% CI)</b>			<b>Certainty of the evidence (GRADE)</b>													
		<b>With mechanical (stapling/ligation)</b>	<b>With energy</b>	<b>Difference</b>														
	<p>Mesenteric venous thromboembolism № of participants: 91 (2 RCTs)</p>	<p><b>OR 6.11</b> (0.68 to 55.19)</p>	<p>Study population <b>1.3%</b> (0.2 to 10.9)</p>	<p>0.0%*</p>	<p><b>1.1% more</b> (&lt; 0.1 fewer to 1.2 more)*</p>	<p>⊕○○○ VERY LOW<sup>a,b</sup></p>												
	<p>Operative Time № of participants: 91 (2 RCTs)</p>	<p>-</p>	<p>-</p>	<p>The mean operative time with energy (stapling/ligation) was 121.4 minutes</p>	<p><b>MD 14.45 minutes higher</b> (5.17 higher to 23.74 higher)</p>	<p>⊕⊕○○ LOW<sup>a,c</sup></p>												
	<p>a. Two studies have high risk of bias from lack or unclear sequence generation, allocation concealment, blinding of participants and blinding of assessors. One study had unclear follow-up.</p> <p>b. There is severe imprecision due to small sample size and confidence interval suggesting potential for both harm and benefit.</p> <p>c. There is imprecision due to small sample size.</p> <p>*0.01 events for the control arm was used to calculate a non-zero absolute effect range</p>																	

**Certainty of evidence**  
What is the overall certainty of the evidence of effects?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<ul style="list-style-type: none"> <li>● Very low</li> <li>○ Low</li> <li>○ Moderate</li> <li>○ High</li> </ul>	<p>All critical outcomes have very low certainty of the evidence.</p>	<p>Importance of transfusion ranged from important to critical, likely</p>

○ No included studies	Outcomes	Importance	Certainty of the evidence (GRADE)	based on patient population – e.g. cancer patients, and Jehovah’s witness. Multiple outcomes deemed critical did not have sufficient data or did not show a difference and were not used in decision-making. No difference in mortality was detected due to lack of events in either arm in both RCTs, with follow-up either unknown or approximately 1 month. No difference was found in port site SSI in Fathi 2020 due to only 1 event in each arm of similar sample size. Organ injury additionally only had 1 event in the stapler group due to minor gastric injury from adhesions, repaired intraoperatively. Due to lack of difference in these previously critical outcomes, outcomes with actual differences were used to make a decision for or against the intervention.
	Mean estimated blood loss (mL)	IMPORTANT	⊕○○○ VERY LOW	
	Transfusion (yes/no)	IMPORTANT -CRITICAL	⊕○○○ VERY LOW	
	Conversion open	CRITICAL	⊕○○○ VERY LOW	
	LOS mean (days)	IMPORTANT	⊕○○○ VERY LOW	
	Mesenteric venous thromboembolism	CRITICAL	⊕○○○ VERY LOW	
	Operative Time	IMPORTANT	⊕⊕○○ LOW	

**Values**  
Is there important uncertainty about or variability in how much people value the main outcomes?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
○ Important uncertainty or		While the low volume difference

variability <input type="radio"/> Possibly important uncertainty or variability <input checked="" type="radio"/> Probably no important uncertainty or variability <input type="radio"/> No important uncertainty or variability		in blood loss is unlikely to be valued, the decrease in transfusions is very likely to be valued by patients. The panel felt that some patients (Jehovah's witnesses, cancer patients) may rate some outcomes as more critical – in particular transfusion.
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**Balance of effects**  
 Does the balance between desirable and undesirable effects favor the intervention or the comparison?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> Favors the comparison <input type="radio"/> Probably favors the comparison <input type="radio"/> Does not favor either the intervention or the comparison <input checked="" type="radio"/> Probably favors the intervention <input type="radio"/> Favors the intervention <input type="radio"/> Varies <input type="radio"/> Don't know	Two small studies with moderate desirable effects and small undesirable effects. However, there is uncertainty in this evidence tempering the balance of effects.	For vessels that are clearly beyond the size recommendation for an energy device, the panel agreed the balance favors the intervention.

**Acceptability**  
 Is the option from balance of effects acceptable to key stakeholders?

<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> No <input type="radio"/> Probably no <input checked="" type="radio"/> Probably yes <input type="radio"/> Yes <input type="radio"/> Varies <input type="radio"/> Don't know		Overcoming surgeon custom/preference is an issue for all evolving techniques, though there is no systematic reason why it cannot be adopted. Some

		surgeons who prefer using energy and have good outcomes may not find a recommendation in favor of mechanical device acceptable. Many surgeons would not accept using energy devices for larger vessels or vessels with substantial calcification.
<b>Feasibility</b> Is the option from balance of effects feasible to implement?		
<b>Judgement</b>	<b>Research evidence</b>	<b>Additional considerations</b>
<input type="radio"/> No <input type="radio"/> Probably no <input checked="" type="radio"/> Probably yes <input type="radio"/> Yes <input type="radio"/> Varies <input type="radio"/> Don't know		Not all institutions may have access to laparoscopic energy devices, though most performing laparoscopic splenectomy will. Lack of instrumentation may make implementation less feasible in limited settings.

### Summary of judgements

	JUDGEMENT						
DESIRABLE EFFECTS	Trivial	Small	<b>Moderate</b>	Large		Varies	Don't know
UNDESIRABLE EFFECTS	Large	Moderate	<b>Small</b>	Trivial		Varies	Don't know
CERTAINTY OF EVIDENCE	<b>Very low</b>	Low	Moderate	High			No included studies
VALUES	Important uncertainty or variability	Possibly important uncertainty or variability	<b>Probably no important uncertainty or variability</b>	No important uncertainty or variability			

	JUDGEMENT						
BALANCE OF EFFECTS	Favors the comparison	Probably favors the comparison	Does not favor either the intervention or the comparison	Probably favors the intervention	Favors the intervention	Varies	Don't know
ACCEPTABILITY	No	Probably no	Probably yes	Yes		Varies	Don't know
FEASIBILITY	No	Probably no	Probably yes	Yes		Varies	Don't know

### Type of recommendation

Strong recommendation for the comparison (energy) ○	Conditional recommendation for the comparison (energy) ○	Conditional recommendation for either the intervention or the comparison ○	Conditional recommendation for the intervention (mechanical) ●	Strong recommendation for the intervention (mechanical) ○
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### Conclusions

#### Recommendation

The panel suggests that endomechanical devices be used to control the hilum for most patients undergoing laparoscopic splenectomy.

#### Justification

The use of mechanical devices in the division of the splenic hilum has slight decreased risk of intraoperative blood loss, need for transfusion, conversion to an open operation, and LOS.

The very low certainty in the evidence available precluded a strong recommendation. The panel felt there was insufficient research information on details for the mechanical devices (e.g. stapler height), and blood vessel sizes. The panel unanimously agreed that very large hilar vessels would be safer to take with mechanical devices.

#### Subgroup considerations

- Large hilar vessels should be taken with mechanical devices.
- Pediatric patients may have more advantages with energy devices due to small vessel size.
- As diminished blood loss as an outcome favors energy devices, patients who place a high value on this outcome (such as Jehovah's witnesses) may benefit more from energy over mechanical devices.

#### Implementation considerations

None

#### Monitoring and evaluation

May need to follow splenic vein thrombosis rates.

#### Research priorities

- High quality studies that compare mechanical versus energy devices to control the splenic hilum during minimally invasive splenectomy using a randomized design, standardized surgical technique (besides the comparators), description of anatomic findings (specifically hilar vessel size and accessory spleen presence), and similar indications
- Studies conducted in this area should report the following outcomes: blood loss, transfusion requirements, VTE rate, conversion to open, rate of pancreatic injury

## References

1. Fathi A, Elmoatasembellah M, Senbel A, Shahatto F, Eldamshety O, Shetiwy M, Abdel Wahab K, Abouzid A, Setit A (2020) Safety and efficacy of using staplers and vessel sealing devices for laparoscopic splenectomy: A randomized controlled trial. *Surg Innov* Aug 26;1553350620953023; doi:10.1177/1553350620953023.
2. Shabahang H, Maddah G, Tavassoli A, Jangjoo A, Alvandipour M, Abdollahi A, Noorshafiee S (2012) Laparoscopic splenectomy: ligasure or clip ligation? *Surg Laparosc Endosc Percutan Tech* 22:136-138.