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Editorial

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Mesh or no mesh in anti-reflux surgery

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INTRODUCTION & BACKGROUND

History of evidence accumulation for anti-reflux surgery

Surgery against refractory gastroesophageal reflux disease and hiatal hernia depends on hiatal closure and prevention of either recurrent herniation or symptoms of ongoing reflux[1]. In the past few decades in anti-reflux surgery (ARS), attempts have been made to judge the quality of the evidence underlying the practices of surgeons in ARS. In the second half of the twentieth century, the evidence base for many practices in ARS was poor[1]. One suggestion to augment hiatal closure was the use of mesh, but its use was supported by mostly case series and reports until the turn of the century. Currently, the use of mesh is not universally accepted, and more studies have accumulated about the use of mesh in ARS[2,3].

Trends of mesh use in ARS

In a 2010 survey of members of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), mesh was commonly used in hiatal hernia repair (HHR) and the most commonly cited indication (45% of respondents) for mesh placement was the size of the hernia defect with 24% citing a size of 5 cm as the decision point[4]. The technique of placement was highly heterogeneous although an onlay technique in some fashion and suture fixation were most common[4]. In a similar survey of SAGES members in 2012, 77% of respondents at least selectively used mesh in HHR with the trend in the data suggesting that younger surgeons were more likely to use mesh than were older surgeons[5]. In both surveys of the SAGES community, mesh types were heterogeneous although biologic meshes were most commonly used[4,5]. Similar results were found in a survey of the European Association for Endoscopic Surgery (EAES) in 2015,

with higher use of mesh at 92.1% of European surgeons at least selectively using mesh although mesh types differed with most surgeons preferring either polypropylene, polyester or PTFE meshes and only 27.9% using biologic meshes[6]. In registry analyses, these survey results are further expanded: mesh is used frequently but in less than half of ARS cases overall[7-10]. As for trends over time, in two National Surgery Quality Improvement Program (NSQIP) analyses between 2010-2015, the use of mesh remained stable over time at around 38%-43%[7,8]. In registry analyses including the second half of the last decade, however, results conflicted. In an NSQIP analysis between 2010-2017 of over 25,000 cases, mesh utilization decreased from 46.2% to 35.2%[9]. In a European analysis between 2010 - 2019, mesh utilization for axial HHR was stable at ~20%, for paraesophageal HHR mesh increased from 33% to 38.9%, and was stable for recurrent HHR at around 45%[10].

Professional society recommendations and directions

The heterogeneous practice patterns in ARS are reflected in recent reviews and in professional society guidelines. In the SAGES Guideline on general Surgical Treatment of GERD from 2021, mesh use is not discussed, but in its Guideline on Management of Hiatal Hernia Repair in 2013, mesh is recommended for large HH based on several randomized controlled trials (RCT), although long-term data is noted to be insufficient beyond the short follow-up interval of the available RCTs as of 2013[11,12]. In this chapter, we will review the most recent data underlying the subscription to mesh use in ARS as well as more specific considerations of mesh implementation in ARS.

Hiatal hernia repair

Highest level of data - the meta-analyses of suture vs. mesh in HHR

In general, mesh utilization in ARS is most relevant in HHR. Given the publication of several RCTs about mesh utilization in HHR since the most recent SAGES guidelines, multiple meta-analyses have subsequently been published [Table 1][13-25]. Although results from earlier meta-analyses might suggest benefits for mesh placement, it should be noted that most early studies include observational data. Two recent meta-analyses are consistent in evaluating the same 7 RCTs only (no observational data included), and both find no advantage to the use of mesh in HHR[13,14]. Caution in interpreting the meta-analytic data is advised as the RCTs included are heterogeneously conducted (see next section).

A granular look at the RCTs conduct on mesh utilization in HHR

As can be seen in the table below, the heterogeneity of available RCTs studying mesh placement in HHR since 2000 is noteworthy [Table 2][26-32], especially when considering years of follow-up and the type of mesh used. Two studies used biologic meshes and the other five used non-absorbable meshes. Additionally, the studies frequently define inclusion size for HH differently. Of note, the two largest, most recent studies both show no definite advantage with mesh utilization[26,27]. This likely accounts for the differences seen in the most recent meta-analyses compared to those from prior years.

Observational data in mesh placement during HHR

Although many observational studies have been published on mesh use in HHR, few add to the RCTs and meta-analyses discussed previously. Heterogeneity is the rule with little standardization across the board, but a few observational studies stand out. The largest observational study featured 795 patients; the mesh-repair group featured mostly biologic mesh[33]. This study agreed with the findings of metanalyses of RCTs in that there was no long-term difference in recurrence between mesh-based and suture-based HHR[33]. In the only study of any style to our knowledge that discusses financial cost, several biologic meshes are compared and the lowest recurrence rate is shown for human tissue matrix at 6 months but not at longer intervals[34]. With respect to cost in this study, porcine tissue matrix is the most costly and biosynthetic mesh is the least costly, but no cost comparison was made with the non-absorbable meshes or suture-based

Table 1. Metanalyses on mesh use in HHR in reverse chronological order

Authors	RCT	Obs	*n*	Hernia recurrence in index procedure Favored	Need for reoperation Favored	Symptomatic improvement Favored	Overall complication Favored
Angeramo *et al.* (2022)[13]	7	0	735	Neither	Neither	---	Suture
Petric *et al.* (2022)[14]	7	0	735	Neither	---	Neither	Neither
Rausa *et al.* (2021)[15]	8	9	1857	Mesh	---	---	Neither
Campos *et al.* (2020)[16]	6	2	520	Neither	Neither	---	Neither
Memon *et al.* (2019)[17]	5	0	478	Neither	Mesh	---	Neither
Sathasivam *et al.* (2019)[18]	4	5	942	Mesh	Neither	---	Neither
Zhang *et al.* (2017)[19]	4	9	1474	Mesh	---	Mesh	Neither
Memon *et al.* (2016)[20]	4	0	406	Neither	Mesh	---	Neither
Tam *et al.* (2016)[21]	3	10	1194	Mesh	Neither	---	---
Huddy *et al.*(2016)[22]	4	5	676	Mesh	Mesh	---	Neither
Antoniou *et al.* (2015)[23]	2	3	295	Mesh	---	---	---
Muller-Stitch *et al.* (2015)[24]	3	9	915	Neither	---	---	Mesh
Antoniou *et al.* (2012)[25]	3	0	267	Mesh	---	---	---

Ellipsis indicates that meta-analysis was not carried out for this metric. RCT: Randomized controlled trials; HHR: hiatal hernia repair; Obs: observational study.

Table 2. RCTs evaluating mesh *vs.* suture in HHR, in reverse chronological order

Authors	*n*	Follow-up	Mesh	Recurrence	Overall satisfaction	Overall complication	Reoperation
Watson *et al.* (2020)[26]	126	5 years	SIS (absorbable) or polypropylene (non-absorbable)	Neither	Neither	---	---
Analatos *et al.* (2020)[27]	159	3 years	PTFE (non-absorbable)	Neither	Neither	Neither	Neither
Ilyashenko *et al.* (2018)[28]	98	4.5 years	Polyester-polylactic composite (non-absorbable)	Mesh	Mesh	Neither	Neither
Oor (2018)[29]	72	1 year	polypropylene (non-absorbable)	Neither	Neither	Neither	Neither
Oelschlager *et al.* (2011)[30]	72	58 months	SIS (absorbable)	Neither	Neither	Neither	Neither
Granderath *et al.* (2005)[31]	100	1 year	polypropylene (non-absorbable)	Mesh	Neither	Neither	Neither
Frantzides *et al.* (2002)[32]	72	2.5 years	PTFE (non-absorbable)	Mesh	---	Neither	Mesh

Ellipsis indicates that study did not compare this metric quantitatively. RCT: Randomized controlled trials; HHR: hiatal hernia repair.

repair[34].

Other considerations in anti-reflux surgery

Gastroesophageal reflux disease without HH

In general, although when considering mesh usage in ARS one is discussing HHR, mesh can be used in non-HH-related ARS. In the only (small, $n = 50$) RCT to our knowledge in non-HH-related ARS comparing mesh- to non-mesh repairs, Muller-Stich *et al.* compared laparoscopic mesh-augmented hiatoplasty with

cardiophrenicopexy (LMAH-C) with laparoscopic Nissen fundoplication (LNF) in patients with GERD but excluded those with Type II-IV HH[35]. Considering endoscopy findings and symptom scores as primary endpoints, they showed that treatment failure with higher reflux-related symptom scores and esophagitis findings was worse in the LMAH-C arm compared to LNF[35]. Although this is a demonstration of improved symptom control in non-HH-related ARS without the use of mesh, it is not clear that the lack of mesh is what was operative in this case as two different operations were compared independent of the mesh use or non-use: a gastropexy *vs.* a fundoplication. Generally, few data exist about mesh- *vs.* non-mesh repairs during non-HH-related ARS.

Reoperative anti-reflux surgery

Little data exists comparing mesh- and non-mesh-based repairs of *reoperative* ARS. Many surgeons consider reoperation an indication of mesh usage, and so perhaps the lack of data owes to the suspected lack of equipoise[4,9]. Nevertheless, in the only comparative study of mesh use in reoperative ARS - essentially a case series that discusses the use of mesh or not in reoperative ARS - Desai *et al.* found similar *re*-reoperation rates (16% *vs.* 20%) in mesh-based and non-mesh-based repairs of failed HHR (n = 82)[36]. Additionally, some of the RCTs for HHR include reoperative HHR, but none provide subgroup analysis of this population[27]. In general, the use of mesh in reoperative ARS has not been sufficiently studied.

Complicated HHs

Almost no data exist to guide the surgeon in choosing how to operate on the difficult population that presents with acute complicated HH, including gastric volvulus, perforation, or obstruction[3]. No comparative studies comparing mesh and non-mesh-based repairs in complicated HH are available.

Reasons not to use mesh

Finally, there are particular risks to the use of mesh not reflected in the apparently benign results in which no difference in complication rates is seen in mesh-based and non-mesh-based arms of RCTs in ARS. Mesh erosion is a feared complication in which the mesh burrows into the esophagus. Mesh erosion can present with dysphagia, abdominal pain, fistula, reduced oral intake, odynophagia, or weight loss. In a recent systematic review, the risk of this complication is about 0.035% of all ARS cases in which mesh is used, and non-biologic mesh is the more frequently associated culprit, with the complication generally occurring within 5 years of the procedure[37].

Though perhaps less often considered, there is a more common reason to avoid mesh if it does not benefit the patient: cost. Although the dollars-and-cents cost of mesh usage was not reported in any of the RCTs and few observational studies, mesh has an obvious cost on top of the simple sutures that would otherwise be used for crural approximation during ARS. In the study cited previously, several biologic meshes are compared and the costs vary but do not seem to affect the overall charge[34]. Aside from that report, however, very few data exist as to the financial cost-benefit analysis of mesh usage in ARS.

CONCLUSIONS

Although the data suffers from biases including heterogeneity in definition, materials applied in mesh-based repairs, follow-up duration, and drop-out, there is little evidence to recommend the routine use of mesh in anti-reflux surgery and a lack of strong evidence to promote selective mesh use, even for commonly cited indications like the large size of hernia or crural tension. Mesh usage for anti-reflux surgery in the United States and Europe remains prevalent, with more than 75% of surgeons selectively using mesh augmentation in 35%-40% of their cases.

DECLARATIONS

Authors' contributions

Made substantial contributions to conception and design of chapter, analyzing available data, and performing interpretation: Bitner DP

Reviewed presented data, as well as provided administrative, technical, and material support: Filicori F

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Not applicable.

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Conflicts of interest

Dr. Filicori has consulting affiliations with Active Surgical and Boston Scientific.

Dr. Bitner has consulting affiliation with Deep Surgery.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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