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PATHOLOGICAL FINDINGS OF TRANSVAGINAL POLYPROPYLENE SLINGS EXPLANTED FOR LATE COMPLICATIONS: MESH IS NOT INERT

Hypothesis / aims of study

Over the last decade, polypropylene mesh slings have become the most commonly performed operations for stress incontinence. Accompanying this surge, there have been increasing reports of mesh related complications that require partial or complete removal of the sling, yet there has been a paucity of studies reporting pathological findings in the explanted meshes. Further, in most hospital pathology labs, explanted mesh slings undergo a cursory evaluation, often no more than a "gross only" or very superficial microscopic examination (1). The aim of this study is to examine pathologic features of explanted transvaginal slings to better understand the mesh-tissue interactions and their role in the development of complications.

Study design, materials and methods

This is a retrospective study of consecutive explanted polypropylene monofilament transvaginal slings received between 2010-14 at our pathology department. Scar tissue from non-mesh excisions were used as reference controls. Sling technique (retropubic or transobturator), in vivo time and reasons for excision were obtained from the medical records. The specimens were assessed grossly for deformation visually and by palpation, processed for paraffin embedding, H&E and S100 staining. Scarring, inflammation, neurovascular ingrowth, muscle involvement, mesh position (rotation, edge curling) were assessed microscopically. A degradation layer was detected by dye absorption and polarization properties. Nerve branches were counted in 200x microscopic fields in explanted transvaginal slings and, for comparison, in 10 polypropylene monofilament meshes explanted for recurrence of ventral hernias.

Results

Table 1 provides patient age, mesh in vivo exposure time, sling technique and the reasons for explantation. The explant specimens showed a spectrum of findings summarized in Table 2 and Figure 1.

Interpretation of results

The most striking findings were that all specimens showed nerve ingrowth, degradation of polypropylene and chronic inflammation independently from mucosal exposure and in vivo exposure time. The latter two indicate that the mesh is not fully inert. In contrast, mature scar tissue after non-mesh surgeries does not show inflammation. Additionally, the mesh structure formed multiple compartments inhabited by living tissue with blood vessels and nerve branches. Within these mini-compartments, the innervated tissue is exposed to potential sources of pain such as compression/stretching, inflammation, ischemia etc. In comparison, the density in sling explants was 11.4 times higher than in the abdominal wall mesh explants (0.12 vs. 1.39, two-tailed p=0.001) providing histological basis for pain and hyperalgesia. An important finding was the detection of a polypropylene degradation layer resembling a tree bark at the filament surface. Surprisingly, easily visible in the microscope, it has been overlooked for over 50 years. For mesh exposure, an important finding was that sling edges rotated/curled towards the surface at the exposure sites detected in the slides. This correlated with edge curling of stretched new slings. Edge curling is likely one of the mechanisms of mucosal penetration.

Concluding message

While the long term fate of mesh in the body is unknown, in our series of meshes explanted for complications, all specimens showed chronic and foreign body inflammation (which is not seen in mature scar from non-mesh surgeries), nerve ingrowth and mesh degradation. The findings suggest that mesh is not inert, but rather degrades and elicits a continuous immune response. The compartmentalizing nature of the meshes and nerve ingrowth might create a background for the pain mechanisms. Polypropylene degradation needs to be studied further for its role in inflammation, mesh hardening and late deformation as well for the properties of chemical degradation products. This preliminary analysis also suggests that edge curling of the tapes contributes to mucosal exposure.

Table 1. Sling types and reasons for excision (some patients had >1 recorded complication)

	% (n)	Median age years (range)	In vivo years (range)	Pain %	Erosion %	Urinary symptoms %
Total	100 (63)	54 (25-71)	4.0 (1.5-8.0)	79	40	19
Retropubic	29 (18)	55 (50-61)	4.7 (2.0-7.6)	75	42	33
Transobturator	71 (45)	49 (28-71)	3.5 (1.5-8.0)	80	40	13

Table 2. Most frequent pathological findings (no significant difference between sling types)

Inflammation, chronic and foreign body (% of cases)	100
Mucosal perforation in sections + edge rotation + acute inflammation (% of cases)	29
Nerve branches ingrown into mesh (% of cases)	100
Striated muscle, adjacent or ingrown (% of cases)	14
Smooth muscle, adjacent or ingrown (% of cases)	71
Polypropylene degradation (% of cases)	100
Vaginal mesh nerve density (nerve branches/200x microscopic field; mean, range)	1.39 (0.6-3.5)
Abdominal wall mesh nerve density (branches/200x microscopic field; mean, range)	0.12 (0-0.41)

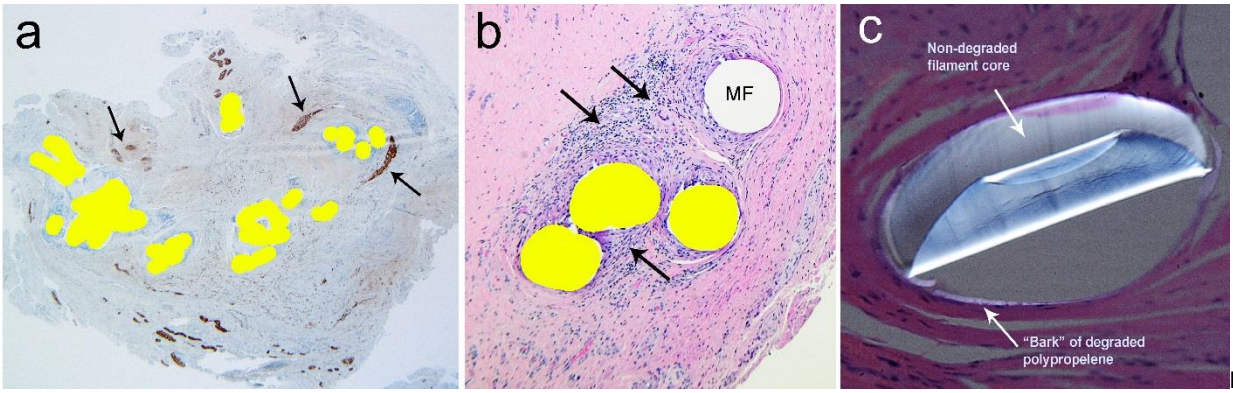

Figure 1. a: Nerve ingrowth. 2.5x objective, S100 stain to highlight nerves (dark brown, some nerves pointed by arrows). Mesh filaments are filled yellow for demonstration. **b:** Foreign body and non-specific chronic inflammation. H&E stain, 20x objective, three filaments filled yellow, one left unfilled (MF), inflammation pointed by arrows. **c:** Polypropylene degradation. 40x objective, partially polarized light. The bark of degraded polypropylene surrounds the central core (in the picture the core detached and folded). Both, the core and the bark show the same polarizing properties (brightly lit). The bark absorbs histological dyes due to it porosity and stains purple while the core remains clear (MF filament left clear in panel "b").

References

1. Smith TM, Smith SC, Delancey JO, Fenner DE, Schimpf MO, Roh MH, Morgan DM. Pathologic evaluation of explanted vaginal mesh: interdisciplinary experience from a referral center. Female Pelvic Med Reconstr Surg. 2013;19(4):238-41.

Disclosures

Funding: Specimens were received at the pathology department for routine diagnostic assessment, no additional funding required. Some specimens were received as external consultations sent for litigation purposes. **Clinical Trial:** No **Subjects:** HUMAN **Ethics Committee:** St. Michael's Hospital Research Ethics Board, Toronto, Canada **Helsinki:** Yes **Informed Consent:** Yes