Updates in Mesh and Biomaterials

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KEYWORDS

• Hernia • Abdominal wall • Biological mesh • Synthetic mesh • Biosynthetic mesh

KEY POINTS

- Additional evidence highlighting the low morbidity associated with synthetic mesh and biosynthetic mesh in clean-contaminated and contaminated fields is provided.
- Additional evidence discussing the limitations of using biologic mesh is provided.
- The future of mesh research may involve trialing novel polymers, alternative ways to deliver antibiotics to surgical sites, and involve data registries including patient-centered outcomes and direct surgeon feedback.

INTRODUCTION

Prior publications of the *Surgical Clinics of North America* have highlighted the technical challenges of abdominal wall reconstruction. In 2008, the issue dedicated to abdominal wall reconstruction discussed the biology of hernia formation, the history of hernia repair, open and laparoscopic ventral hernia repair, and the benefits of the use of prosthetic mesh on patient outcomes. Despite the vast selection of mesh brands available, nearly all mesh continues to use 1 of 3 basic materials—polypropylene, polyester, or polytetrafluoroethylene in various combinations with or without barrier coating. The mesh types differ in many characteristics, including their tensile strength, elasticity, and weight, which depends on pore size and the weight of the polymer. Heavy weight mesh uses thick polymers, small pore size, and high tensile strength, whereas light weight mesh uses thinner polymers and larger pores.

In the 2008 *Surgical Clinics of North America* publication, Bachman and Ramshaw[1] discussed the wide variety of mesh products available for abdominal wall reconstruction and the challenge facing surgeons to choose the most appropriate mesh for ventral hernia repair. Interestingly, they concluded that there was no "best" mesh. Still

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a decade later, the decision of which mesh to use is based on several factors: the type of procedure being performed, the clinical situation (elective vs emergent, Centers for Diseased Control and Prevention [CDC] wound classification, etc), the desired handling characteristics to optimize mesh placement, material costs, and the products available to the surgeon based on hospital material contracts.[1] In the same publication, Jin and Rosen[2] described the limited data available specifically when comparing the long-term outcomes of for synthetic to biologic mesh. It seemed that most mesh selections were based on surgeon's anecdotal experience. Clearly, prospective studies comparing clinical outcomes for the variety of meshes available is needed.[2] In that same issue, Earle and Mark[3] discussed the many variables of mesh designs, including the polymer used, fiber size, fiber strength, elasticity, pore size, density, and bioreactivity. These multiple variables do not allow for direct comparisons. Earle and Mark also stressed that, as more mesh types are being developed, surgeons must balance the uncertainty of long-term outcomes when introducing a new prosthetic against the more certain outcomes of existing products.[3] This challenge remains true a decade later.

The 2013 publication of the *Surgical Clinics of North America* on abdominal wall reconstruction further addressed the clinical outcomes of biologic mesh and the safety of prosthetic mesh repair in contaminated settings. The literature exploring the use of biologic grafts in infected and contaminated fields was disappointing. Preclinical animal studies failed to demonstrate consistent evidence of biological mesh remodeling and long-term clinical outcomes using biologics revealed higher than expected recurrence rates.[4] Alternatively, Carbonell and Cobb[5] cited a relatively low morbidity rate associated with the use of light weight and even heavy weight polypropylene mesh in clean-contaminated and contaminated fields. At that time, however, many surgeons remained reluctant to change their practice based on this literature owing to fears of complications, specifically wound and mesh infections, and using prosthetic mesh off-label in CDC class II and III wounds.

The *Surgical Clinics of North America* is dedicating another publication to abdominal wall reconstruction in 2018, and this article provides an update on biomaterial research. This article specifically reviews synthetic, biologic, and biosynthetic mesh research and concludes with thoughts about the future of mesh research. This update highlights research that has been conducted since the prior publication to guide surgeons to make evidence-based choices about biomaterial for ventral hernia repair that are most appropriate for their patients.

UPDATE ON SYNTHETIC MESH RESEARCH

Since Usher and associates[6] first introduced polypropylene prosthetics for incisional hernia in the late 1950s, synthetic mesh has been the predominate material used for hernia repair. Permanent synthetic meshes provide long-term mechanical support to the hernia defect and have been shown to reduce recurrence rates compared with sutured or primary repair. As the use of synthetic mesh became more commonplace, clinical outcomes studies have been conducted that directly impact the surgeon's decision making with regard to mesh selection. Although permanent synthetic meshes have been engineered for strength and durability, short- and long-term complications have been attributed to their use. As such, additional modification in fiber diameter and pore size to decrease the density of the material were implemented. These meshes are categorized into heavy weight, midweight, and light weight depending on the grams per square meter.[7] Studies before 2013 demonstrated an improved quality of life (QOL) with light weight mesh. However, Groene and

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