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BIOCOMPATIBLE PROPERTIES OF SURGICAL MESH USING AN ANIMAL MODEL

Hypothesis / aims of study

Meshes have been used in prolapse and incontinence surgery for some time now without significant research or clinical data to support its use. Types of mesh vary substantially with regard to composition of the fibres, type of weave, pore size, tensile strength, and flexibility of the material. The aim of this study is to compare the biocompatibility of 7 surgical meshes (used in pelvic reconstructive surgery) in an animal model.

Study design, materials and methods

Animal Ethics Committee approval was obtained prior to commencement of the study. The meshes employed were polypropylene meshes (Atrium, Gynemesh, Prolene), mixed fibre mesh (Vypro II), and mid-urethral sling polypropylene meshes (TVT, SPARC, IVS). Meshes were implanted onto the sheath of the abdominal wall of 40 male Sprague-Dawley rats at 70 days of age. Meshes were implanted in a standardised manner on the right of the midline of the abdomen, over intact fascia. The meshes were explanted (with fascia intact) after 12 weeks and stained with haematoxylin and eosin. Light microscopy was used to assess parameters of tissue rejection and incorporation. An independent pathologist blinded to the mesh types, assessed the sections and graded the parameters qualitatively. Interobserver and intraobserver comparisons were undertaken to ensure reproducibility of results.

Results

All mesh samples analysed were composed of non-absorbable prosthetic materials. With histological review, the samples could be divided into 4 groups by mesh pattern and cellular response. All Type 1 meshes (Atrium, Gynemesh, Prolene, SPARC, TVT) had similar mesh patterns and cellular responses, and were not distinguishable from each other. IVS mesh had distinct features allowing these mesh samples to be grouped separately, and Vypro II had characteristics also dissimilar from the other groups. Finally, the control group was identified as containing no mesh. There were variations in the inflammatory cellular response to the different meshes. Vypro II and IVS (Type 3 meshes) had a higher proportion of giant cells and histiocytes compared to Type 1 meshes. Vypro II mesh and IVS mesh had a more marked fibrotic reaction than the Type 1 meshes. The pattern of fibrosis in IVS mesh was different, with perimeter fibrosis present. Type 1 meshes had small quantities of fibrosis.

Interpretation of results

All Type 1 meshes tested were macroporous and composed of monofilamentous polypropylene. Despite significantly different mesh architecture, no differences were noted in cellular tissue responses. Material and filament composition of the mesh, therefore, appears to be the main factors in determining cellular response. The inflammatory response in both Type 3 meshes was more marked than the Type 1 meshes. The Type 3 meshes (IVS and Vypro II) are both macroporous and composed of multifilamentous polypropylene. Vypro II also contains multifilamentous polyglactin fibres within its structure. The marked inflammatory response of giant cells and histiocytes, may be due to the multifilamentous polypropylene components of these meshes. This finding is consistent with other studies comparing monofilamentous and multifilamentous polypropylene mesh (1). Comparison of the fibrous reaction in Type 1 and Type 3 meshes showed a more marked fibrotic response in the Type 3 meshes tested. Once again, the multifilamentous polypropylene fibres may promote added fibrosis compared to monofilamentous polypropylene. The more vigorous inflammatory response of the Type 3 meshes may also contribute to fibrosis. While adequate fibrosis is anticipated to give good tissue strength, excessive tissue fibrosis may result in reduced tissue flexibility (2).

Concluding message

The Type 1 and Type 3 meshes assessed demonstrated different biocompatible properties within the context of this animal model. All Type 1 meshes displayed similar cellular responses despite strikingly different architecture. Inflammatory cellular response and fibrosis was most marked with Vypro II and IVS. Biomechanical testing on these tissues may provide functional correlation between tensile strength and histological appearance.

References

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