The use of prosthetics in hernia repair

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Since the early 19th century different prostheses have been tried and tested to prevent recurrences after hernia repairs. This article reviews the evolution of prostheses and their use in hernia surgery. Tension-free mesh hernia repairs using polypropylene fibre seems to be associated with very low recurrence rates and minimal complications.

Since Bassini introduced modern anatomical hernia surgery in 1887, recurrence has plagued surgeons. Prosthetic biomaterials are sometime needed to bridge or reinforce natural and unnatural defects in the integrity of groin and abdominal wall hernias.

TYPES OF PROSTHESES

Metal prostheses

The earliest manmade prosthetic reinforcement for hernia repair was silver wire coils used on the floor of the inguinal canal by Phelps in 1894. The idea was to induce a foreign body reaction and fibrosis to reinforce the repair. This gave rise to silver wire mesh, which became the first prosthetic mesh to be routinely incorporated in the repair of difficult or recurrent hernias. Tantalum (wire) gauze became popular for repair of both inguinal and ventral incisional hernia repairs, followed by the use of stainless steel mesh (Babcock, 1952). Stainless steel was in use up to 1986, and good success rates have been reported in repair of large incisional hernias (Validire et al, 1986).

Non-metallic synthetic prostheses

Infections and fatigue fractures associated with metallic prostheses initiated the need to develop non-metallic synthetic prostheses. In 1952 Fortison, a cellulose fabric, was introduced as a biologically inert mesh, but was never accepted because of problems with infection. Polyvinyl sponge, nylon mesh, silastic sheets, Teflon mesh (EI Dupont, Wilmington, Delaware) and carbon fibre mesh were subsequently used but not accepted because of a variety of complications.

Prosthetics in current use

In 1946 polyester Dacron mesh (Ethicon, Somerville, New Jersey), also known as Mersiline mesh, was introduced and became popular because of its strength, elasticity, inertness, pliability and low infection rates. This has been widely used to treat groin and incisional hernia, with good results, over the past four decades.

In 1963 a new knitted mesh of polypropylene monofilament fibre, Marlex (CR Bard, Bellarica, Massachusetts) mesh, was introduced. This had superior qualities to any of its predecessors and has been used for repair of primary and recurrent groin, incisional, femoral and parastomal hernias. Marlex mesh has also been used for reconstruction of the abdominal wall after laparostomies, abdominal trauma and repair after radical abdominal wall surgery. In 1983 polytetrafluoroethylene (PTFE) was used to develop the Gore-Tex soft tissue patch (WL Gore, Arizona). Its properties differentiate it from other mesh prostheses. The smooth surface of a PTFE patch is non-abrasive and elicits minimal foreign body reaction. The incidence of postoperative visceral adhesion formation is low with fewer long-term bowel complications (LeBlanc and Booth, 1992). Polyglycolic acid (dexon; Davos and Geck, Puerto Rico) and polyglactin (Vicryl; Ethicon, Somerville, New Jersey) have been developed as absorbable meshes. Their role in hernia repairs is yet to be determined.

GROIN HERNIA REPAIR

Hernia plugs

Lichtenstein introduced the rolled cylindrical or 'cigarette' mesh plug for treatment of femoral and recurrent inguinal hernias (Lichtenstein and Shore, 1974). The first ready to use preformed umbrella hernia plug (Prefix; CR Bard, Masachusetts) came out in 1993 and is widely used both for inguinal and femoral hernia repairs, with <1% recurrence rates for primary and <3% recurrence rates for recurrent hernias (Robbins and Rutkow, 1993; Rutkow and Robbins, 1998). Other advantages include reduction in short- and long-term postoperative pain, operating time and postoperative neuralgia. This technique is not recommended for multi-recurrent hernias where recurrence rate is quite high after plug repairs.

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Tension-free mesh repair: Lichtenstein and laparoscopic methods

Lichtenstein popularized his tension-free hernioplasty using plastic mesh 'onlay' technique in the early 1970s. In 1989 he reported zero recurrence rate in 1000 patients after follow up of 1–5 years (Lichtenstein et al, 1989). Others have reported recurrence rates as low as 0.2% from 3000 patients (Shulman et al, 1992). Originally described under local anaesthetic it can be carried out on patients previously considered unsuitable for hernia repairs. Early mobilization, decreased pain and early return to work are some of the benefits compared to conventional open repairs. With the advent of the laparoscopic era, tension-free mesh repairs are increasingly performed laparoscopically although this is not widely accepted in the UK. Evidence suggests that laparoscopic mesh repair is of value in recurrent and bilateral hernias, and unilateral hernias in young people where a contralateral hernia is suspected.

Giant prosthetic reinforcement of the visceral sac

Stoppa et al's (1984) revolutionary and innovative bilateral properitoneal prosthetic hernioplasty with Dacron involves replacement of the transversalis fascia in the groin with a prosthesis that extends beyond the myopectanial orifice. The mesh adheres to the peritoneum and renders it inextensible so that it cannot protrude through the parietal defect. The technique is sutureless and tension free and is especially effective for recurrent or re-recurrent groin hernias.

INCISIONAL HERNIA REPAIR

Primary incisional hernia repairs are notorious for their recurrence rates which vary from 10–48% (Bauer et al, 1987). Dacron, Prolene (Ethicon, Somerville, New Jersey) and PTFE meshs have been used successfully in tension-free repair of incisional hernias with a reduction in recurrence rates of 5–10%. Successful repair of giant incisional hernias has been performed using mesh repair. A laparoscopic study of 407 ventral and incisional hernia mesh repair reported a low recurrence rate, less blood loss and shorter hospital stay (Heniford et al, 2000).

COMPLICATIONS ASSOCIATED WITH PROSTHETIC USE IN HERNIA SURGERY

Infection remains the 'bete noir' of prosthetics and rates up to 1–2% have been reported. Meshes are eventually 'inhabited' by fibroblasts and will fibrose, causing a rigidity and buckling that is felt by some patients. Contact between severed nerve ends and polypropylene mesh can lead to late postoperative pain. All prosthesis form adhesions, although Gore-Tex probably forms the fewest fibrotic adhesions in the peritoneal cavity. There is no evidence that prosthetics are carcinogenic; but this issue is not completely resolved.

CONCLUSIONS

Use of synthetic mesh allows large gaps in tissues to be bridged without tension, making it possible to cure almost every hernia, regardless of shape or size. Stoppa (1989) wrote that hernial surgery has advanced to the point that one must consider systematic surgical cure of all diagnosed hernias. However, as Zimmerman (1968) said, 'Prostheses, whatever their value, cannot replace a full knowledge of the underlying anatomy and pathology of hernia, or substitute for the exercise of time-honored principles of surgical techniques'. HM

Conflict of interest: none.

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KEY POINTS

- Recurrent hernias have plagued surgeons since hernia surgery began.
- Metal prostheses followed by non-metallic synthetic prostheses have been used with low success and high complication rates in the past.
- With the advent of polypropylene and polytetrafluoroethylene fibre mesh the recurrence and complication rates have decreased dramatically.
- A tension-free mesh repair method has been accepted as the gold standard for a number of types of hernia repair.
- Infection of the mesh and postoperative pain in a minority of patients remain the main complications.