



Ten-Year Personal Experience of Using Low Density Polyethylene (LDPE) Mesh for Inguinal Hernia Repair

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Abstract

Introduction: An innovative frugal technology that has recently been reported with positive short-term clinical outcomes is the use of sterilised mosquito net as an alternative to commercial hernia meshes. However, long-term clinical data supporting the use of this mesh is lacking.

Methods: A ten year retrospective analysis of consecutive patients undergoing inguinal hernia repair using Low Density PolyEthylene (LDPE) mesh with 12-18 months follow up.

Results: During the study period 713 inguinal hernia repairs were performed using low cost polyethylene mesh in 651 patients. Thirty-two patients were lost to follow up. There were six superficial surgical site infections (0.9%), one seroma (0.1%), two patients who experienced chronic pain (0.3%), and two hematomas (0.3%). There were no recurrences or cases of mesh rejection.

Discussion: The results of this retrospective study confirm the long-term safety and effectiveness of the use of LDPE mosquito net mesh for inguinal hernioplasty.

Keywords: Using Low Density Polyethylene (LDPE); Inguinal hernia repair; Mosquito net

Global Burden of Schistosomiasis

The use of prosthetic mesh to reinforce the abdominal wall in inguinal hernia repair is now accepted as the gold standard and has led to recurrence rates below 5% [1-3]. However in most low-income, resource-poor developing countries a traditional sutured repair, with significantly inferior results, is still commonplace as commercial mesh is either unavailable or unaffordable [4]. The implications of neglected inguinal hernias in resource-limited settings are well documented [5-11]. In rural areas of underdeveloped countries, where poverty is endemic and modern healthcare is a luxury, there is an unspoken global acceptance for allowing patients to live with chronic disabilities such as hernias [12]. In these settings, solutions that employ cheaper, alternative and innovative technologies will have significant economic advantages for patients and the healthcare systems. One example is the use of sterilised mosquito net as a cheaper alternative to commercial mesh used in hernia repair.

Over the last few years, a number of studies have examined the use of locally available mosquito net, of various polymers, for hernia repair in developing countries [8-11,13,14]. Despite several studies demonstrating that mosquito net can be implanted with low complication rates, using the global term 'mosquito net' to describe these meshes has potential problems. Mosquito net meshes with unknown polymers, coatings and biomechanical properties may lead to intense inflammatory responses and even mesh extrusion. In an effort to standardise the use of mosquito net, the mechanical properties of a commonly available Low Density PolyEthylene (LDPE) mosquito net have recently been documented and have been shown to be substantially equivalent in relation to commercial hernia meshes [15,16]. However, long-term clinical data supporting the use of this mesh is lacking. This article documents outcomes from one of the pioneers of this material in a ten-year experience of using LDPE mesh for inguinal hernia repair.

Methods

The STROBE criteria [17] for cohort studies were consulted when designing this retrospective analysis.

Study design and setting

A retrospective analysis of consecutive inguinal hernia repairs conducted at Dr. Tongaonkar Hospital, Dondaicha, District-Dhule (Maharashtra) between 1st January 2002 and 1st January 2012 was performed.

Eligibility

Consecutive patients undergoing inguinal hernia repair using Low Density PolyEthylene (LDPE) mesh produced by Amsa Plastics, Karur, India were included. All patients received questionnaire follow up surveys at 6-18 months post operatively.

Data sources and outcome variables

Data was obtained from the theatre logbooks and patient notes including the completed follow-up questionnaires were then consulted. A standard data collection table was used in order to record patient demographics (age and sex), operative characteristics (emergency vs. elective repair, primary vs. recurrent hernia, hernia size), and

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postoperative complications (surgical site infection—as defined by the internationally accredited ‘Centers for Disease Control and Prevention’ [CDC] [18], haematomas—defined as any evidence of a bruise in the postoperative site, seromas—defined as any clinically apparent fluid collection at the site of mesh placement, recurrence, chronic pain—defined as pain limiting daily activity at more than three months postoperatively, and any other complications).

Data presentation

Data was presented as absolute numbers and percentage rates of adverse outcomes. For demographic data, means and standard error form the mean were used where appropriate. Any missing data or loss to follow up was recorded and presented with the results. Since the study represented retrospective follow up of a single intervention, no sensitivity analysis or specific statistical tests were applied. Data was presented to one decimal place.

Results

During the study period 713 inguinal hernia repairs were performed using low cost polyethylene mesh in 651 patients. Patient demographics for sex and age are shown in Table 1. There were 62 bilateral inguinal hernias and 589 unilateral inguinal hernias.

The majority of the inguinal hernias were small and confined to the inguinal canal (n=622 [87.2%]). There were 692 (96.2%) primary inguinal hernias and 27 (3.8%) recurrent inguinal hernias. The hernia characteristics are shown in Table 2.

Follow-up questionnaires at 6-18 months were available for the majority of patients; 32 (4.9%) of patients were lost to follow-up. Of those followed up (n=619 patients, 639 inguinal hernias) there were six superficial surgical site infections (0.9%), all of which were treated successfully with antibiotics, one seroma (0.1%), two patients who experienced chronic pain (0.3%), and two hematomas (0.3%), which resolved with conservative management. There were no recurrences or cases of mesh rejection. The follow-up data is shown in Table 3.

Variable	N [%] (n=651)
Sex	
Male	647 [99.4%]
Female	4 [0.6%]
Age	
<30 yrs.	32 [4.9%]
31-40 yrs.	107 [16.4%]
41-70 yrs.	426 [65.4%]
>70 yrs.	86 [13.2%]

Table 1: Demographic data.

Variable	N [%] (n=713)
Emergency vs. elective	
Emergency	23 [3.2%]
Elective	690 [96.8%]
Primary vs. recurrent	
Primary	692 [96.2%]
Recurrent	27 [3.8%]
Hernia size	
Confined to inguinal canal	622 [87.2%]
Inguinoscrotal	59 [12.8%]

Table 2: Hernia characteristics.

Outcome variables	N of hernias [%] (n=713)
Loss to follow up	74 (10.4%)
Superficial surgical site infection	6 [0.9%]
Deep surgical site infection	0 [0%]
Seroma	1 [0.1%]
Haematoma	2 [0.3%]
Recurrence	0 [0%]
Chronic pain	2 [0.3%]
Mesh rejection	0 [0%]

Table 3: Follow-up data of 639 inguinal hernia repairs using LDPE mesh.

Discussion

Mosquito net hernioplasty is a frugal innovation dating back to 1996 [14]. In a recent systematic review of the use of sterilized mosquito nets for hernioplasty, Sorensen and Rosenberg [19], commented that their utilization was highly cost-effective and should be recommended for use in resource-limited settings. However, they cautioned that the long-term consequences are unknown. Frugal innovation involves the search for tools and techniques that spare resources, yet maintain or improve outcomes. This study presents the longest follow-up to date for mosquito mesh inguinal hernioplasty, and reports outcomes for up to 10 years.

The burden of untreated inguinal hernias in low-income countries is huge and parallels the absence of surgical care in these settings. Using data from the National Health and nutrition Examination Survey prospective cohort study of inguinal hernia, Beard et al. created a method to estimate hernia epidemiology in Ghana [20]. The prevalence in the Ghanaian population was calculated to be 3.15% (greater than the 1.9% prevalence of HIV/AIDS), with symptomatic hernias estimated to number 530,082. Since the hernia repair rate is so low (about 30/100,000 population), a backlog of one million untreated hernias will build up in 10 years. Yang et al. [21] working from the 2.7% prevalence calculated by “Operation Hernia” in the Bole district of Ghana, estimated that a total of 6.3 million adult African males have untreated hernias. A simple, low-cost solution to this public health burden exists with the adoption of mosquito net hernioplasty and has been endorsed by Farmer as “a fabulously clever, inexpensive, and context-appropriate way to treat inguinal hernia” [22].

The low long term complication rates reported in this study are reassuring, but predictable from the recent knowledge that the material characteristics of Low Density Poly Ethylene (LDPE) mosquito net mesh are identical to commercially produced hernia meshes [15,16]. Using sophisticated techniques including vibrational spectroscopy, scanning electron microscopy, and burst strength, LDPE is comparable in fiber diameter, thickness, pore diameter, weight, linear mass density and bursting force, to a Class I “large pore” commercial mesh.

The only legitimate concern about the use of LDPE mosquito net mesh in resource-limited settings is its sterilization [23]. The senior author (Tongaonkar) uses a steam autoclave with accurate temperature control, and a holding time of at least 15 minutes at 121°C. This is clearly effective since the wound infection rate in the study was <1%. Less accurate temperature control has deleterious consequences on the LDPE mesh structure with cross-sectional shrinkage and eventual plasticization at temperatures over 134°C. Advanced health care systems demand routine steam sterilization to 134°C in order to eliminate prions.

The results of this retrospective study confirm the long-term safety

and effectiveness of the use of LDPE mosquito net mesh for inguinal hernioplasty, provided adequate sterilization facilities exist.

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