

# The Use of Mosquito-Net Cloths as Prosthesis in Inguinal Hernia Repair: An Experience in Southern Sudan

Alberto Kiss<sup>1,2</sup>, Daniele Corona<sup>2</sup>, Oscar Kiss<sup>2</sup>

<sup>1</sup>General Surgery Department, Ospedale Maggiore, Chieri, Italy

<sup>2</sup>CCM, Comitato di Collaborazione Medica, Torino, Italy

Email: [danielecorona.md@gmail.com](mailto:danielecorona.md@gmail.com)

Received July 1, 2011; revised December 10, 2011; accepted January 16, 2012

## ABSTRACT

Inguinal hernia is one of the commonest medical problems in Africa and the treatment via open repair is considered as one of the most affordable and secure procedures. In the industrialized countries, the gold standard treatment is represented by placing a prosthesis which is usually a mesh, made of alloplastic material, such as polypropylene. In developing countries, a piece of nylon mosquito-net without insecticide is a cheaper and safe alternative as prosthesis. This study shows the security of implant of nylon mosquito-net in 70 patients, operated on with Lichtenstein's tension-free technique, and performed in rural hospitals of Southern Sudan. The easy use of analyzed low-cost material and the demonstrated safety of these sterilized prostheses are two important factors that make them excellent solutions in poor and rural areas such as Southern Sudan. **Objective:** the aim of this article is to demonstrate that prostheses, made of well analyzed low-cost material, can be cost-effective and a valid solution for surgical inguinal hernia repair in both poor and rural developing areas.

**Keywords:** Inguinal Hernia; Repair; Mosquito-Net; Developing Countries

## 1. Introduction

Surgery is a fundamental component in public health systems, but for a long time it has been ignored because it has been considered too expensive, especially in poor and developing areas.

According to a recent study by the World Health Organization (WHO), surgery, along with vaccinations, anti-malaria drugs and anti-retroviral drugs, represents one of the priorities of the public health system in low-income countries [1].

Hernia disease is one of the most fundamental problems within the area of surgical needs of poor countries, especially in Sub-Saharan Africa [2].

In some areas of Africa, the incidence of inguinal hernia per year exceeds 175 cases per 100,000 inhabitants [3]; nowadays, less than 40% of these patients are treated with a surgical operation; this fact means that there is a high incidence of under-treated cases, which may lead to complications and may cause an important rate of morbidity and mortality.

Therefore, the search for effective techniques, which are easily reproducible even in small rural hospitals, with low-cost materials, is an aim to pursue [4].

Today, the gold standard of hernia repair in western countries is represented by the use of meshes as prosthe-

ses, made of polypropylene [5].

Starting from the experience of Dr. Tongaonkar, a new idea for hernia prostheses has been used for some years: the use of locally produced pieces of mosquito-net cloths, which have not been treated with pesticide [6].

Experimental studies on mice have demonstrated that implanted pieces of mosquito-net cloths in tissues, made of polyester, are able to create an inflammatory reaction, comparable to the reaction created by the most sophisticated polypropylene meshes [7].

According to these assumptions we purchased Nylon cloths, which had not been soaked with any pesticide, in local African markets, made of 100% Nylon (Polyamide 6/6) and we used them for inguinal hernia repair in small rural hospitals in Southern Sudan.

## 2. Material and Methods

### 2.1. Setting

Southern Sudan is one of the most tormented countries in the world. It is a victim of one of the longest civil wars in Africa and, even for this reason, it still has a disastrous sanitarian situation.

During some surgical missions arranged by the charity medical organization CCM (Comitato di Collaborazione Medica, Turin, Italy), we operated on 70 patients affected

by inguinal hernias, using Nylon mosquito-net cloths as prostheses. These procedures were performed in rural hospitals in Adior and Bunagok, in the Bharl Ghazal region, in order to spread the concept of Primary Surgery among the staff of these hospitals and train them to treat the main surgical disorders at the same time.

The operating theatre was always very basic and equipped with local instruments and furniture. Although the environment was furnished with the bare essential, the safety of patients and staff was always assured.

The team involved an experienced visiting surgeon, a local scrub nurse and usually one or two theatre nurses. Sudanese surgeons participated in some procedures, in order to learn the technique.

In every case, the visiting surgeon taught the staff how to perform the Lichtenstein's technique: at the end of every period in these hospitals, both the scrub nurses and the local surgeons were able to operate on and use the mosquito-net correctly.

## 2.2. Patients

We operated on 45 men and 25 women; every patient was previously informed about the procedure with the aid of local medical staff who translated for us.

The local laboratory could perform only haemoglobin dosage and simple microbiological search of parasites, therefore every patient was carefully assessed by the surgeon and the rest of the staff (scrub nurse, anaesthetic nurse or visiting anaesthetist), without the help of blood tests.

An antibiotic prophylaxis was performed in every patient who was supposed to be older than 50 years old. The most available antibiotic at the location of the hospital was administered one hour before the operation: we used amoxicillin per oral or intramuscular depot penicillin.

The other cases did not receive any prophylaxis with antibiotic and we did not notice any rise of the incidence of surgical wound infection.

## 2.3. Meshes

Some Nylon meshes which we bought were examined at the Chemical Engineering Department of Turin Polytechnic in Turin, Italy, showing the following results:

- **Composition:** non-soaked Nylon 100% (Polyamide 6/6).
  - ◆ Weight: 27 g/m<sup>2</sup>;
  - ◆ Thickness: 0.22 mm;
  - ◆ Maximum diameter of the pores: 2.5 mm.
- **Price:** a 15 m<sup>2</sup> Nylon mesh costs around \$4 in local markets, and a piece of mesh, measuring 10 × 15 cm, costs around \$0.043.

We also used some other mesh which they were made

of Polyester: there were no traces of pesticide in each composition. The technical characteristics were:

- **Composition:** Polymer of polyethylene and polypropylene.
  - ◆ Melting point: 144.59°C;
  - ◆ Breaking load point: 126 N (on 25 mm width sample);
  - ◆ Weight: 200 g/m<sup>2</sup>;
  - ◆ Thickness: 0.68 mm;
  - ◆ Porosity: around 50 μm.
- **Price:** a piece of Polyester mosquito-net cloth, measuring 200 cm × 150 cm, costs in total \$2 and it can be used for 200 patients.

In Sudan, a pressure cooker was used for the sterilization of the mesh; it was easily used by the local staff.

The pressure cooker we used reached the temperature of 134°C. The sterilization was always carried out for 40 minutes, to allow the wet heat to destroy saprophytes, viruses and pathogens such as the formidable post-operative tetanus, bacterial vegetative forms and spores [8].

## 2.4. Technique

The standard Lichtenstein tension-free technique was performed in every case, with local or local-regional anaesthesia (3 cases received a higher level of anaesthesia).

A solution of lidocaine hydrochloride 1% - 2% was used in order to administer the local anaesthesia.

Loco-regional anaesthesia was performed few times as spinal injection of lidocaine hydrochloride at the same percentage mentioned above or with hyperbaric bupivacaine (depending on the availability on local pharmacy).

3 cases (4%) required the use of ketamine in order to induce a higher level of anaesthesia because of the big size of the hernia. All the cases had no complication regarding the administration of ketamine.

The local anaesthesia was usually performed by the visiting surgeons whilst the loco-regional anaesthesia was performed by trained local anaesthetic nurses or visiting anaesthetists.

Every piece of mosquito-net we sterilized with the pressure cooker measured 10 × 15 cm and it was packed in a single paper envelop. It was then cut directly during the operation, depending on the patient's needs.

Nylon suture thread was used to fix the mesh.

## 3. Results

Because of the backwardness of the general conditions of Sudan, including the lack of registry offices, it was impossible to obtain proper and precise information about the age of the patients.

65% of patients (45 cases) had spontaneous reducible hernias, 27% of patients (19 cases) had manual reducible hernias and 6 cases (8%) were affected by irreducible

hernia, but not strangulated.

10 hernias (15%) had a direct sac and the rest (60 cases: 85%) were external oblique.

There were not cases of immediate prosthesis infection and no evidence of any medical condition related to the procedure in the post-operative period. The patients' follow-up was slightly short because of logistic and territorial difficulties (many patients were several days on foot far from the hospital).

Hence, 30 days was the average period of time for the follow-up:

- 3 cases (4%) had haematoma of the surgical scar and they needed aspiration using syringe on the seventh post-operative day.
- 2 cases (3%) needed further antibiotic administration for 7 days.

There were not cases of rejection or major infections.

#### 4. Discussion and Conclusions

Hernioplasty represents one of the most important surgical needs in Sub-Saharan Africa.

Hernia disease repair reduces the incidence of complications, such as obstruction and strangulation, which are the most important causes of intestinal obstruction. It should be avoided the development of intestinal obstruction in any case, because its treatment has a mortality rate of 20% [9], even in the developed countries.

Much like the locally available Nylon thread (which was originally a fishing line) used as a surgical suture material by surgeons in Africa for many years, the mosquito-net cloth could be a cost effective alternative in countries where commercial meshes are not available or affordable [10-13].

The evidence that Nylon is an acceptable material for intracorporeal implant has been shown by many studies, also with long term results. It is now widely used as suture material for hernia repair. We also noticed that there were not important practical differences between Nylon and Polyester meshes, both in using during the operations and in our clinical results (including the patient's comfort during the follow-up).

The use of both simplified techniques and appropriate, low-cost technologies represents an excellent solution in low-income countries.

These simple and easily reproducible techniques are easily learnt by the local staff who, in extreme conditions of poverty, can successfully treat the most common and simple diseases and the surgical problems, even though they may not have any academic title or formal qualification, such as a degree in medicine or in health care.

The experience of teaching basic surgery to unqualified or not graduated staff proved to be very effective strategy in countries such as Mozambique, New Guinea, Zaire, Thailand, Bangladesh and India [14].

#### REFERENCES

- [1] D. Ozgediz, D. Jamison, M. Cherian and K. McQueen, "The Burden of Surgical Conditions and Access to Surgical Care in Low- and Middle-Income Countries," *WHO Bulletin*, Vol. 86, 2008, pp. 646-647.
- [2] M. King, Primary Surgery Vol. 1 and Non-Trauma Vol. 2, 2008.  
<http://www.primary-surgery.org/start.html>
- [3] E. M. Nordberg, "Incidence and Estimated Need of Caesarean Section, Inguinal Hernia Repair and Operation for Strangulated Hernia in Rural Africa," *British Medical Journal*, Vol. 289, 1984, pp. 92-93.  
[doi:10.1136/bmj.289.6437.92](https://doi.org/10.1136/bmj.289.6437.92)
- [4] T. J. Wilhelm, S. Anemana, P. Kyamanywa, J. Rennie, S. Post and S. Freudenberg, "Anaesthesia for Elective Hernia Inguinal Repair in Rural Ghana. Appeal for Local Anaesthesia in Resource-Poor Countries," *Tropical Doctor*, Vol. 36, 2006, pp. 147-149.  
[doi:10.1258/004947506777978046](https://doi.org/10.1258/004947506777978046)
- [5] F. Battocchio, O. Terranova and L. De Santis, "Grande Atlante di Tecnica Chirurgica: Chirurgia Delle Ernie," UTET Scienze Mediche, Torino, 2004, pp. 1-383.
- [6] R. Tongaonkar, *et al.*, "Preliminary Multicentric Trial of Cheap Indigenous Mosquito-Net Cloth for Tension-free Hernia Repair," *Indian Journal of Surgery*, Vol. 65, No. 1, 2003, pp. 89-95.
- [7] U. Klinge, B. Kolsteihalfen, *et al.*, "Foreign Body Reaction to Meshes Used for Repair of Abdominal Wall Hernias," *European Journal of Surgery*, Vol. 165, No. 7, 1999, pp. 665-673. [doi:10.1080/11024159950189726](https://doi.org/10.1080/11024159950189726)
- [8] V. Beltrami, S. Galvagno and G. Meo, "Chirurgia Tropicale e dei Paesi in Via di Sviluppo," Centro Scientifico Editore, Centro Scientifico Torinese, 1988.
- [9] B. Tilde Fevang, J. Fevang, L. Stangeland, O. Søreide, K. Svanes and A. Viste, "Complications and Death after Surgical Treatment of Small Bowel Obstruction," *Annals of Surgery*, Vol. 231, No. 4, 2000, pp. 529-537.
- [10] S. Freudenberg, D. Sano, E. Ouangrè, C. Weiss and T. Wilhelm, "Commercial Mesh versus Nylon Mosquito Net for Hernia Repair. A Randomized Double-Blind Study in Burkina Faso," *World Journal of Surgery*, Vol. 30, No. 10, 2006, pp. 1784-1789. [doi:10.1007/s00268-006-0108-3](https://doi.org/10.1007/s00268-006-0108-3)
- [11] S. K. Saha, "Hernioplasty: A New Approach against the Recurrence," *Hernia*, Vol. 9, No. 2, 2005, pp. 134-139.  
[doi:10.1007/s10029-004-0297-3](https://doi.org/10.1007/s10029-004-0297-3)
- [12] A. A. El-Bakry, "Application of Darn for the Repair of Inguinal Hernia. A University Hospital Experience," *Saudi Medical Journal*, Vol. 23, No. 11, 2002, pp. 1347-1349.
- [13] A. Koukourou, W. Lyon, J. Rice, *et al.*, "Prospective Randomized Trial of Polypropylene Mesh Compared with Nylon Darn in Inguinal Hernia Repair," *British Journal of Surgery*, Vol. 88, No. 7, 2002, pp. 931-934.  
[doi:10.1046/j.0007-1323.2001.01818.x](https://doi.org/10.1046/j.0007-1323.2001.01818.x)
- [14] G. Meo, A. Kiss, *et al.*, "Rural Surgery in Southern Sudan," *World Journal of Surgery*, Vol. 30, No. 4, 2006, pp. 495-504. [doi:10.1007/s00268-005-0093-y](https://doi.org/10.1007/s00268-005-0093-y)