The Lichtensein technique is modified for solving complex groin hernias such as huge hernias with massive transversal fascia destruction associated with the increased intraabdominal pressure or recurrent hernias with the destroyed Poupart's ligament. Whilst these hernias are usually managed by preperitoneal techniques (open or laparoscopic) under general or regional anesthesia, as an "in-patient" procedure, they can be solved applying a modified Lichtenstein technique, most frequently under local anesthesia, as an "out-patient" procedure. The modifications of Lichtenstein technique include the following: a) lateral movement and fixation of the lower corner of the mesh, caudally to the tubercle, by 20-30 degrees in relation to its lower border, fully protecting the medial triangle (direct inguinal recurrence prevention); b) fixation of the lower border of the mesh by a running "U" suture to both Poupart's and Cooper's ligaments, from the tubercle to the femoral vein, fully protecting the femoral triangle (femoral recurrence prevention); c) the lower mesh border fixation by a running suture, 2-3 cm laterally to the internal inguinal ring, together with the "locking" of the internal inguinal ring by two interrupted sutures, one fixing the superior mesh tail to the inferior one - cranial to the spermatic cord, 1-1,5 cm medially to the Poupart's ligament, and the other fixing the lower border of the superior mesh tail and the lower border of the inferior mesh tail to the inferior part of the Poupart's ligament, 1 cm cranially and laterally to the preceding suture, fully protecting the lateral triangle (indirect inguinal recurrence prevention). One thousand eighteen patients with 1236 (unilateral 800, bilateral 218) inguinal hernias were electively operated on by the modified Lichtenstein technique between January 2003 - January 2011. All operations were performed by a single surgeon. One hundred and thirty (10.5%) hernias were recurrent following one or more tension or tension-free repairs, and 203 (16.4%) hernias had a ≥ 5 cm hernial defect. In seven hundred and twentyfour (71.1%) patients, the operation was performed under local, in 271(26.6%) under general, and in 23(2.3%) under regional anesthesia, while 635(62.4%) patients were operated on an "out-patient" basis, and 383(37.6%) on an "in-patient" basis. The ASA score was: 388 ASA I, 450 ASA II, 153 ASA III, and 27 ASA IV. The mean stay at a day surgery unit was 2.5 (2-8) hours, and the mean hospital stay was 1.6 (1-10) days. During the mean follow-up of 37 (1-96) months, the rate of complications was: 23(1.86%) haematoma, 5(0.4%) seroma, 5 (0.4%) wound infections, 6(0.48%) ischaemic orchitis, 2(0.16%) testicle atrophy, 1 (0.08%) disseculation, 3(0.24%) hydrocoella, 21(1.7%) pain, and 2(0.16%) recurrence. There were 6 reoperations due to the complications. The modified Lichtenstein technique performed usually under local anesthesia as "a day-case" procedure is a good solution for challenging groin hernias.

Key words: modified Lichtenstein technique, complex groin hernia, local anesthesia, out-patient surgery

INTRODUCTION

The main cause of both inguinal hernia development and the failure of inguinal herniorraphy is a collagen tissue disease. The understanding of the significance of collagen disorders in the pathogenesis of the inguinal hernias and the consequent introduction of the prosthetic hernia repair have led to a breakthrough in the treatment of inguinal hernias. The number and variety of prosthetic methods for inguinal hernia repairs has induced The European Hernia Society to publish the guidelines for their management. Based on a comprehensive analyses of randomized controlled trials and metaanalyses, The European Hernia Society Guidelines recommend Lichtenstein or en-
Laparoscopic repair for primary unilateral and bilateral inguinal hernias in adults. The Lichtenstein technique was most frequently used for inguinal hernia repair in the late 20th century. For challenging situations in groin hernia repair, such as indirect, direct or combined inguinal hernias with massive transversal fascial destruction, frequently associated with potential weakness of the femoral canal and the increased intra-abdominal pressure due to concomitant intra-abdominal diseases, or multiple recurrent groin hernias with destroyed Poupart's ligament in result of previous operations, the preperitoneal techniques (open or laparoscopic) are the techniques of choice. They are normally performed under general and less frequently under regional anesthesia, as an "in-patient" procedure. Its main principles having been taken into account, the Lichtenstein technique is modified in order to solve these challenging defects under local anesthesia, as an "out-patient" procedure.

MATERIAL AND METHODS

The modified Lichtenstein technique is performed under local infiltrative or, less frequently, under general anesthesia. Local anesthesia - the combination of 20 ml 0.5% bupivacaine, 50 ml 2% procaine and 30 ml saline solution, is administered by "step-by-step" principle. While, on average, less than half of this anesthetic mixture is needed to solve a single hernia, in case of huge or complex hernias the whole quantity shall be used. At the administration of the local anesthetics one should always be certain of the maximal dose which can be used in one patient (procaine dose 500 mg max, bupivacaine dose 175 mg max). Sedation with midazolam was used in 1-3% of patients. Because of cardiotoxic effect of bupivacaine, it is recommendable to use its isomer levobupivacaine or ropiva-
and incisional) should be solved in a single operation under local anesthesia, if possible. Inguinal hernias are solved with modified Lichtenstein technique, and ventral (umbilical, epigastric and spigelian) or small/medium incisional hernias with "the open preperitoneal flat mesh technique" (consisting of flat mesh positioning into the intra-abdominally restored hernial sac and securing it with mattress stitches on the front side of the fascia).11

The procedure of local anesthetic administration is as follows: skin and subcutaneous tissue infiltration along the site of incision with 20-30 ml of anesthetic solution mixture, followed by 2-3 ml anesthetic solution infiltration under the external oblique muscle aponeurosis (MOE); after the MOE aponeurosis incision, 1-2 ml of anesthetic solution is infiltrated around (not into) the ilioinguinal nerve, the ilioipogastric nerve and along the lower border of the cremasteric muscle, i.e. the genital branch of the genitofemoral nerve, in the spermatic cord at the level of the internal inguinal ring and in the internal inguinal ring itself; the additional 10-15 ml of anesthetics solution is infiltrated around the tubercle, the Cooper’s ligament and in the hernial sac wall; to relieve the postoperative pain for the next 4 hours, a 1-2 ml of anesthetics solution is administered into all sites of mesh fixation after it has been positioned.

The antibiotics and thromboembolic prophylaxis is not routinely given to the patients operated on under local anesthesia; second-generation cephalosporine and low-molecular heparin are given exclusively to the patients who are on anticoagulant therapy or have undergone heart surgery. All the patients operated on under general anesthesia are given low-molecular heparin as thromboembolic prophylaxis.

In elective hernia repair, the inguinal canal is approached through an oblique skin incision of 4-5 cm, the hernial sac is dissected and restored into the Bogros space without opening, regardless of hernia type (direct or indirect). After the direct hernial sac reposition into the Bogros space, the transversal fascia (TF) defect is reconstructed with a running 3-0 resorbable monofilament suture. Following the tension-free principle and the need for the lower border of the mesh fixation to the Cooper’s ligament, TF should not be tight, but slightly bulged. After the indirect hernial sac reposition into the Bogros space,
"annulorraphy" is performed which consists of tightening the internal inguinal ring caudally with one single 3-0 or running 3-0 resorbable monofilament suture (depending on the defect size), heeding not to injure lower epigastric vessels. The procedure for infection-free incarcerated or strangulated hernia (direct or indirect) is as follows: the opening of the hernial sac, the release and restoration of its contents into the abdominal cavity, the reconstruction and reposition of the hernial sac into the Bogros space, and finally TF suture or "annulorraphy". In case of large inguinoscrotal hernias, the scrotal part of hernial sac is not dissected so as to avoid testicle complications. The hernial sac contents is repositioned into the abdominal cavity, the sac itself transected at the level of the neck and ligated (the peritoneum is sutured with a 3-0 resorbable monofilament suture to prevent postoperative pain). The scrotal part of the hernial sac is longitudinally incisioned on the anterior side to prevent hydrocoella formation.

During the procedure, the nerves should be left intact. If the ilioinguinal nerve extends in the direction of the spermatic cord and the hernial sac, it can be dissected in the course of hernial sac dissection. It should be pointed out that the cremasteric muscle is not resected, and the iliohypogastric and genital branches of the genitofemoral nerve are not dissected. The thin transparent fascia covering the iliohypogastric nerve and the cremasteric muscle protecting the genital branch of the genitofemoral nerve are left intact. This procedure prevents direct contact between the mesh and the nerves. If injured during the mesh positioning and fixation procedure, the nerves can be resected. The proximal end of the resected nerve is pressed into the oblique internal muscle (MOI) through a small incision and the site of incision is closed with a 3-0 resorbable monofilament suture. Thereby, the muscle fibers completely cover the end of the resected nerve, preventing the direct contact between the mesh and the nerve as well as the neurinoma formation.

In the modified Lichtenstein technique, polypropylene mesh 15x10 cm is used (low-weight polypropylene with large pores is highly advisable), and fashioned according to the size, i.e. anatomic characteristics of the inguinal canal floor after being positioned and fixed. Before positioning the mesh into the inguinal canal, a small part of the mesh (5-7 mm in diameter) is semicircularly cut along its inferior border, 2 cm from the caudal corner of the mesh. The mesh is positioned so that its corner extends 2 cm caudally to the tubercle and the semicircular notch is lying on the tubercle. This notch prevents the mesh wrinkling during the fixation of its lower border to the Cooper’s and Poupart’s ligaments and allows for lateral movement of the caudal mesh corner by 20-30 degrees in relation to the lower mesh border. It is sometimes necessary to notch the lower part of the MOE aponeurosis for 5-10 mm above the tubercle in medial direction, whereby more free space
In contrast to the original Lichtenstein technique, the fixation of the lower border of the mesh is performed in 3 planes: to the tubercle, along the Cooper’s ligament lying 1-1.5 cm lower, and finally, to the lower part of the Poupart’s ligament lying 1 cm superior to the Cooper’s ligament. The notch of the mesh prevents its wrinkling when shifting the plane of fixation from the tubercle to the Cooper’s ligament (the lower mesh border caudal to the tubercle in relation to the lower mesh border, lying cranially from the tubercle to the femoral vein, is fixed in 2 planes differing 1-1.5 cm in height). Lateral movement of the lower mesh corner by 20-30 degrees in relation to its lower border provides complete caudal coverage of the tubercle in the lateral and medial direction in the duck’s foot shape. This procedure enables mesh overlapping the tubercle and the symphysis by 2-3 cm, excluding the possibility of medial hernia recurrence next to the tubercle.

The running 2-0 nonresorbable monofilament suture is used for the fixation of the lower mesh border. The fixation begins at the level of the semi-circular notch of the mesh, 3-4 mm from its lower border with a running "U" suture to the fibrous tissue around the tubercle (not to the periost in order to prevent chronic pain). After tying the first "U" suture at the region of the tubercle, the running "U" suture is passed through the lower mesh border, the Cooper’s ligament and the inferior part of the Poupart’s ligament. To place this suture, it is necessary for the bulged and loosely reconstructed TF to be pushed by a finger downwards along the iliopectineal line and the Cooper’s ligament. This could not be performed if TF would be tightened during the reconstruction. Controlled by a finger, the suture passes through TF, the Cooper’s ligament and finally, through the inferior part of the Poupart’s ligament. The suture is passed 2 to 3 times up to 3-4 mm from the femoral vein. It is essential that the running "U" suture near the femoral vein simultaneously passes through the Cooper’s and Poupart’s ligaments to completely close the femoral canal. /Figure 2/ The running suture continues laterally to the femoral vein, anchoring the lower mesh border to the inferior part of the Poupart’s ligament, and terminates 2-3 cm laterally to the internal ring. /Figure 3/ The running suture anchoring the lower mesh border is composed of two consequent parts: a running "U" suture from the tubercle to the femoral vein (passing through TF, the Cooper’s and Poupart’s ligaments) and a running simple suture, lateral to the femoral vein up to 2-3 cm cranial to the internal ring (passing only through the Poupart’s ligament).

As in the original Lichtenstein technique, the lateral end of the mesh is slit into 2 tails (superior tail of 2/3 and inferior tail of 1/3 of the mesh width) to pass the spermatic cord. The slit extends to the medial border of the internal ring where the spermatic cord passes through the inguinal canal floor. Any further slitting of the mesh would induce indirect hernia recurrence, caudal to a new internal ring on the mesh. The spermatic cord and the ilioinguinal nerve are pushed together through the slit on the mesh, and the mesh is placed flat over the floor of the inguinal canal. The tension-free principle requires the mesh to be slightly wrinkled, not tightened.

FIGURE 10 A, B, C
(A) PATIENT WITH RIGHT PRIMARY HUGE HERNIA OPERATED ON WITH MODIFIED LICHTENSTEIN TECHNIQUE UNDER LOCAL ANESTHESIA ON AN "OUT-PATIENT" BASIS - PREOPERATIVE FINDINGS; (B) HERNIAL SAC AND HERNIAL DEFECT LARGER THAN 5 CM; (C) RIGHT HUGE HERNIA SOLVED WITH MODIFIED LICHTENSTEIN TECHNIQUE

is obtained for flat mesh positioning in the region of the conjoined tendon and rectus muscle, medial and cranial to the tubercle. /Figure 1/
The corner of the mesh, caudal to the tubercle is fixed by 2 interrupted "U" 4-0 monofilament nonresorbable sutures. The first one is placed on the very corner of the mesh, fixing it 20-30 degrees laterally to the lower mesh border. The second one is placed 1 cm medially to the first one along the caudal mesh border. /Figure 4/

These two sutures hold the mesh in flat position, caudally to the tubercle. Otherwise, running suture along its lower border at the tubercle and the Cooper’s ligament, due to the fixation plane shift, may "raise" the caudal corner of the mesh protecting the region around the tubercle, causing the loss of 2 cm mesh/tubercle overlap in caudal and medial direction.

The next interrupted "U" 2-0 monofilament nonresorbable suture anchors the mesh to the rectus sheath or the conjoined tendon 2-3 mm from the MOE aponeurosis, and 1-2 cm medial and cranial to the second "U" suture in the caudal mesh corner. /Figure 5/

The placement of "U" suture at further distance makes the adequate overlapping of the slit tails of the mesh around the spermatic cord impossible and leads to possible indirect recurrence in the caudal area of the new internal ring on the mesh.
Then follows the overlapping of the slit tails around the spermatic cord at the angle of 40-50 degrees. The superior tail is fixed to the inferior one cranial to the spermatic cord 1-1.5 cm medial to the Poupart’s ligament with an interrupted "U" 2-0 monofilament nonresorbable suture. In addition, the internal ring is "locked" with an interrupted simple 4-0 monofilament nonresorbable suture fixing the lower border of the superior tail and the lower border of the inferior tail of the mesh to the inferior part of the Poupart’s ligament, 1 cm cranially and laterally to the preceding "U" suture. /Figure 6/ The latter suture actually fixes the lower border of the superior tail to the running suture which had previously anchored the lower border of the inferior tail to the Poupart’s ligament, thus securing the internal ring with two interrupted sutures instead of one as in the original Lichtenstein technique. This thin 4-0 suture fixing the tails to the Poupart’s ligament in modified Lichtenstein technique is the same suture by which a new internal ring is being created in the original Lichtenstein technique, but 1 cm further apart cranially. The new internal ring on the mesh should not be too tight nor too loose, with the diameter of 7-8 mm. Owing to the way in which the tails are fixated around the spermatic cord, it is placed 1 cm medial to the Poupart’s ligament, unlike its position next to the Poupart’s ligament in the original Lichtenstein technique.

One interrupted "U" 2-0 monofilament nonresorbable suture anchors the upper mesh border passing 2-3 mm from it, to the MOI 2-3 mm from the MOE aponeurosis. This "U" suture along the upper mesh border is just lateral to the newly created internal ring on the mesh. /Figure 7/ During the fixation of the upper mesh border, special care must be taken not to injure the iliohypogastric nerve. The mesh fixation being completed, excess part is trimmed starting with the superior tail extending beyond the Poupart’s ligament and the excess part beyond the superior line of fixation in the shape of inguinal canal floor. The tails are pulled underneath the MOE aponeurosis at least 5 cm cranial to the internal ring. /Figure 8/ In case of large hernial defect or the use of low-weight mesh, it is recommendable to additionally fixate the upper mesh border with 1 or more "U" 3-0 monofilament resorbable sutures between the two existing sutures in order to prevent direct recurrence or mesh bulging. /Figure 9/

The MOE aponeurosis is reconstructed with a running 3-0 resorbable monofilament suture. The suture of MOE aponeurosis begins from the cranially incised end and terminates at 1.5-2 cm caudal to internal inguinal ring on the mesh, so that the reconstructed MOE aponeurosis protects the internal ring (the "telescopic" recurrence as in Halsted herniorrhaphy is avoided). The complete MOE aponeurosis reconstruction should be avoided because of the postoperative pain arising from strain due to the spermatic cord tightening in the region of fully reconstructed external inguinal ring. After tying the running suture on the MOE aponeurosis in the newly-formed external ring area, the same running suture is passed through the 2 layers of the subcutaneous tissue (first, the suture cranially fixates the deeper layer of subcutaneous tissue to the sutured MOE aponeurosis, and then, the upper layer of the subcutaneous tissue 2-3 mm under the skin caudally). This procedure suppresses the occurrence of any free space in the operative incision area, which, together with careful
dissection, almost completely prevents fluid collections such as seroma or haematoma. Finally, the skin is stitched by a running intradermal suture.

RESULTS

Between January 2003 and January 2011 one thousand eighteen patients were electively operated on for 1236 (unilateral 800, bilateral 218) inguinal hernias. All operations were performed by a single surgeon. Seven hundred and eighty-one patients had unilateral inguinal hernia, 205 patients had bilateral inguinal hernia, 19 patients had the combination of unilateral inguinal and ventral or incisional hernias (7 epigastric, 9 umbilical, 1 spigelian and 2 incisional), and 13 patients had the combination of bilateral inguinal and ventral or incisional hernias (1 epigastric, 10 umbilical and 2 incisional). All inguinal hernias were solved with the modified Lichtenstein technique, and all ventral or incisional hernias with "the open preperitoneal flat mesh technique".

Operations were performed under local anesthesia in 724(71,1%) patients, under general in 271(26,6%), and under regional (spinal or epidural) in 23(2,3%) patients. Local anesthesia was administrated in 606 patients with unilateral inguinal, in 97 with bilateral inguinal, in 13 with unilateral inguinal and ventral or incisional, and in 8 with bilateral inguinal and ventral or incisional hernias. General anesthesia was administrated in 160 patients with unilateral inguinal, in 100 with bilateral inguinal, in 6 with unilateral inguinal and ventral or incisional, and in 5 with bilateral inguinal and ventral or incisional hernias. Regional anesthesia was administrated in 15 patients with unilateral inguinal and in 8 with bilateral inguinal hernias.

One hundred and thirty (10.5%) hernias were recurrent and 203(16.4%) hernias had hernial defect ≥5 (5-10) cm. Seventy-nine patients with 83 (75 unilateral, 4 bilateral; 72 after 1 or more tension repairs, 11 after 1 or more tension-free repairs) recurrent hernias and 128 patients with 135 (121 unilateral, 7 bilateral) hernias with hernial defect ≥5cm were operated on under local anesthesia. Forty-two patients with 44 (40 unilateral, 2 bilateral; 33 after 1 or more tension repairs, 11 after 1 or more tension-free repairs) recurrent hernias and 55 patients with 62 (48 unilateral, 7 bilateral) hernias with hernial defect...
>5cm were operated on under general anesthesia. Three patients with unilateral recurrent hernia after 1 or more tension repairs and 6 patients with unilateral hernia with hernial defect >5 cm were operated on under regional anesthesia. Recurrent hernias were solved under local anesthesia in 63.9% of cases, under general in 33.8%, and under regional anesthesia in 2.3%. Huge hernias with hernial defect >5 cm were solved under local anesthesia in 66.5% of cases, under general in 30.6% and under regional anesthesia in 2.9%.

ASA score was: 388 (38.1%) ASA I, 450 (44.3%) ASA II, 153 (15%) ASA III, and 27 (2.6%) ASA IV. Six hundred and thirty-five (62.4%) patients were operated on an “out-patient” basis and 383 (37.6%) on an “in-patient” basis. The mean stay at a day surgery unit was 2.5 (2-8) hours, and the mean hospital stay was 1.6 (1-10) days.

During the mean follow up of 37 (1-96) months the rate of complications was: 23 (1.86%) haematoma, 5 (0.4%) seroma, 5 (0.4%) wound infections, 6 (0.48%) ischaemic orchitis, 2 (0.16%) testicle atrophy, 1 (0.08%) disejaculation, 3 (0.24%) hydrocoella, 21 (1.7%) pain, and 2 (0.16%) recurrence. Six reoperations were performed due to the following complications: 1 operative wound exploration and haemostasis because of large groin haematoma, 2 mesh excisions and McVay herniorrhaphy due to late mesh infection, 2 mesh excisions and triple neurectomy due to chronic pain and 1 mesh excision and Rives hernioplasty through direct inguinal approach due to hernia recurrence.

**DISCUSSION**

Mesh techniques have been preferred in the management of inguinal hernias regarding their origin in the collagen tissue disease (“herniosis”). Ingual hernia repairs can be performed under local, regional or general anesthesia. According to the experience of the British Hernia Centre 14, "a day-case" surgery under local anesthesia is recommendable for 95% of noncomplicated primary groin hernias, and many noncomplicated primary umbilical and epigastric hernias. Amid 15 recommends using local anesthesia for all reducible adult inguinal hernias. Acevedo and Leon 16 recommend elective repair of primary or recurrent small- or medium-sized inguinal, umbi-
lical, epigastric, and incisional hernias on "a day-case" ba-
sis using local anesthetic. From the author’s point of view,
all patients with hernias, when justifiable for medical rea-
sons, should be operated on under local anesthesia as an 
out-patient procedure. The basic principle is that all pati-
ents with reducible inguinal hernias either unilateral or bei-
lateral, primary or recurrent, regardless of the size of her-
nial sac or defect, or the presence of the prosthesis materi-
als in the groin from previous repairs should be operated 
on under local anesthesia. All hernias in one patient (bilat-
eral inguinal, or inguinal and ventral or incisional) should 
be simultaneously operated under local anesthesia if the 
patient’s condition and surgical findings so allow. General 
anesthesia should be used in patients with non-reponible,
incarcerated or strangulated hernias.

Local anesthesia is as ideal for the patient as for "a day 
case surgery" - local analgesia is provided, muscular mo-
torics preserved and urinary retention and systematic effe-
tcts avoided. The author’s experience is complying with 
the European Hernia Society guidelines on the treatment 
of inguinal hernia in adult patients where it is said that
"we will have to acknowledge the level 1 evidence data 
that indicate strongly reduced morbidity with local anae-
thesia". The principle is that an anesthesiologist is present in the 
operating room during the surgery. For local anesthesia, the mixture of 2% procaine and 0.5% bupivacaine is used. 
Procaine has quick but short effects (analgetic effect oc-
curs almost immediately and duration is 20-30 minutes),
while bupivacain has slow and long effects (analgetic ef-
fect occurs in 1-5 minutes and duration is 120-240 min-
utes). The increase of the dose of the anaesthetic de-
pends on the duration of the surgery in the simultaneous 
repairs of 2 or more hernias in one patient, i.e. the dura-
tion of the surgery, being up to 60 minutes for one ingui-
nal hernia, which is now prolonged to 120 or 180 minutes 
depending on the number of hernias. According to Berde 
and Strichartz the dosage of local anesthetic required 
for adequate infiltration anesthesia depends on the extent 
of the area to be anesthetized and the expected duration of 
the surgical procedure. During the simultaneous operati-
on of 2 or more hernias, the dose of the administered an-
esthetics is gradually increased under continuous monitor-
ing of the patient’s vital functions (non-invasive blood pressure, pulse oxymetry, ECG monitoring and general condition) by the surgeon and the anesthesiologist. If bradycardia or hypotension occurs, the anesthesiologist responds accordingly to vital parameters, by administering fluid solutions (saline) and, if necessary, atropine, amino-philline, ephedrine, dopamine, noradrenaline or crystalloid solutions.

The surgeon and the anesthesiologist make decision whether the patient should be operated on an "out-patient" or "in-patient" basis, which primarily depends on the ASA score and not on the hernia type. All ASA I-II status patients and some of ASA III status patients are operated under local anesthesia as "a day case" and discharged 2-8 hours after the surgery. The patients are only required to urinate before discharge. Some of ASA III status patients and all ASA IV status patients are operated under local anesthesia, if medical reasons so allow, but are required to spend at least 24 hours in hospital. The mean hospital stay in patients with commorbidities is 1-2 days. In practice there are no indications for longer stay. General anesthesia is used in very young, anxious or psychiatric patients. Regional anesthesia (spinal or epidural) is rarely used in elective inguinal hernia operations because it may cause urinary retention in middle-aged or elderly male patients who frequently suffer from prostate adenoma and make the majority of the patients with inguinal hernia.

In the execution of hernioplasty, close attention should be paid to certain maneuvers in hernial sac dissection and mesh positioning. In elective inguinal hernia repair, the hernial sac is restored into the Bogros space without opening, and the TF is reconstructed. The hernial sac is never excess since it is always desirable to have as much tissue (peritoneum) between the mesh and the intestine as possible. The TF reconstruction (direct hernia) or the narrowing of the internal inguinal ring (indirect hernia) is not herniorraphy but only serves the purpose of easier flat mesh positioning during the operation impeding the hernial sac to "fall out or push" the mesh. It should be pointed out that the internal ring narrowing is performed caudally, not cranially in order not to injure the nerves or disturb the "shutter" action of the internal ring. Some surgeons, misunderstanding this maneuver, perform the real herniorrho-
phy adding the mesh in onlay position. This may induce risk of postoperative pain (tension repair) as well as of hernia recurrence because herniorrhaphy does not allow for adequate mesh positioning and fixation, as mesh serves as "the roof of the house" while recurrence occurs "in the foundations" at the level of herniorrhaphy. For the solution of large inguinoscrotal hernias, Wantz procedure\textsuperscript{18,19} is used avoiding the hernial sac dissection at the scrotum (hernial sac is cut at the neck, peritoneum is sutured and scrotal part of the hernial sac is incised at the anterior wall for hydrocella prevention). This maneuver is safe, avoiding the damage of the spermatic cord and the testicle in extensive hernial sac dissection. In the postoperative period, the scrotal part of the hernial sac is manifest as thickness above the testicle which disappears in time.

In mesh hernioplasty, cremasteric muscle is routinely preserved (preventing the contact between the vas deferens and the mesh as well as the injury of the genital branch of genitofemoral nerve). The genital branch of the genitofemoral nerve (the external spermatic nerve) is always next to the external spermatic vein ("blue line" according to Amid\textsuperscript{2}) which is situated along the inferior border of the spermatic cord so that the preservation of the vein means the preservation of the nerve itself. In patients who have had large indirect hernia for years, there may arise adhesions to the spermatic cord. In that case, the cremasteric muscle must be sometimes cut in the hernial sac dissection. The cutting of the cremasteric muscle provides better exploration of the internal inguinal ring and the adequate indirect inguinal sac dissection at its level. If the indirect hernial sac is not adequately dissected, and its part adhered to the spermatic cord is left near the internal inguinal ring, despite the mesh placement, indirect recurrence is likely because the spermatic cord in these cases "pulls" the hernial sac through a new internal ring on the mesh. When the cremasteric muscle is transected, its ends are sewn with a 3-0 resorbable monofilament suture. Its distal end is fixed to the reconstructed MOE aponeurosis with a 3-0 resorbable monofilament suture leaving the testicle in "high" position. In some patients, the cremasteric muscle resection can cause the testicle to fall into the scrotum. The position of this testicle is then lower than the one of the testicle on the opposite side and in time continues to drop, which causes great discomfort in some patients, even greater than the recurrence itself. The cutting of the cremasteric muscle means the simultaneous cutting of the external spermatic nerve and the external spermatic vein. This proceeding is a part of Shouldice herniorrhaphy and does not affect the increase of chronic pain.

The nerves are not dissected during the hernial sac preparation, unless it is necessary. If the nerve lies on the way of the dissection or mesh fixation, it is resected because it is always better to cut the nerve than risk postoperative pain occurrence.

The modified Lichtenstein technique may provide both protection and closure of the medial, lateral and femoral triangles of the myopectineal orifice regardless of the type and size of hernia. The fashion in which the lower mesh border is fixed to the Cooper’s ligament provides a strong support to hernioplasty. This support is significant in the solution of large direct or recurrent hernias (where the Poupart’s ligament is very weak and thin, "worn out" by previous operations), and also prevents femoral hernia occurrence. The fashion in which the mesh is positioned and fixed in the tubercle region, as well as its fixation to both the Cooper’s and Poupart’s ligaments fully protects the medial (Hesselbach) and femoral triangle. The lower mesh border fixation 2-3 cm lateral to the internal inguinal ring (in the original Lichtenstein technique the lower mesh border is fixed just to the lateral border of the internal inguinal ring) has its certain advantages. The patients with large indirect hernias whose defect may extend even several centimeters cranial to the internal inguinal ring, often have the increased intra-abdominal pressure pushing the lateral part of the mesh downwards which may lead to indirect recurrence, cranial to the lateral mesh border. This is why it is important to fix the lower mesh border 2-3 cm lateral to the internal inguinal ring. It should be pointed out that the running suture, lateral to the internal inguinal ring must not be placed deep into the tissue, but only through the thin layer of the Poupart’s ligament in order to avoid the lesion of the femoral and the lateral cutaneous femoral nerves. The indirect recurrence in the lateral triangle (the internal inguinal ring and the region 5-6 cm lateral to the internal inguinal ring) is altogether avoided owing, on the one hand, to the fashion of mesh tails fixation around the spermatic cord providing complete "locking" of the internal inguinal ring, and, on the other hand, to the inferior mesh tail fixation to the Poupart’s ligament 2-3 cm lateral to the internal inguinal ring.

It is important that the mesh should not be taut, but slightly bulged. While positioning the mesh, a surgeon should bear in mind two important points: mesh contraction ("shrinkage") due to the connective tissue ingrowing into the mesh and the impact of the intra-abdominal pressure greatly varying from 8 - 12 cm H\textsubscript{2}O in supine and standing position to 80 cm when coughing and vomiting.\textsuperscript{20} Thus, the procedure is in compliance with the tension-free principle preventing chronic postoperative pain at maximal strain.\textsuperscript{21-23}

The use of low-weight polypropylene mesh with large porous induces less fibrous reaction, less shrinkage, and less pain compared to the use of heavy-weight small porous polypropylene mesh.\textsuperscript{21-23}

However, less fibrous reaction following low-weight polypropylene mesh hernioplasty in large hernial defects may lead to mesh bulging, so it is recommendable to use more sutures for fixation. In case of very large hernial defects sizing 7-8 cm or more and the increased intra-abdominal pressure, it is advisable to use heavy-weight polypropylene mesh which is fixed in the above mentioned fashion, taking care that the upper border of the mesh is fixed with several interrupted non-resorbable sutures, only two being insufficient.

In conclusion, it can be said that the modified Lichtenstein technique performed under local anesthesia as an "out-patient" procedure is one of better solutions in the repair of huge or recurrent inguinal hernias in the presence of the increased abdominal pressure.
SUMMARY

MODIFIKOVANA LICHTENSTEIN TEHNIKA U REŠAVANJU KOMPLEKSNIH PREPONSKIH KILA

Lichtenstein tehnika je modificovana radi uspešnijeg rešavanja kompleksnih preponskih kila - velikih kila sa masivnom destrukcijom transverzalne fascije i povišenim intrabdominalnim pritiskom ili recidivantnih kila sa uništenim Poupartovim ligamentom. Kompleksne kile najčešće se rešavaju preperitonealnim tehnikama (otvorenim ili laparoskopskim) u opštoj ili regionalnoj anesteziji kao ambulantna procedura. Modifikovana Lichtenstein tehnika mogu rešiti u lokalnoj anesteziji na ambulantnom principu. Modifikacija Lichtenstein tehnike sastoji se u sledećem: a) lateralno pomeranje i fiksacija donjeg čoška mrežice kada je dobro visina od tuberculuma za 20-30% stepeni u odnosu na njenu. b) fiksacija donje mrežice od tuberculuma da se premošćuje prevencija direktnog recidiva; c) fiksacija donje mrežice premošćuje prevencija indirektnog recidiva; d) fiksacija donje mrežice premošćuje prevencija direktnog recidiva.

REFERENCES


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