



# Current Options in Local Anesthesia for Groin Hernia Repairs

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Inguinal hernia repair is one of the most common procedures in general surgery. All anesthetic methods can be used in inguinal hernia repairs. Local anesthesia for groin hernia repair had been introduced at the very beginning of the last century, and gained popularity following the success reports from the Shouldice Hospital, and the Lichtenstein Hernia Institute.

Today, local anesthesia is routinely used in specialized hernia clinics, whereas its use is still not a common practice in general hospitals, in spite of its proven advantages and recommendations by current hernia repair guidelines.

In this review, the technical options for local anaesthesia in groin hernia repairs, commonly used local anaesthetics and their doses, potential complications related to the technique are evaluated. A comparison of local, general and regional anesthesia methods is also presented.

Local anaesthesia technique has a short learning curve requiring simple training. It is easy to learn and apply, and its use is in open anterior repairs a nice way for health care economics. Local anesthesia has been shown to have certain advantages over general and regional anesthesia in inguinal hernia repairs. It is more economic and requires a shorter time in the operating room and shorter stay in the institution.

It causes less postoperative pain, requires less analgesic consumption; avoids nausea, vomiting, and urinary retention. Patients can mobilize and take oral liquids and solid foods much earlier.

Most importantly, local anesthesia is the most suitable type of anesthesia in elder, fragile patients and patients with ASA II-IV scores.

Key words: Inguinal hernia, local anesthesia.

## INTRODUCTION

Inguinal hernia repair is one of the most common procedures in general surgery. These operations consume an important part of health care resources because of the high incidence of the problem. It is estimated that 20 millions of inguinal hernia repairs are performed globally every year<sup>1</sup>.

Virtually all anesthetic methods have been used in inguinal hernia repairs. General inhalation anesthesia is still most common method in most institution and is always the method for endoscopic/laparoscopic repairs. Some surgeons feel themselves more comfortable and free when their patients are received a full anesthesia. However, local anesthesia has certain advantages for the patients.

Local anesthesia for groin hernia repair was first introduced at the very beginning of the last century<sup>2</sup>. The method gained its great popularity following the success reports from the Shouldice Hospital and the Lichtenstein Hernia Institute during the second half of the same century<sup>3,4</sup>. There are numerous reports in the literature from different countries and continents on local anesthesia for groin hernia repairs<sup>5-11</sup>. Today, local anesthesia is routinely used in specialized hernia clinics<sup>12-14</sup>, while its use is still not a common practice in district general hospitals and teaching hospitals, in spite of its proven advantages.<sup>15,16</sup> In 2005., Danish Hernia Database including 57,505 operations revealed that 63.6% of elective open hernia repairs were performed in general anesthesia (GA), 18.3% with regional anesthesia (RA) and 18.1% with local anesthesia (LA).<sup>17</sup>

Numerous repair procedures have been described to date for groin hernias. Almost all of them, excluding laparoscopic techniques, can be performed with LA.<sup>4,13,18-26</sup> There are also a limited number of reports on the feasibility of laparoscopic repairs with LA.<sup>27,28</sup> The current guideline of the European Hernia Society states that LA is suitable for open repairs, should be considered in ASA

TABLE 1

## ADVANTAGES OF LOCAL ANESTHESIA FOR GROIN HERNIA REPAIRS.

For patient	For surgeon
Avoiding general anesthesia	More accurate diagnosis with coughing
Shorter time in the operating room	More delicate surgical dissection
Less postoperative pain	Checking the success of repair with coughing
Less analgesic consumption	Shorter time spent per procedure
Early mobilization	
Shorter stay	
Avoiding nausea and vomiting	
Early oral intake	
Avoiding urinary retention	
Suitable for ASA III-IV patients	
Suitable in elderly	
More economic	

III/IV patients however it cannot be possible in young anxious patients, morbid obesity, incarcerated hernia.<sup>29</sup>

The technique for establishing LA for inguinal surgery may differ among surgeons. Mainly two techniques, neural blockade and tissue infiltration, are in use; however, the choice of local anesthetic agents and their doses may show variability. In this paper, the technical options for LA in groin hernia repairs, commonly used local anesthetics and their doses, potential complications related to the technique are discussed. An evidence based comparison of local, general and regional anesthesia methods is also presented.

#### FACILITY

Although there are some series reporting unmonitored LA for groin hernia repairs, the most suitable facility for hernia surgery with LA is still an institution where patients can receive GA, if needed or requested, by means of endotracheal tube, laryngeal mask, or inhalation anesthesia (The American Association for Accreditation of Ambulatory Surgery Facilities Level C Center).<sup>30</sup> However, conversion to GA is very low.<sup>10,31</sup> Main reason for conversion is pain. Some centers even reported no need for conversion to GA in hundreds of consecutive patients<sup>19,32</sup>

#### APPLICATION

Today, a step-by-step infiltration technique (SSIT) is the widely used method for establishing LA, and dose of anesthetic agents can be always kept in the limit of confidence.<sup>19</sup> Intravenous mild sedation is also added to maxi-

mize intraoperative comfort. This technique was popularized by the Lichtenstein Hernia Institute.<sup>4</sup>

In SSIT, the incision is marked with a permanent pen. The first injection is given subdermally and then intradermally by the guidance of skin marking; 5-8 ml of lidocaine is injected at this level (Figure 1). Some more local is given while the dissection is going deeper. One of the main steps of the procedure is to give a volume of 6-10 ml local anesthetic agent under the external oblique aponeurosis prior to its opening (Figure 2). Additional small doses may be given when needed with no blind and deep injections with long needles. Usually some more local anesthetics are used at the pubic corner and the root of the hernia sac at the internal inguinal ring.

Truncular ilioinguinal and iliohypogastric nerve block (IIHNB) has long been considered a suitable anesthetic method for both children and adult patient population during surgical procedures in inguinal region, mainly hernia repairs. The technique is also used for postoperative analgesia for surgical procedures completed under general<sup>33-35</sup> or regional anesthesia.<sup>36-38</sup> Besides, nerve block may be an effective solution for primary or surgery related pains of the inguinal region.<sup>39,40</sup>

IIHNB requires a blind puncture at a point close to anterior superior iliac spine and a 10-15 ml local anesthetic agent injection into the planes between external and internal oblique muscles or internal and transversal muscles to block the nerves before entering the inguinal region.<sup>41</sup> However, it has been reported that inguinal nerve block can have 10-30% failure rate when a blind technique is used.<sup>42</sup> In addition, this technique may be resulted in some complications. One can pass the peritoneum and puncture the major vessels, small or large bowels or the given

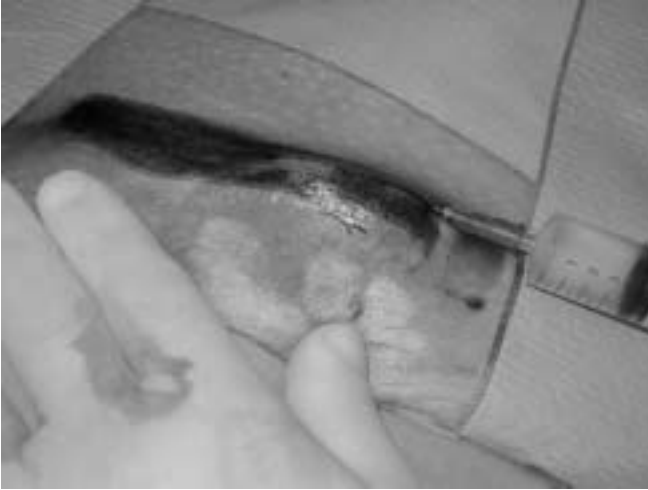


FIGURE 1.

5-8 ML OF LOCAL ANAESTHETICS IS INJECTED SUBDERMALLY AND THEN INTRADERMALLY BY THE GUIDANCE OF SKIN MARKING.

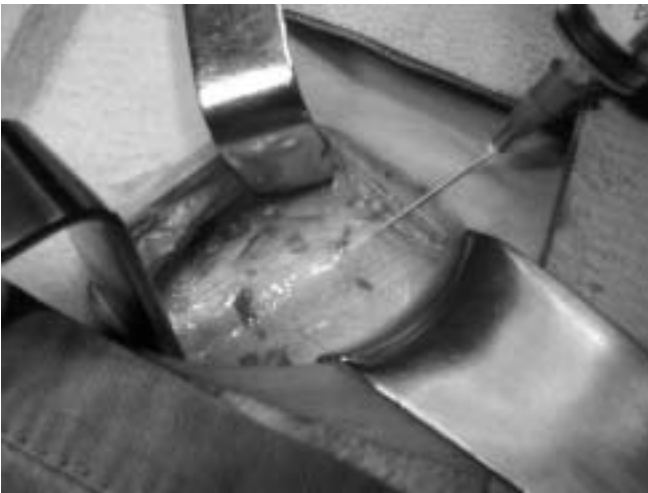


FIGURE 2.

6-10 ML LOCAL ANAESTHETIC AGENT (PREFERABLY BUPIVACAINE) IS GIVEN UNDER THE EXTERNAL OBLIQUE APONEUROSIS PRIOR TO ITS OPENING FOR INFILTRATION OF OPERATION FIELD.

fluid may escape deep into the femoral region unintentionally.<sup>43,44</sup> The first one is a major but very uncommon event, whereas the second is a minor complication that can return within hours, but not rare.<sup>45-48</sup> Its incidence has been reported to be 6% in adult hernia patients.<sup>49</sup>

Rosario and colleagues shown by a cadaver study that the needle point is very close to the femoral nerve along the posterior abdominal especially in male.<sup>47</sup> One milliliter methylene blue injection within the plane superficial to the transversus abdominis and another 1 ml in the plane deep to the transversus abdominis resulted in a dye tracking medially and slightly cephalad under the iliacus fascia. Eventually, a dye pooling around the main trunk of the femoral nerve and other branches of the lumbar plexus was seen.

They reported that the first superficial plane seemed safe however the second plane deep into the trans-versus abdominis was responsible for femoral involvement. Then, the authors suggested that it was better and safer to infiltrate the superficial layers, that is, skin sub-cutaneous tissues and external oblique aponeurosis first, and continue on the deeper layers under direct vision with surgical exploration.

A newer cadaveric dissection has been carried out by our study team.<sup>50</sup> We compare two different techniques in the same body on two sides. The injected volume of 10 ml is more realistic and matches the clinical application for adult patients. A similar discoloration pattern to that in Rosario's study was observed during the present cadaver dissection after IHNB. On the other side, step-by-step infiltration with its main step of injecting the agent under the external oblique aponeurosis caused little discoloration in deep tissues and the area around the femoral nerve (Figure 3). This was the case for both intraperitoneal and preperitoneal dissections. This finding seems to explain why percutaneous inguinal field block cause femoral nerve palsy more frequently than a step-by-step infiltration does.

Classical complaints of transient femoral nerve palsy are leg weakness and knee buckling (inability to stabilize the knee to stand up and walk). This may last for 8 hours after the operation. Tension-free inguinal hernia repairs with prosthetic material are easily performed as day case procedures today, especially in the specific hernia clinics. Patients are generally sent home only 2 hours after the operation. Femoral nerve palsy obviously an obstacle for early discharge. A step-by-step local infiltration technique under direct vision may be considered to decrease the incidence of this complication.

Several centers recently reported ultrasound guided ili-inguinal-iliohypogastric nerve block.<sup>51,52</sup> Surgeons or anesthesiologists can see where they administer the local anesthetic during this procedure. In fact, no consensus exists about the correct plane for local anesthetic injection. Many authors consider the plane between the internal oblique muscle and transversus abdominis, which is contradictory to Rosario's findings, as safe. Although it was reported that ultrasound guidance can supply a 100% success rate, Weintraud wrote that a satisfactory block rate was achieved in only 62% of the patients and accurate placement was accomplished in just 14% of the cases.<sup>51</sup> Eichenberger carried out a cadaver dissection to establish a correct point for the block and suggested that the needle should be targeted to the nerves from 5 cm cranial and posterior to the anterior superior iliac spine, which is not consistent with the classical description of the technique.<sup>52</sup>

Some centers prefer applying both IHNB and field infiltration together to lower intraoperative pain.<sup>53,54</sup> A limited number of surgeons also establish local infiltration percutaneously in the preoperative preparation room. Although this is also a blind method, it can be considered as a time sparing way in busy institutions.

## AGENTS

Different local anesthetic agents have been used to date in groin hernia repairs. All work by preventing the conduction of nerve impulses primarily in nerve cell membranes by inhibition of voltage-gated Na<sup>+</sup> channels.<sup>55</sup> Local anesthetics can be evaluated mainly under two subtitles: short-to-medium lasting agents with quick onset of anesthesia, and long-acting agents. Lidocaine is a good example for the first one and widely used for most centers. It can be used in its simple form or with added adrenaline. On the other hand, bupivacaine, levobupivacaine and ropivacaine are three long-acting amide-based local anesthetics most commonly used in clinical practice.<sup>55</sup>

Lidocaine has a very rapid onset of action within just 2-4 min. Because of the slow onset of action of bupivacaine, which can be observed within 5-8 min at the earliest, it is recommended that lidocaine should use for subcutaneous infiltration.<sup>56</sup> Bupivacaine is much more potent than lidocaine regarding the duration of anesthetic agent. It can retain its anesthetic action for 4-6 h, whereas lidocaine has 1-2 h of lasting action.<sup>55,58</sup> Therefore, bupivacaine and its equivalents are good choices for the infiltration under the external oblique aponeurosis. Lidocaine is proper again for additional small doses when required. In the original description of SSIT local anesthetic solution is given as a mixture of these two agents.<sup>4</sup> Some surgeons prefer buffered solutions. Sodium bicarbonate buffering neutralizes pH and provides quicker onset, better patient comfort during infiltration and surgery.<sup>4,59,60</sup>

## DOSES

The names and concentrations of local agents have usually been given by the authors in the papers on the feasibility of LA for inguinal hernia repair, but few articles mention the exact doses of local agents. In fact, the maximum doses of local anesthetics have been well-documented. However, there is still a global concern about the safety of large doses of local agents.

As a textbook reference, lidocaine, without adrenaline, can be administered as up to a total dose of 200-300 mg with no harm.<sup>57,61</sup> The U.S. Food and Drug Administration recommend dose of lidocaine is as high as 7 mg/kg currently.<sup>62</sup> Bupivacaine is generally used in a total dose of 150-200 mg or 2 mg/kg, while 4 mg/kg is the current recommended dose.<sup>12</sup> Kastrissios et al. demonstrated that the peak plasma level of bupivacaine was far lower than its cardiovascular and central nervous system toxicity levels after using 20 ml of 0.5% solution for wound in infiltration after inguinal hernia repair.<sup>63</sup> It is also possible to perform a hernia repair with almost half of that dose.<sup>19</sup> The peak level was observed at between the 15<sup>th</sup> min and the 2<sup>nd</sup> h after bolus administration. Karatassas et al. reported that a similar pattern is true for lidocaine. They observed that the peak lidocaine concentration was still much lower than the toxic level, despite the fact that a 7-mg/kg infiltration dose was used.<sup>64</sup> These observations make a completely safe discharge 2 h after the completion of the operation.

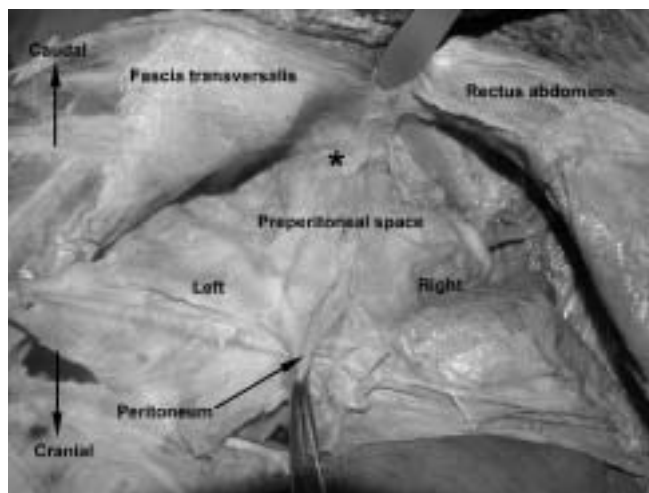


FIGURE 3.

A CADAVERIC DISSECTION STUDY BY USING BLUE DYE. PREPERITONEAL DISSECTION DISPLAYED A MASSIVE STAINING INCLUDING TESTICULAR VASCULAR PEDICULE AND VAS DEFERENS AT RIGHT SIDE WHERE A PERCUTANEOUS ILIOINGUINAL NERVE BLOCK APPLIED. ON THE CONTRARY, A VERY LIMITED STAINING WAS SEEN AT LEFT SIDE WHERE A STEP-BY-STEP INFILTRATION TECHNIQUE WAS SIMULATED. THE DYE SOLUTION INFILTRATED THE LEFT FEMORAL NERVE AREA PROMINENTLY AT RIGHT SIDE AFTER PERCUTANEOUS BLOCK (HAKAN KULACOGLU ARCHIVE).



FIGURE 4.

A MASSIVE OMENTECTOMY SPECIMEN FORM AN INDIRECT INGUINAL HERNIA REPAIR WITH LOCAL ANESTHESIA AND INTRAVENOUS SEDATION.

The use of a mixture of local anesthetics has become popular in recent years, despite some advocates that there are no significant advantages to the use of mixtures.<sup>57</sup> However, as explained above, the differences between two agents in respect of action time and duration provide lidocaine and bupivacaine with different advantages for using them separately. Diluting the local agents with saline cre-

ates increased volume solutions with lower concentrations. This may avoid complications and provides better analgesic cover in generously infiltrated areas.<sup>65,66</sup> Bupivacaine is generally a safe agent for local infiltration, as explained above. Nevertheless, its use may pose some risks when the patient has concomitant cardiovascular or central nervous system disorders. Respiratory depression can be developed or bradycardia can be observed if the patient has been using beta-blockers.<sup>55</sup> However bradycardia during hernia repair is mainly related to peritoneal tension during sac dissection.<sup>19</sup> Some patients may need atropine administration and respond quickly, while others can become normal with just a little more jetocaine infiltration into the local peritoneum.

It has been a personal observation and other hernia specialists' informal statements that older patients may need fewer local agents because of their less muscular body structure and free-of-stress on-table situation. A recent study confirmed this assumption by showing that the older the patient, the lower the bupivacaine and total local anesthetic doses needed.<sup>19</sup> Nienhuijs et al.'s used a total of approximately 30 ml as a mixture of 0.5% lidocaine and 0.125% bupivacaine with no complications in patients older than 65 year.<sup>67</sup>

In fact, the doses of local agents are given in 'mg/kg' their preparations are commonly based on a 70-kg person. This approach may cause an inefficient local anesthetic dose for overweight patients. However, Reid et al. recently reported that the mean local agent volumes of normal weight and overweight/obese (BMI>25) patients who underwent inguinal hernia repair are not significantly different, while the same level of patient satisfaction was provided.<sup>68</sup> In contrast, another prospective study revealed that doses of local anesthetics may differ between normal and overweight patients. Obese patients obviously have larger volumes of subcutaneous tissue and a larger area of the inguinal floor to infiltrate for a comfortable procedure. It is the similar findings of the two series that the required doses even for obese patients stay within recommended safety margins in inguinal hernia repairs. A very recent report from Acevedo and Leon has stated that patient satisfaction rate among obese individuals is slightly lower, but this decrease is balanced with lower preoperative risk and lower cost.<sup>69</sup> In spite of these promising results, some surgeons still prefer excluding patients over 100 kg.<sup>70</sup>

Recurrent inguinal hernias, which have a higher surgical failure rate and require more surgical experience in comparison with primary hernias, create a problematic group for surgeons. Uvela reported that only less than half of a mixture containing 20 ml 0.5% bupivacaine, 50 ml 2% procaine and 30 ml saline was needed for an average recurrent hernia, while huge or complex hernias might require whole quantity.<sup>71</sup> In a recent series, patients with a recurrent hernia needed higher local agent doses in the univariate analysis, whereas this effect disappeared in the multivariate test. Callesen et al. reported an amount of 50 ml of 0.25% bupivacaine solution, which was equal to 125 mg of bupivacaine.<sup>72</sup> Unfortunately, they did not discuss this particular dose in detail. This was also the case

for the size of hernias, while high BMI and longer operation still retained the importance. An inguinal hernia operation under GA generally reduced the sac content after the induction of anesthesia, even in some cases with incarceration. However, sac content can remain out of the abdominal cavity in a great portion of the cases when the operation is done with LA and the related muscles are not relaxed. Intestinal loops were seen in 42% and omentum in 12% of the cases in our series when the hernia sac was opened. The existence of omentum in the hernia sac was found to be a significant factor for lidocaine dose needed in the multivariate analysis. This was probably due to the fact that omentum usually created a mass resistant to easy reduction in a conscious patient contrary to intestinal loops. In the meantime, peritoneal manipulation caused bradycardia and, as the faster and safer agent, lidocaine was the recommended agent by the anesthesiologist in this situation to make the patient comfortable and free of pain. For this reason, omentum in the hernia sac as an independent factor affected lidocaine dose but not bupivacaine dose (Figure 4).

#### INTRAVENOUS SEDATION

Although some surgeons do not request an anaesthesiologist colleague for intravenous sedation, this application seems to a key point for high success rate during inguinal hernia repair with LA. Intravenous sedation is generally set with midazolam (0.07 mg/kg) and fentanyl.<sup>19</sup> A light to mild sedation is sufficient. An experienced anaesthesiologist who is familiar to local anaesthesia in day-case setting is an invaluable companion for a hernia surgeon. Discomfort during hernia sac dissection may be an annoying problem. Local anaesthesia blocks pain sensation, but pressure sensation and traction on deeper tissues like peritoneum is not abolished. Anaesthesiologist can adjust the level of intravenous sedation at this stage of the operation and make the surgeon and patient comfortable during the rest of the procedure. Anaesthesiologists also more correctly evaluate home-readiness of the patient for early discharge.

#### PATIENT SATISFACTION

Tolerance to the LA is generally very good. Patient satisfaction has been reported as 82 to 98%.<sup>32,70,72-76</sup> Adjuvant intravenous mild sedation offers amnesia following surgery and is recommended for increasing patient satisfaction rate.<sup>19,78</sup>

LA is the best option for day surgery settings. Early discharge within a couple of hours is common.<sup>19,79</sup> Moderate to severe pain has been recognized a very common reason of the delay in discharge after ambulatory surgery.<sup>80</sup> Post-operative pain after LA is very low and this provides early discharge and high rate of day-case success after groin hernia repairs. Indeed, most of the overnight stays are social admissions (come from another town, no close relatives to help, etc.) after hernia repair with LA.<sup>19</sup> Readmission, mainly due to dizziness, is also as rare as 1-2.7%.<sup>19,81</sup>

It is the key point for success to explain the natural course to the patients preoperatively. The patients must be told that they can walk to the bed from the operating table right after the surgery, do not feel considerable pain during mobilization after standing up, and can eat and drink soon.

#### COMPARISON WITH GENERAL AND REGIONAL ANESTHESIA

Modern equipment and new agents have made GA a very safe method for most procedures and patients. However any person who undergoes surgery under GA naturally worries about the procedure. Besides, GA is more expensive way than a LA. Postoperative period may not be comfortable due to nausea and vomiting.

Three types of anesthesia have been compared in many studies. Main outcomes are usually patient comfort, perioperative risk, postoperative pain, mobilization and discharge time, ability for oral intake. However secondary parameters like oxidative stress and cost have also been investigated. Most studies revealed better results in favor of LA for certain parameters.

The first comparative study on local versus GA by Maturia et al. published in 1979 revealed that patients having LA required postoperative analgesics and antiemetics significantly less often and also returned home sooner than patients having GA anesthesia.<sup>82</sup> Three years later, Teasdale and colleagues reported that patients having LA were able to walk, eat, and pass urine earlier than those having GA, who experienced more nausea, vomiting, sore throat, and headache.<sup>77</sup> Schumpelick et al. also compared LA with GA and reported that LA resulted in fewer need of analgesics, shorter stays in hospital, and less complications; the pain level was lower and ventilatory function was better.<sup>83</sup> Gönüllü et al. also reported better pulmonary function in LA group than GA group.<sup>84</sup>

Behlia and colleagues carried out a comparative study by measuring cardiac output before induction of anesthesia, during and after operation, and calculating total peripheral resistance. They found no statistically significant differences between cardiac output, mean arterial pressure, total peripheral resistance and heart rate in the two groups at any time period during the study. Patients in the LA group did not require parenteral medication for relief of postoperative pain, whereas all those in the GA group did. Significant cost benefits were realized by the LA group because of elimination of general anesthetic and reduction of recovery room fees.<sup>85</sup> O'Dwyer and colleagues compared LA and RA regarding tests of vigilance, divided attention, sustained attention, memory, cognitive function, pain, return to normal activity, and costs. Most outcome measures were similar. While patients in the LA group had significantly less pain on moving, at 6 hours they were less likely to recommend the same operation to someone else. GA hernia repair cost only 4% more than the same operation under LA. The authors concluded that patients undergoing inguinal hernia repair should be offered a choice of anesthesia.<sup>86</sup>

Della Rocca et al. compared local, regional and general anesthesia in a more recent study.<sup>59</sup> They found similar results in respect of postoperative supplemental analgesic drugs, and length of hospital stays. There was also no difference in intra- and postoperative complications. A similar study from Song et al. revealed that LA had the shortest time-to-home readiness, lowest pain score at discharge, highest satisfaction at 24-h follow-up, and least cost in comparison with GA and RA.<sup>87</sup> Ozgün and colleagues reported that LA resulted in shorter operating room time, lower incidence of nausea and urinary retention, and more satisfaction than GA and RA (spinal). In the LA and RA groups, postoperative analgesic requirements and length of hospital stay were less than in the GA group.<sup>88</sup>

A multicenter Swedish study compared LA, GA, and RA.<sup>89</sup> Primary endpoints in the study were early and late postoperative complications. Secondary endpoints were duration of surgery and anesthesia, length of postoperative hospital stay, and time to normal activity. In the early postoperative period, LA was superior to the other two types with respect to almost all endpoints. At 8 days' and 30 days' follow-up, there were no significant differences between the three groups. Mean duration of surgery was longer for LA, but total anesthesia time was significantly shorter than GA and RA groups. A recent study looked at the point from another view by comparing three types of anesthesia regarding oxidative stress.<sup>90</sup> Total WBC and neutrophil count responses fade away after 24 hours in LA groups, but these changes persisted in RA and GA groups. RA was found to be more advantageous than local and general types of anesthesia when C-reactive protein as an acute phase marker was considered. Total antioxidant status showed minor alterations in three types of anesthesia, however, GA seems to be the least reliable method.

Yilmazlar et al. compared IINB with spinal anesthesia (SA).<sup>91</sup> The use of IINB resulted in a shorter time-to-home readiness, quicker oral intake post surgery, and no need for recovery room care, when compared with the use of SA. Gultekin et al. also compared the two methods and found that LA did not increase the post-operative complications; on the contrary, it was shown to prevent the complications of SA.<sup>92</sup> Although visual analogue pain score (VAS) values were found to be lower in LA group than the spinal anesthesia, this difference did not reach the level of significance. Also, it was discovered that LA did not retard the operation duration. A multicenter study from the Netherlands showed that VAS scores after LA were significantly lower than those after SA.<sup>93</sup> Urinary retention is more frequent after SA. More overnight admissions occurred after SA as well. Total operating time is significantly shorter in LA group, whereas no significant differences were found between the two groups with respect to the activities of daily life and quality of life.

Spinal anesthesia causes urinary retention frequently. Patients received SA is generally not happy with motor block that render them unable to stand up and walk for a while. Severe headache is also an annoying problem, whi-

ch is not easy to overcome following SA. Epidural anesthesia has better outcomes for last two parameters.<sup>94</sup>

#### POTENTIAL AND PROVEN ADVANTAGES

First of all, LA in groin hernia repairs simply avoids general anesthesia. As presented above while discussing three types of anesthesia, LA offers shorter time in the operating room, less postoperative pain, less opioid and oral analgesic need, earlier mobilization, shorter in-hospital stay, very low incidences for nausea, vomiting and urinary retention, early oral intake (Table 1). It is a very good, sometimes the only, option for ASA III-IV patients. LA is also more economic than GA and RA. Since the patient is conscious during the procedure surgeon can ask him/her to give a cough to increase intraabdominal pressure for exact localization of the hernia or checking the safety of the repair.<sup>95</sup> LA is also considered as an assurance for more delicate surgical manipulation. Surgeon will have to dissect the tissues gently without and the assistant will have to retract the wound edges with caution.

#### LIMITATIONS, DRAWBACKS?

Recurrent hernias and hernias in obese patients are already difficult to repair. However these hernias can be repaired with local anesthesia. Giant inguinoscrotal hernias also seem problematic at first look. However, giant or massive inguinal hernias can be cured avoiding general anesthesia with a good patient acceptance.<sup>19,96</sup> Simultaneous bilateral repairs are also possible by using local anesthesia. Successful bilateral repairs with local anesthesia in hundreds even thousands of patients have been reported to date.<sup>97-99</sup>

Kehlet and Bay-Nielsen's report from the Danish Hernia Database revealed that the use of LA was followed by higher reoperation rates due to recurrence compared with GA or RA after Lichtenstein repair for a direct hernia in general hospitals.<sup>100</sup> However, reoperation rates after both direct and indirect hernia repairs were lower among private hernia surgeons, with uniform use of LA compared with reoperations following primary surgery in hospitals. Nevertheless the risk does not seem to be related to LA itself or the repair technique. This is a matter of experience and will be solved after specific education.

Surgical experience may also be a factor for the dose of local anesthetic agents. Sanjay and Woodward have reported that the volume of local anesthetic used is significantly higher for trainees than the consultant; 42 ml versus 69 ml.<sup>101</sup> Interestingly the day-case rate is higher for the consultant than the trainees; 84% versus 69%. However these figures should not be taken as disappointing findings. In contrast, it is clear that experience enhances the success rate. In addition, the best way to increase the frequency of local anesthesia in hernia repairs is teaching the trainees during postgraduate education.

LA is rarely used for emergency repairs due to incarceration or strangulation. De Martino et al. used LA in 37 elderly patients aged 80 to 92 for incarcerated inguinal hernias with no mortality.<sup>102</sup> Their average operative time

was 33 minutes. Nilsson and colleagues employed LA in 5 of 152 patients underwent emergency groin hernia repairs.<sup>103</sup> In their series, LA was used less frequently for patients who died postoperatively than for other patients, both in elective and in emergency surgery. These two reports show the feasibility of LA in emergency repairs however we do not have a prospectively comparative data about the superiority of LA over GA or RA in respect of mortality and morbidity yet. Besides, these papers did not give any detailed information about the progress when a bowel resection was necessary.

It may be logical using LA while starting the operation for an incarcerated groin hernia. This also keeps the hernia content in place at the beginning since no muscle relaxant has been used. The surgeon can see what is in the hernia sac without any spontaneous reduction. Obviously, the sac content may be only omentum in many incarcerated cases, and these cases will not be different from other irreducible groin hernias repaired on an elective basis. When the sac contains intestine, the surgeon can evaluate the viability of the involved bowel loops for a while before a gentle reduction to the abdominal cavity. The operation then can be completed with a Lichtenstein repair. If the small bowel seems to be grossly ischemic or very questionable vitality, it is also possible to do a limited resection and anastomosis via the inguinal incision. This may require a further induction of general anesthesia but still avoids an unnecessary laparotomy. The choice of repair then can be a Bassini-Shouldice suture repair or even prosthetic repair again.<sup>104</sup>

#### CONCLUSIONS

Although LA provides maximum comfort for the patients in selected institutions, its use may result in discomfort to the patient and surgeon when the application is not performed properly. Inexperience with local anesthetic technique can cause both discomfort to patients and an increased recurrence rate. A satisfactory LA for inguinal hernia repair requires both an appropriate technique and satisfactory doses at the same time. It may not be possible to set a perfect LA if the given dose is not enough.

The LA technique has a short learning curve requiring simple training. It is easy to learn and apply, and its use is in open anterior repairs a nice way for health care economics. Therefore, every surgeon should be capable of not only performing current repair methods but also applying LA successfully in his/her daily practice.

#### SUMMARY

##### MOGUJ NOSTI LOKALNE ANESTEZIJE U OPERACIJAMA PREPONSKIH KILA

Operacija preponskih kila je jedna od naj-e{ih operacija u op{toj hirurgiji. Sve vrste anestezije se mogu koristiti u operaciji preponskih kila. Lokalna anestezija je kori{ena jo{ od po~etka pro{log veka a dobila je na popularnosti posle uspe{nih iskustava Shouldice klinike i Lichtenstein Hernia Instituta. Danas se lokalna anestezija rutinski primenjuje u specijalizovanim klinikama za kile dok u

op{tim bolnicama ona i dalje nije deo svakodnevnih prakse bez obzira na dokazane prednosti o preporuke vodi-na za le-enje preponskih kila. U ovom radu evaluirana je tehnika lokalne anestezije, naj-e{}e primenjivani anestetici i njihove doze kao i potencijalne komplikacije. Predstavljeno je i poredjenje lokalne, regionalne i op{te anestezije. Lokalna anestezija ima kratku krivu u-enja i zahteva jednostavnu obuku. Lako ju je nau-iti i primeniti i kod otvorenih anteriornih tehnika i ekonomski je isplativa. Pokazano je da lokalna anestezija ima prednosti u odnosu na op{tu i regionalnu anesteziju. Povezana je sa kra}ima trajanjem operacije kao i kra}im boravkom u bolnici. Povezana je sa manjim postoperativnim bolom i zahteva manje analgetika; prevenirana mu-ninu, povra}anje, i urinarnu retenciju. Bolesnici se odmah mobilizuju i znatno ranije mogu da unose te-nost i hranu. Najva'nije, lokalna anestezija je i idealna kod bolesnika starije 'ivotne dobi i bolesnika ASA skora II-IV.

Klju~ne re-i: ingvinalna kila, lokalna anestezija

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