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## MICROLAPAROSCOPY (Needlescopic Laparoscopy)

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The ambition of surgeons towards the ideality of minimally access and invasive surgery has not yet reaching a limit. Laparoscopic surgery when commenced at the closing decade of 19<sup>th</sup> century was thought to be the optimum surgery. Years were passing, to uncover the robotic, telesurgery and virtual reality computer assisted laparoscopic surgery. At the same time researchers are developing the new generation of microlaparoscopy or called (needlescopic) instruments, to begin the era of the microlaparoscopic surgery.

### Definition

Due to the extra ordinary advances in microfiber technology, laparoscopes measuring 2-3mm in diameter (called microlaparoscopes to differentiate from the usual 10 mm and 5 mm laparoscopes) now provide the access for laparoscopy with 2-3 mm skin incisions .

**Microlaparoscopic surgery:** was considered successful if all ports that

were used are of 3 mm or less in diameter. If any one of these ports was increased to 5 mm or beyond during the course of the procedure, or a conventional laparoscopic tool was necessary to complete the procedure, surgery is counted as a conversion to standard laparoscopic procedure, or open surgery, respectively. <sup>1,2,3,4</sup>

### Instruments

#### *Telescopes:*

Of small diameters (2-5mm) are available, some times blamed for poor visualization, but ordinarily the 10 mm port and telescope is usually utilized for both good vision and specimen extraction. High intensity light cable and source will enhance visibility.

#### *Ports:*

Ranging from (2-3mm) are utilized.

#### *Forceps:*

Forceps, scissors, hooks, and other instruments included a 1.7-mm ball-tipped coagulator(MIST; Smithfield, North Carolina, US) and insulated instruments including Maryland forceps, L-hook, spatula, and scissors of either 2.5 mm or 3 mm in size (Ackermannare Instrumente GmbH, Rietheim-Weilheim, Germany), readily available at needlescopic sizes (2-3 mm). <sup>3</sup>

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The ability to easily and rapidly change from one laparoscope to another is paramount. It is essentially to sterilize the video camera head in order to avoid having a drape. If the camera head have to be draped, it is impractical to change from one laparoscope to another. A special sterilization system like (STERIS), make the microlaparoscope readily available on a Mayo stand will permit switching laparoscopes within seconds.<sup>3</sup>

*Skin incisions:*

All the wounds for the needlescopic instruments were closed with tape, and the sub-umbilical wound was closed with sutures in layers. Some authors stated that: needlescopic surgery skin incisions length range from 2-3 mm, requiring *no stitch neither band aid* at the end of procedure. This as well shortens the time of surgery.<sup>3</sup>

**Procedures**

Minilaparoscopy (Needlescopic surgery); is a logical evolution from conventional surgery<sup>1</sup>. Applications are many even some are developing. Procedures can be divided into:

**Primary procedures**

- Cholecystectomy
- Appendectomy
- Funduplications
- Heller myotomy
- Extrapeitoneal inguinal hernioplasty
- Ventral hernia repair
- Clipless adrenalectomy
- Needlescopic axillary lymphadenectomy
- Pelvic gynaecological procedures
- Thoracic sympathectomy for palmer hyperhydrosis

- Urological procedures
- Other developing procedures

**Secondary procedures<sup>5</sup>**

- Combined use with macrolaparoscopic instruments
- Specimen removal without 2° large ports.
- Diagnostic procedures
- Periumbilical lysis of adhesions
- Enhanced surgical perspectives
- Umbilical port site closure
- Initial primary entry
- Left upper quadrant entry

Those secondary benefits are also applied to alternating use of microlaparoscopes and macrolaparoscopes.<sup>5</sup>

*Needlescopic Cholecystectomy<sup>1,2,3,3</sup>:*

Thousands of needlescopic cholecystectomies were performed during the last years utilizing the miniaturized instruments of 3mm or less in diameter, and incisions. Some are combined with macrolaparoscopic splenectomy. Patients operated upon are with or without gallstone complications. The procedure proved to be of much benefit and comparable to ordinary laparoscopic cholecystectomy. No intraoperative complications were recorded peculiar to needlescopic procedure. Operative time is approximately 20% longer for the needlescopic operations. Analgesia used postoperatively found 70% less in the needlescopic operations.

*Microlaparoscopic Fundoplication<sup>6</sup>:*

The outcome of needlescopic fundoplication with those of conventional laparoscopic fundoplication was searched recently in many studies. There was a non significant trend toward decreased operative time,

blood loss, narcotic requirements, and length of hospital stay in the needlescopic surgeries. There were no significant differences in intraoperative complications. There were a significant reduction in mean operative time for needlescopic fundoplication. In conclusion of those studies; needlescopic fundoplication poses no disadvantage, and it offers the added cosmetic benefit of smaller incisions.

#### *Heller myotomy*<sup>7</sup>:

The use of "needlescopic" technology in the surgical management of achalasia was under recent researches. Needlescopic Heller myotomy appears to be a safe treatment option, resulting in a decreased length of stay and improved wound cosmesis.

#### *Inguinal hernia repair*<sup>8,9,10</sup>:

Needlescopic inguinal hernioplasty has been made feasible with the miniaturization of instruments and recent advances in laparoscopic surgical technique. Postoperative outcome of needlescopic totally extraperitoneal inguinal hernioplasty (TEP) has not been previously compared with that of conventional TEPs. Needlescopic TEP is a safe technique for the repair of inguinal hernia. Postoperative recovery following needlescopic and conventional TEPs was similar. Needlescopic TEP conferred a significantly lower pain score upon coughing on the first day after operation. In other studies Nyhus type II, III, or IV inguinal hernia without associated pathology by laparoscopic surgery using 2-mm surgical instruments and a modified preperitoneal Dulucq technique were performed. At 6 months there has been no recurrence of hernia. It was evident that the 2-mm procedure produced less surgical trauma. Overall, needlescopic

extraperitoneal repair of inguinal hernias is a feasible procedure in male patients seeking better cosmetic results than can be achieved with standard laparoscopic extraperitoneal repair. This procedure is technically more demanding. The operative time is longer. The cosmetic aspect is the only advantage of this technique.

#### *Microlaparoscopic adrenalectomy*<sup>11,12</sup>:

Clipless laparoscopic adrenalectomy with needlescopic instruments is feasible for most benign adrenal tumors. In addition to the benefits of conventional laparoscopic surgery, clipless needlescopic laparoscopic adrenalectomy further decreased postoperative pain, shortened convalescence and improved wound cosmesis. In another study comparing the open versus laparoscopic adrenalectomy, a conclusion stated in favor of this procedure; (the already low morbidity of laparoscopic adrenalectomy can be reduced further by using needlescopic techniques). In a financial analysis of needlescopic versus open adrenalectomy, in addition to providing a shorter hospital stay, decreased morbidity and quicker recovery, needlescopic adrenalectomy also is 17.9% less expensive than open adrenalectomy.

#### *Microlaparoscopic urosurgery*<sup>12</sup>:

Needlescopic techniques have been used to particular advantage in four specific clinical applications: adrenalectomy, pediatric orchiopexy, detaching the bladder cuff during laparoscopic nephro-ureterectomy, and as an adjunctive needlescopic port for retraction purposes during conventional laparoscopic surgery. Given the urologist's natural facility with small diameter endoscopes, the specialty is uniquely positioned to take a leadership position in this emerging

field. Increased experience and careful comparisons with conventional laparoscopy will determine the true role of needlescopic technology in the armamentarium of the urologic surgeon.

#### *Needlescopic thoracic surgery*<sup>13,14</sup>:

Endoscopic thoracic sympathectomy or sympathectomy of the lower part of the stellate ganglion is an efficient method for the treatment of craniofacial hyperhidrosis, but postoperative compensatory sweating may be troublesome in some patients. Needlescopic thoracic sympathetic block by clipping may achieve a similar effect as well as providing a possible reverse operation for patients who suffer from intolerable postoperative compensatory sweating. The technique allowed healing without a scar and improved the patient's cosmesis.

Needlescopic operation using instruments with a diameter of 2 mm has not been applied to partial lung resection because of the difficulty in grasping the lung firmly or the possibility of injuring the lung easily with 2-mm forceps. A technique developed using a mini-loop retractor and successfully performed partial lung resection in 35 patients with pneumothorax, small lung tumor, or interstitial pneumonia.

#### *Axillary lymphadenectomy*<sup>15</sup>:

For a better cosmesis and least postoperative pain experience the needlescopic lymphadenectomy in breast cancer was tried and found that: endoscopic axillary lymphadenectomy can be performed safely with needlescopic instruments, but further study is needed to establish this technique.

Furthermore other sophisticated colonic procedures were tried since 2002 utilizing the microlaparoscopic technique. Some colon procedures that

require major reconstruction may be performed needlescopically in selected patients like sigmoid tumors and rectopexy<sup>16</sup>.

Solid organs procedures have gain a place in the microlaparoscopy. So needlescopic splenectomy for idiopathic thrombocytopenic purpura is feasible and safe with less postoperative pain and a superior cosmetic result compared with conventional laparoscopic splenectomy<sup>17</sup>.

## **Discussion**

Following the success of laparoscopic cholecystectomy, and other laparoscopic procedures with standard instruments of 5 mm or 10 mm in size, surgeon shave strived to further improve the results. A number of technical modifications have focused either on reducing the number of ports, or the diameter of the instruments used. There was considerable skepticism in the early stage of development of needlescopic surgery, which used instruments of 3 mm or less. Concerns related to the safety of the operation as a result of the inferior resolution and illumination of the mini-laparoscope, increased risk of tissue damage with the smaller graspers, risk of contamination and extra time required from the change of laparoscope at different phases of the operation, and the increased cost of the procedure, given that these delicate instruments have a theoretically shorter life-span. The more practical issue which affects surgeons, however, is the more difficult retraction needed to provide a satisfactory exposure, adaptation to the fine instruments, and the absence of miniaturized metal clips of less than 5 mm in diameter to control the ductal structures.

Although micro-laparoscopic (needlescopic) procedures could be per-

formed safely and expeditiously for the great majority of pathologies, one should be clear about its exact benefit over conventional laparoscopic intervention. Two of three randomized studies, from Singapore and Copenhagen, found a significant reduction in post-operative pain after needlescopic surgery. However, all three trials failed to demonstrate any difference in other objective parameters, including operating time, hospital stay, and duration for recuperation. The only distinct advantage of adopting needlescopic surgery is, perhaps, the better cosmetic results possible and, as a result, better patient acceptance. From the lessons learned from those studies, we believe that a mini-laparoscope of either 2.5-mm or 3-mm. Hopkins rod lens system should be used so that the safety and duration of surgery are not compromised. Even for skilled laparoscopic surgeons, a learning process is still required to adapt to these miniaturized instruments and to achieve an acceptable success rate with minimal instrument. As some authors point out, their success rate of the needlescopic procedure improved with increasing experience, reaching a remarkable 96% with the last 50 consecutive patients. Obviously, even for a skilled laparoscopic surgeon, a learning curve would still be required to allow adaptation to the fine needlescopic instruments involved, and to achieve ever-improving results. Unlike conventional open surgery, in which operative manoeuvres are mostly intuitive, surgeons practicing

laparoscopic surgery have first to master the necessary endoscopic surgical skills and learn to operate under a limited telescopic view rather than under direct vision. Instead of having a 3-D perspective of the surgical field, surgeons must see and assess organ structures only on a television monitor showing a flat 2-D picture; the important sensation of touch is also lost. Movements are restricted by the keyhole access and become paradoxical in nature.

One must always be mindful that performing minimal access surgery using needlescopic instruments neither automatically nor necessarily implies reduced surgical trauma, or minimal invasiveness, to patients. Prospective randomized controlled studies that compare needlescopic and standard laparoscopic cholecystectomy have yielded conflicting results regarding their relative advantages. Whereas some studies have reported that the needlescopic approach results in less postoperative pain than does laparoscopy, other studies have shown no significant advantage of the needlescopic approach over the standard laparoscopic technique.

Accordingly, microlaparoscopic surgery learning using live surgery on patients, and prior adequate training in laparoscopic surgery in a simulated environment (ie in virtual reality) has become mandatory.

Microlaparoscopic surgery is the future ambition, and is chosen as the first commencing procedure in most laparoscopic endosurgeries at many developed centers all over the world.

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