

Lost needles during pediatric laparoscopic surgery: proposition of an algorithm derived combining a pediatric minimally invasive surgery center's experience and literature analysis

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Table of Contents

INTRODUCTION	2
METHODS	2
RESULTS	2
DISCUSSION	5
CONCLUSION	7
REFERENCES	7

Abstract. INTRODUCTION: we are the first to propose an algorithm to apply when a needle is lost during a pediatric laparoscopic procedure. MATERIALS AND METHODS: we derived this protocol combining our experience with the current literature on the topic. RESULTS: the event of losing a needle during a minimally invasive procedure has happened three times in our 21-year experience, each time for a different reason. Combining information from these experiences with risk factors and suggestions for retrieval of a needle from the literature, we formulated the algorithm. DISCUSSION: losing a needle during a laparoscopic procedure, though a rare occurrence, represents a major dilemma and challenge due to the difficulties in finding it, even for an experienced surgeon. The risks associated with the loss of needles or other foreign objects in the body are not fully known. Few authors have proposed radiological, surgical or other methods for retrieving lost needles during surgery. CONCLUSION: prevention of loss, an immediate and localized laparoscopic search with a simultaneous accurate recount, trocar inspection, the use of electromagnetic devices, a radiological search (if the needle is >15/17 mm in width) and finally a systematic laparoscopic search are the steps to follow, according to our study. The problem of what to do when a needle is not found remains controversial. Although, a fairly large needle presenting a high risk of organ damage if retained (> 15 mm) can usually be traced through an intraoperative radiograph.

Keywords. lost needle, protocol in laparoscopy, complications in minimally invasive surgery.

INTRODUCTION

The loss of a needle during a laparoscopic procedure, though a rare occurrence, represents a major dilemma and challenge due to the difficulties in finding it, even for an experienced surgeon.

The risks associated with the loss of needles or other foreign objects in the body are not fully known; the literature only reports a few cases; therefore, it is not clear how a minimally invasive surgeon should behave in front of such an eventuality.

Most guidelines are focused on prevention of lost surgical instruments in the field. Prevention should be based on an accurate instrument count by the scrub nurses, but also, as we learned in one of our cases, on needle retrieval once the procedure is over.

Some authors have offered detailed instructions regarding the discovery process of a lost needle. There are only a few cases and they all come from experiences on adult patients. No literature exists, to our knowledge, concerning these issues in pediatric patients undergoing a minimally invasive procedure. It seems that pediatric laparoscopic surgery is more associated to such events than other surgical specialties . [1,2].

METHODS

We conducted a systematic search of all English articles regarding the issue of lost needles during minimally invasive surgical procedures (including thoracoscopic, traditional laparoscopic and robot-assisted laparoscopic procedures) in PubMed and ScienceDirect.

We also report experiences with lost needles in our pediatric minimally invasive surgery center from 1995 to 2016. Combining existing literature on the issue together with an analysis of our experiences in our center, we came up with an algorithm (figure 4) that can help guide laparoscopic pediatric surgeons in recovering an eventual lost needle as quickly as possible, minimizing the risks associated with such an event. Our goal is also to raise awareness in the international pediatric surgery community on the topic in order to develop and implement what we propose in this paper.

RESULTS

During the period of 1995 to 2016, 4315 laparoscopic procedures were performed in our pediatric minimally invasive surgery center. The most frequent procedures requiring the use of a needle were (in order of frequency): inguinal hernia repair, anti-reflux funduplicatio (Nissen or Dor), some lung wedge resections performed, thoracoscopic congenital diaphragmatic hernia repair, thoracoscopic esophageal atresia correction, laparoscopic choledocal cyst removal and hepatico-jejunostomy, laparoscopic trans-peritoneal pielooplasty. The needles utilized in these procedures range from 13 mm (PDS 6-0) to 22 mm. The loss of a needle occurred three times: 1) during an inguinal hernia repair; 2) during a laparoscopic trans-peritoneal pielooplasty; 3) during an esophageal atresia correction. 1) during a left transperitoneal laparoscopic pyelooplasty in a 6 year-old child, an attempt was made to pass the needle through the trocar but, being too large, it fell into the abdomen. The 13 mm needle could not be detected with imaging. Thanks to a laparoscopic systematic search the needle

was found on the anterior surface of the liver. It is important to note that this mistake could have been prevented if the passage of the needle through the trocar had been checked pre-operatively (figure 1 and 2); 2) a 22 mm needle was lost during the retrieval after a laparoscopic hernia repair in a 3 year-old patient. After an immediate laparoscopic search in the retrieval area without success, an x-ray was performed, where the needle was identified in the trocar area and taken out. The needle was found within the anterior abdominal wall (figure 3); 3) at the end of a thoracoscopic esophageal atresia correction, during a rapid look over the whole right pleural cavity, by chance, we noticed a lost needle in the pleural cavity. This would not have happened if an accurate count had been performed by the nursing staff. This underscores the idea that prevention is the most important aspect of the issue.



Figure 1: the needle was lost when attempting retrieval through the trocar.



Figure 2: the 13 mm needle could not be detected radiologically; therefore, the needle was found through a systematic laparoscopic search.

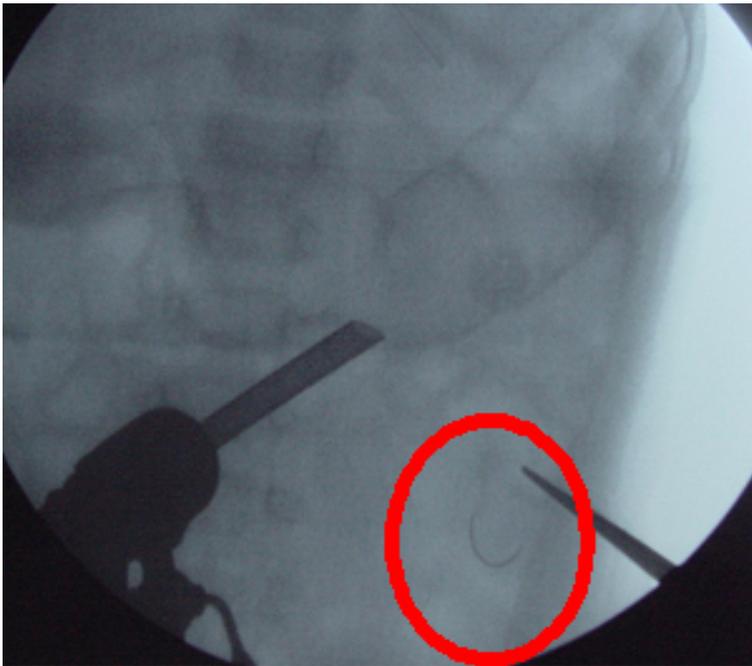


Figure 3: the lost needle (22 mm) was detected radiologically and localized inside the anterior abdomen wall.

A close analysis of existing literature reveals risk factors for losing a needle: high body mass indexes, high number of surgical instruments in the field, presence of more than one surgical team, complex and prolonged procedures, and emergency or trauma surgery. The surgical specialties associated with loss of a needle appear to be pediatric surgery, urology and robotic surgery [1,2]. In fact, a recent advisory statement by The Joint Commission stressed the high number of incidents of foreign objects being retained after robotic surgery as reported to its Sentinel Event database and advised that standardized processes must be implemented during robotic surgery to ascertain the whereabouts of these objects and facilitate their recovery [3]. From the survey conducted by Jayadevan et al., it emerges that surgeons with greater experience in needle loss are no faster in needle recovery times than those who have experienced fewer lost needles. Similarly, a greater number of years in surgical practice is not associated with faster recovery needle times [2].

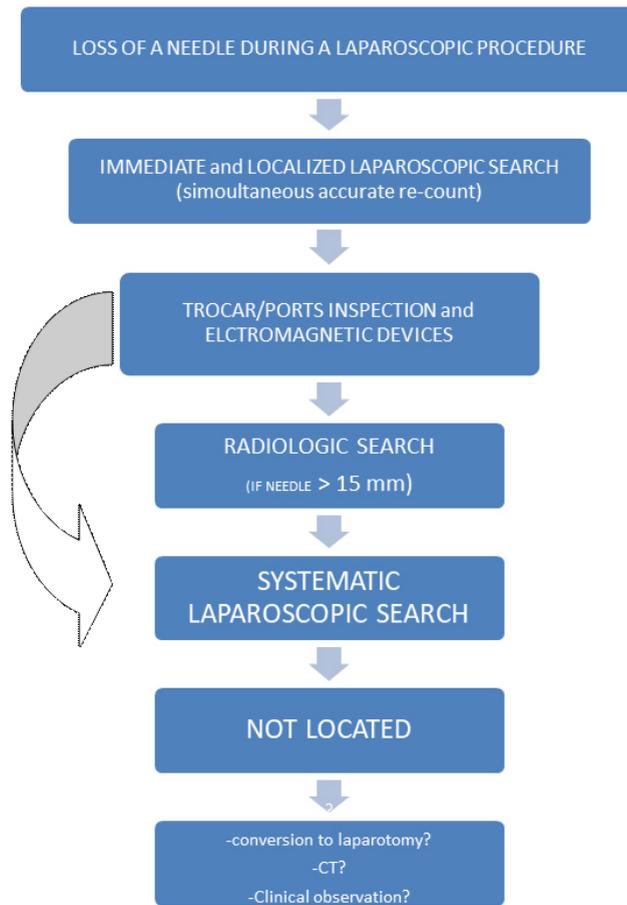


Fig.4: proposition of an algorithm when a needle is lost during a minimally invasive procedure.

DISCUSSION

The loss of a needle during a laparoscopic procedure, though a rare occurrence, represents a major dilemma and challenge due to the difficulties in locating it, even for an experienced surgeon. The risks associated with the loss of needles or other foreign objects in the body are not fully known; the literature, only reports a few cases; it is therefore not clear how a minimally invasive surgeon should behave in front of such an eventuality. Most guidelines focused on preventing the loss of surgical instruments in the field. Prevention should be based on an accurate instrument count by the scrub nurses but also, as we learned in one of our cases, on the needle retrieval once the procedure is over. Some authors have offered detailed instructions regarding the lost needle discovery process based on only a few cases which all come from experiences on adult patients. No literature exists, to our knowledge, about these issues on pediatric patients undergoing a minimally invasive procedure. It seems that pediatric laparoscopic surgery is more frequently associated with such an event than other surgical specialties. Combining existing literature on the issue and analysing the behaviour in our three cases, we came up with an algorithm that can help guide laparoscopic pediatric surgeons in recovering an eventual lost needle as quickly as possible, minimizing the risks associated with such an event. First, once it has been established that a needle is lost, an immediate laparoscopic search in the work area must be done; this search should be conducted

with the optic only; avoid moving the patient and any already inserted instruments, thus respecting the patient's position (neutral, anti or Trendelenburg, etc....). All these measures are aimed at decreasing further needle movement. During this first step the nursing staff should continue the re-count in the field and in the room [2]. If this first step fails, trocars should be inspected. They can be dismantled by an O.R. nurse or even x-rayed, as reported in a robotic prostatectomy by Omar [4]. More or less simultaneously, some authors have successfully used some laparoscopic electromagnetic devices. These are electromagnetic probes at the end of a semi-flexible rod made in Teflon [5,6]. We have not yet tried this kind of device but it seems to be a very good option when dealing with this situation. Should these maneuvers not result in finding and retrieving the needle, intraoperative radiographs should be taken into consideration. From existing literature, it is clear that not all needles can be detected. For instance, Grossberg [7] concluded that performing an x-ray for needles smaller than 13 mm in width is probably useless since they cannot be detected. This falls into line with our experience of the lost needle in the laparoscopic pielloplasty where the needle could not be radiographically detected, a PDS 6-0 (width 13 mm). The narrowest width of a visible needle has not been clearly defined. Barrow concluded that needles <17 mm are difficult to find radiologically; there is no evidence in the literature they may cause damage to large body cavities [8]. Furthermore, it seems that needles > 17 mm can cause chronic pain, chronic irritation and organ damage (intestinal perforation). Others put the cut-off for the x-ray at 15 mm [9]. Ostrenseki proposed a method of detecting a missing needle or instrument fragment intraoperatively during laparoscopy. A plain abdominal radiograph may show the missing equipment, but it is challenging to actually find it with a laparoscope. His method used radiopaque threads removed from radiograph-detectable sponges to create a "net" or "grid" on the abdomen. A metallic instrument was then used to pinpoint the missing fragment more accurately. In this manner, the surgeon was able to localize and retrieve the missing fragment without having to convert to open surgery [9]. At this point, the risks associated with retaining small sized needles are still not fully known and no one can guarantee that they will cause problems in the future. Of course, even if the risk is low, a systematic laparoscopic search is always recommended. Jayadevan et al. proposed a protocol derived from a survey offered to laparoscopic surgeons in the US where they give some advice on the modality of such a systematic search, as follows:

- the right lobe of the liver should be retracted anteriorly to expose the perihepatic space for visual inspection. Careful attention should be paid to areas in which the needle may have become lodged, such as the apposition between the inferior duodenal flexure and the transverse colon.

- The left lobe of the liver should be retracted anteriorly to expose the superior aspect of the gastric fundus. Next, the body of the stomach should be gently retracted laterally to expose the spleen, and a visual search around the periphery of the posterior splenic attachments should be made.

- Both right lateral and left lateral paracolic gutters should be thoroughly inspected.

- A control run of the bowel should be conducted, beginning with the descending colon and running in reverse in the direction of the duodenum. We recommend applying gentle anterior traction to the bowel segments to properly visualize the needle if shaken loose.

- Visual inspection of the inferior abdomen and superior pelvis should be made, with attention to areas adjacent to the bladder [2].

At this point, after all these steps are accomplished, if the search has failed in finding the needle, there is no consensus on how to proceed. Some suggest a conversion to laparotomy, others a clinical observation, and still others a CT.

The problem of what to do when a needle is not found remains controversial. A fairly large needle presenting a high risk of organ damage when retained, is usually traced through an intraoperative radiograph.

CONCLUSION

Combining existing literature on the issue along with an analysis of experiences in our pediatric minimally invasive center, we came up with an algorithm that can help guide laparoscopic pediatric surgeons in recovering an eventual lost needle, as quickly as possible, minimizing the risks associated with such an event. In addition, our goal is to raise awareness in the international pediatric surgery community on the topic in order to develop and implement what we propose in this paper.

However, even after the algorithm has been correctly applied, the problem of what to do when a needle is not found remains controversial, given that a fairly large needle with a high risk of organ damage when retained, is usually traced through an intraoperative radiograph.

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