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Laparoscopic pyloromyotomy can be performed safely by senior pediatric surgery trainees without supervision at high volume centers

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ABSTRACT

Aim of the Study: Pediatric surgery trainees at our institution perform 15 to 20 supervised laparoscopic pyloromyotomies during their junior year, and are allowed to perform the operation independently without supervision during their senior year. We reviewed the outcomes of laparoscopic pyloromyotomies performed by senior trainees operating without supervision and compared them to experienced pediatric surgeons.

Method: We did a retrospective reviewed of all unsupervised laparoscopic pyloromyotomies (n = 90) performed by the last 12 pediatric surgery fellows (2012–2018) during their senior year, and the most recent 90 consecutive laparoscopic pyloromyotomies performed by 9 experienced pediatric surgeons. Statistical significance was determined by T-test and Fisher's exact test. Data is expressed as mean (SD) or median (range). A p value of ≤0.05 was considered significant.

Results: Mean age at surgery was 4.7 (SD: 1.6) and 5 (SD: 2.3) weeks in the trainees and surgeons group, respectively (p = 0.38). Mean operative time was 28 (SD: 13) minutes in the trainees group vs. 25 (SD: 10) minutes in the surgeons group (p = 0.09). Intraoperative complications occurred in 3 of 90 (2.7%) cases in the trainees group (three mucosal perforations, all detected during the operation, one repaired laparoscopically, two repaired open), and none in the surgeons group (p = 0.11). One postoperative complication requiring reoperation occurred in the trainees group (omentum eviscerated through an incision site), while none occurred in the surgeons group (p = 0.36). No incomplete pyloromyotomies occurred in either group. The median length of postoperative hospital stay was 1 (1 to 10) and 1 (1 to 6) days in the trainees and surgeons group, respectively (p = 0.63).

Conclusion: Senior trainees at high-volume training programs can perform unsupervised laparoscopic pyloromyotomies safely as a mean to promote surgical autonomy without compromising patient outcomes.

Level of Evidence: III

Promoting surgical autonomy and intraoperative decision making skills must be an integral component of any surgical training program that aims to produce mature trainees. The mere acquisition of technical skills is not enough to ensure an appropriate independent professional practice after the completion of a surgical residency or fellowship. Yet, operating truly independently during surgical training is generally limited to a handful of minor bedside procedures (e.g. chest tube placement, drainage of skin abscesses, bedside central line placements). This reality of trainees not being allowed to do procedures independently in the operating room when they are technically ready is mostly driven by ever growing medico-legal concerns, and by an increasingly paralyzing culture of patient safety. Ideally, when trainees achieve the appropriate level of maturity in skills and surgical decision making, they should be allowed to perform certain procedures without supervision, in order to experience first-hand the responsibilities that come with the autonomous practice of surgery. We reviewed our experience with a program where senior pediatric surgery trainees are allowed and encouraged to do laparoscopic appendectomies without supervision at our institution. We concluded that it is a safe practice and that it is highly regarded by our trainees as a way to develop autonomy [1]. We have empirically applied the same concept to laparoscopic pyloromyotomies in the last 7 years. In this study we evaluated the safety of this educational strategy by comparing the outcomes of patients operated on independently by senior fellows versus the outcomes of patients operated on by experienced pediatric surgeons.

1. Materials and methods

After obtaining Institutional Review Board approval (IRB #18–015812), we performed a retrospective review of all unsupervised laparoscopic pyloromyotomies performed by the most recent pediatric surgery trainees (n = 12) during their last year of training between 2012 and 2018. This

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group of *trainees* performed 90 independent laparoscopic pyloromyotomies. We compared those to the most recent 90 consecutive laparoscopic pyloromyotomies performed by the 9 experienced board-certified pediatric surgeons in our practice who routinely do this operation.

Demographic and surgical outcome data including operative time, intraoperative and postoperative complications, and length of postoperative hospital stay were compared between groups. Statistical significance was determined by T-test and Fisher's exact test. Data is expressed as mean (SD) or median (range). A p value of ≤0.05 was considered significant.

Pediatric surgery trainees in all U.S. programs have completed 5 years of general surgery residency and are American Board of Surgery board-certified or board-eligible general surgeons, legally allowed to practice independently. Additionally, senior pediatric surgery trainees have completed a full year of pediatric surgery training before being allowed to perform selected procedures independently, and are covered by a malpractice insurance policy. Immediate help from attending/staff pediatric surgeons is always available, if needed, for the pre-operative evaluation, the operation, and the postoperative care. The senior fellows decide who does the operation. It is not mandatory for them to take on the cases, and they have the first right of refusal. The faculty member on call, the time of the day or the health insurance status play no role in deciding who performs the operation.

2. Results

The mean patient age at surgery was 4.7 (SD 1.6) and 5 (SD 2.3) weeks in the *trainees* and *surgeons* group, respectively ($p = 0.38$) (Table 1). The mean operative time was 28 (SD 13) minutes in the *trainees* group versus 25 (SD 10) minutes in the *surgeons* group ($p = 0.09$).

Intraoperative complications occurred in 3/90 (2.7%) cases in the *trainees* group (Table 1). All intraoperative complications were mucosal perforations. All were detected during the operation. The repair was done laparoscopically in one case, and via a laparotomy in two cases (trans-umbilical in one and through the right upper quadrant in one). No intraoperative complication occurred in the *surgeons* group ($p = 0.11$). There were no conversions related to the inability to complete the procedure in either group. No open pyloromyotomies were done by the trainees or by the attending surgeons during the analyzed period.

Postoperatively, one (0.9%) complication was encountered in the *trainees* group (Table 1): omentum eviscerated through a glued stab incision site, requiring reoperation. No postoperative complication occurred in the *surgeons* group ($p = 0.36$). No incomplete pyloromyotomies occurred in either group.

There was one (0.9%) reoperation in the *trainees* group (reduction of eviscerated omentum) and no reoperations in the *surgeons* group ($p = 0.36$).

The median length of postoperative hospital stay was 1 (range: 1 to 10) and 1 (range: 1 to 6) days in the *trainees* and *surgeons* group, respectively ($p = 0.63$) (Table 1).

There was one (0.9%) readmission in the trainees groups (umbilical port site infection, readmitted on postoperative day 5, remained admitted for 48 h), and one (0.9%) readmission in the surgeons group (readmitted on postoperative day 5 with dehydration due to persistent vomiting that resolved spontaneously without a reoperation, discharged home 5 days later) ($p = 1$).

There were no mortalities on either group.

3. Discussion

During their first year of training, pediatric surgery fellows at our training program perform 15 to 20 laparoscopic pyloromyotomies under supervision, with the staff surgeon scrubbed in. Like with any other operation, early in the training the trainees assist the staff surgeon. As experience and skills improve, the trainees gradually take on a more relevant role in the operation, to finally complete the entire operation with the staff surgeon in the operating room but not scrubbed, and providing no guidance. In addition, with 9 staff surgeons in the call pool, trainees are exposed to a variety of techniques and maneuvers, which provides them a wide range of surgical armamentarium. The same is true for the postoperative management, which varies according to the surgeon of record. During the second and last year of training, our trainees are given the opportunity to perform laparoscopic pyloromyotomies independently, with no staff surgeon in the operating room. The program goes beyond the operating room, since the senior trainees are formally in charge of the preoperative and postoperatie care of the patients on whom they operate, and are the ones who interact with the patients' parents. The senior fellows disclose to the patients' parents, prior to the operation, that they are Board Certified General Surgeons but in-training Pediatric Surgeons, and the vast majority of the parents have no objections at all. We consider this the ultimate way to promote autonomy and confidence. Even though performing laparoscopic pyloromyotomies won't correlate with the ability to perform more complex procedures independently, caring for patients independently from admission to follow-up allows them to experience, to some degree, aspects of surgical care that can be applied to any patient. We believe that opportunities like this are key in the development of not just technically skilled trainees, but well rounded, confident surgeons. There have been numerous recent reports in the literature stating that surgical trainees do not feel ready to practice independently at the end of their training, an unfortunate consequence of the limited exposure associated to work hour restrictions [2–4]. It is critical that surgical training programs develop innovative ways to mitigate this phenomenon, and the ever-expanding field of surgical simulation is just not enough. A technical skill can be simulated, but the interaction with the parents, the intraoperative decision making process, and so many other aspects of surgical care simply cannot. It is critical that trainees are exposed to real-life situations while they are still under the umbrella of the training program. Furthermore, as long as patient safety is not compromised and standard of care is maintained, training programs should accept complications, if they were to occur, from the cases done independently by trainees, and use them as learning opportunities. We compared the outcomes of patients operated on independently by senior trainees versus patients operated on by attending/staff surgeons and found no clinically significant differences in outcomes. Most importantly, we did not observe any statistically significant differences in the incidence of intra- or postoperative complications. Regardless of the lack of statistical significance, there were three mucosal perforations in the *trainees* group and non in the *surgeons* group. At first glance, this could be perceived as a reason to stop allowing trainees to do the operation on their own. We believe, however, that it is better for a trainee to have this occur while he or she is still under training, than after the training is

Table 1
Demographic and outcome data of patients undergoing laparoscopic pyloromyotomy by senior pediatric surgery trainees vs. experienced pediatric surgeons.

	Cases by *Trainees* (n = 90)	Cases by *Surgeons* (n = 90)	p Value
Age at surgery in weeks (mean [SD])	4.7 [1.6]	5 [2.3]	0.38
Operative time in minutes (mean [SD])	28 [13]	25 [10]	0.09
Intraoperative complications (n [%])	3 [2.7]	0	0.11
Postoperative complications (n [%])	1 [0.9]	0	0.36
Postoperative stay in days, (median [range])	1 [1–10]	1 [1–6]	0.63
Readmissions	1 [0.9]	1 [0.9]	*1*

completed. The three trainees who had this complication recognized it during the operation, appropriately called the staff surgeon for help, and were able to solve the complication efficiently. They were supervised by staff surgeons during their subsequent cases to ensure the quality of the procedure as well as to ensure that they felt appropriately supported. The fellows involved in the adverse events were encouraged, and continued, to do cases independently later on.

It is well documented that clinical outcomes and safety parameters remain stable for patients undergoing laparoscopic appendectomies performed by suitably experienced trainees [5, 6]. We believe that our study provides support to allow pediatric surgery trainees, when they achieve the appropriate level of training, to do laparoscopic pyloromyotomies independently. The training for an operation is not fully completed until one can do that operation independently without supervision. Such opportunities need to be provided by training programs if the goal is to produce competent and mature surgeons. Valid for trainees and surgeons alike, complications (as a rough surrogate marker for lack of experience) are reduced as experienced is gained [7–10].

4. Conclusion

We believe that allowing senior pediatric surgery trainees at high-volume training programs to do laparoscopic pyloromyotomies independently is a safe way to promote surgical autonomy that does not compromise patient outcomes.

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