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Laparoscopic Surgery Compared to Open Surgery for Complicated Appendicitis

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Abstract

Background: Laparoscopic appendectomy (LA) and Open appendectomy (OA) are two standard procedures to surgically remove appendix in acute appendicitis. nowdays, LA has been preferred over OA because of many benefits, for example, decreased wound infection, minimal pain, reduced hospital stay, minimize the cost of procedure. In the present study we aimed to investigate and clarify the efficacy of laparoscopic appendectomy in patients with complicated appendicitis as regard surgical techniques, operative time and hospital stay in young females.

Patients and methods: This retrospective study has been conducted in General Surgery Department, Faculty of Medicine, Zagazig University, from March 2020 to September 2020. The study was conducted on 36 patients with suspected appendicitis.

Results: The operative time was significantly longer in the laparoscopic group (Group B) with mean time 84.6 minutes than open group (Group A) with mean time 54.2, P value was 0.0001. The Overall post-operative complications showed no significant difference between the 2 groups with PV=0.14. Also, Post-operative hospital stays, and time needed to return to normal daily activities were lower in the laparoscopic group (B) than in the open group (A) with P Value = 0.09 and 0.0002 respectively. Post-operative time interval for analgesia needed was significantly higher in the laparoscopic group (B) than in the open group (A) with P Value=0.0001.

Conclusion: Laparoscopic appendectomy (LA) constitutes a safe and feasible procedure for the treatment of complicated appendicitis and can be the first choice with no increase in postoperative complications.

Keywords: Laparoscopic appendectomy, appendectomy, McBurney's

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INTRODUCTION

Complicated appendicitis is an acute appendicitis complicated with peritonitis, rupture, gangrene, or intra-abdominal abscess, accounts for 14% to 55% of all appendicitis. The studies have proved that it is associated with the incidence of major complications after appendectomy. The major postoperative complications include wound infection and intra-abdominal abscess, which remain the important causes of prolonged hospital stay and higher hospital charges, while compromising the quality of life of patients [1].

Currently, the application of the LA has been extended to complicated appendicitis (CA). In the current literature, CA is defined as a perforated acute appendicitis accompanying purulent peritoneal collection, abscess formation, and generalized peritonitis. There are evidences supporting the use of the laparoscopic technique in the management of CA, therefore LA is now considered as an alternative procedure to an open appendectomy (OA) [2-4].

Since the introduction of laparoscopic appendectomy (LA) in 1983 by Semm, LA has been performed with increasing frequency for treatment of acute appendicitis [5].

In 1889, McBurney performed the 1st open appendectomy, [6]. Since then, it has been the gold standard for the treatment of acute appendicitis for more than one hundred years. Although it is safe, the incidence of postoperative complications is 10% to 20% [6].

The idea of minimal surgical trauma, resulting in significantly shorter hospital stay, less postoperative pain, faster return to daily activities and better cosmetic outcome has made laparoscopic surgery for acute appendicitis very attractive [7].

The aim of the current study was investigate and clarify the efficacy of laparoscopic appendectomy in patients with complicated appendicitis as regard surgical techniques, operative time and hospital stay in young females.

PATIENTS AND METHODS

This retrospective study was carried out in General Surgery Department, Faculty of Medicine, Zagazig University, from March 2020 to September 2020. It included 36 patients with confirmed complicated appendicitis randomly allocated (by alternation) into two groups 18 patients, Group (A): patients

underwent open appendectomy by gridiron incision at McBurney's point. Group (B): patients underwent laparoscopic appendectomy. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Age above 18 years. Patients with confirmed complicated appendicitis (perforated, gangrenous appendix or acute appendicitis with pus formation). Medical fitness for general anesthesia and laparoscopic appendectomy. Complicated cases proved by CT. Exclusion criteria: Patients with diagnosis other than appendicitis. Patients underwent previous abdominal surgeries. Patients with bleeding diathesis. Patients with renal or hepatic impairment. Patients with cardiopulmonary or cerebrovascular disorders. Pregnant females.

All patients were subjected to:

- Full history taking
- Clinical examination
- Laboratory investigations [CBC, PT, PTT and INR, Kidney and liver functions in patients more than 30 years, Na and K in markedly dehydrated patients, Urine analysis in suspected cases of urinary tract infection].
- Radiological investigation.
  -Ultrasound (transvaginal or pelvi abdominal).
  -CT scan in complicated cases (appendicular abscess or masses)

Patients were fully informed about the risks and benefits of the 2 procedures and an informed consent was obtained from every patient. Markedly dehydrated patients had fluid resuscitation and Foley catheter to ensure adequate urine output. Any electrolyte deficiencies were corrected prior to the induction of general anesthesia. Prior to the surgical incision, all the patients received a standard regimen of intravenous antibiotics (1.5 gm of ampicillin, salbactam and 500 mg of Metronidazole).

Technique of Open Appendectomy (OA)

The patient was placed in the supine position and underwent general anesthesia with endotracheal intubation. While the patient was anesthetized and the abdominal musculature relaxed, the patient's abdomen was carefully examined for appendicular mass. The skin incision on McBurney's point was carried through the subcutaneous tissue until the external oblique fascia was exposed.

A small incision was made in the external oblique fascia along the line of its fibers. This incision was sharply extended with scissors along the direction of the fibers. The underlying fibers of the internal oblique muscle and the transversus abdominis muscle were identified, split and retracted along the direction of their fibers. Next, retractors were adjusted to expose the peritoneum. Then grasping the peritoneum with clamps was done, carefully verifying that intra-abdominal viscera had not been inadvertently grasped. A small incision was made in the peritoneum by scissors.

The cecum was delivered into the field gently grasping the cecum with moistened gauze and delivering it into the wound using a rocking movement and the anterior tenia of the cecum was followed till identification of appendix. Medial mobilization of the cecum was done bluntly with a finger combined with sharp or electrocautry in cases of difficult retrocecal appendix. The mesoappendix was divided between clamps and ligated with an absorbable suture (Vicryl 2.0). The base of the appendix was divided and ligated with absorbable suture material. Purse string sutures were done in cases of inflamed base of the appendix. The wound was closed in layers. If perforation or gangrene were present, the skin and subcutaneous tissue closure was by widely spaced sutures.

Technique of Laparoscopic appendectomy

The patient was placed supine in a 15° Trendelenburg position with both arms tucked. Rotation to the left was done. The surgeon stood on the patient's left side. The first assistant stood on the surgeon's left side. The monitor was on the patient's right side. After the induction of general anesthesia, a urinary catheter was placed**.** A pneumoperitoneum was created in standard fashion, using either the Veress needle technique or the open technique according to the surgeon preference. The first trocar (10 mm) was introduced at the lower margin of the umbilicus. The intraperitoneal pressure was set to be 14 mmHg. Laparoscopy was then performed with "zero" angle viewing laparoscope to ensure the clinical diagnosis and identify the position of the appendix to determine the best site of insertion of the other trocars.

A second 5 mm suprapubic trocar was inserted. A third operating trocar was inserted in the left iliac fossa**.** In 2 cases 4th trocar in the right upper quadrant was inserted to facilitate dissection of retrocecal appendix.

After insertion of the ports, a quick diagnostic laparoscopy was performed in order to confirm the diagnosis and assess other pathologies. The surgeon's left hand held a intestinal clamp grasper to retract the cecum and subsequently expose the appendix. Cautery was used to incise the retroperitoneal attachments of the cecum in difficult cases. The surgeon's right hand operated a dissecting instrument or cautery scissors, which were used to create a window in the mesoappendix at the base of the appendix. The mesentery and base of the appendix were secured and divided separately using clips or bipolar diathermy for mesoappendix and clips or endoloop technique for appendiceal base.

After transection, the appendiceal stump mucosa was carefully cauterized. The appendix was pulled into the umbilical port and withdrawn with the whole port then removed. Irrigation and insertion of a drain were done only in complicated cases. Trocars were removed under direct vision**.**

Fascia at the 10-mm trocar site was closed, and all wounds were closed primarily. In patients with complicated appendicitis, antibiotics were not discontinued but were modified according to the culture results and continued for 7 to 10 days till the patient was afebrile. The specimens were sent for pathology for assessing pathological diagnosis.

Post-operative

Analgesics were given intramuscularly. Antibiotics were continued or stopped according to the clinical findings. Oral intake was started as soon as patients could tolerate it and when bowel function become adequate. Patients were discharged as soon as they take orally adequately and mobilize. Postoperative complications were recorded both during hospitalization and at follow up. The follow up in the outpatient's clinic was at one week, one month and six months. Patients' follow up record was maintained and updated in computer data. Patients were instructed to report back immediately for any complication related to the surgery irrespective of the duration of follow up.10 days later stitches were removed.

Postoperative

Postoperative morbidity including wounds infection: all of them are managed conservatively by wound dressing twice daily by saline wash and betadine, also wound culture and sensitivity was done and antibiotics was given according to it.

Pelvic abscess: underwent conservative management on antibiotic course according to culture and sensitivity.

Statistical analysis

All data were analyzed using IBM SPSS 23.0 for windows

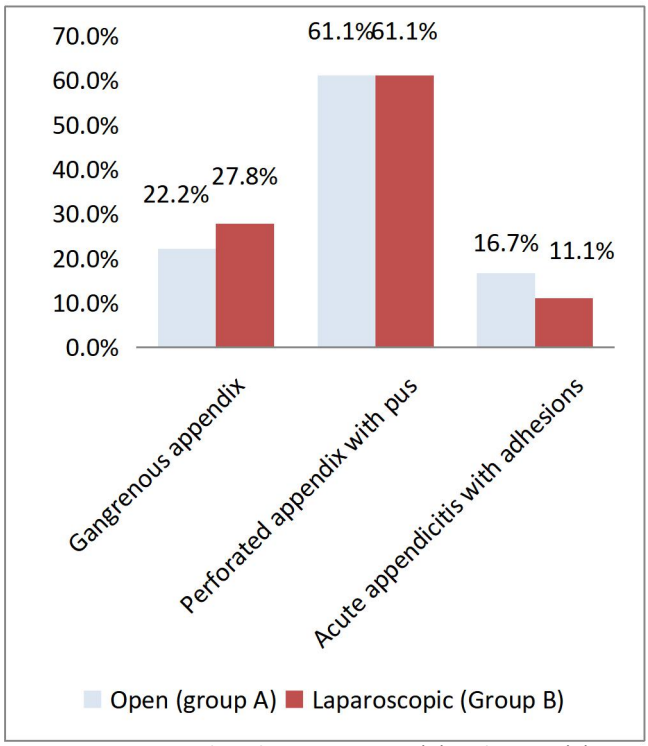
(SPSS Inc., Chicago, IL, USA) and NCSS 11 for windows (NCSS LCC., Kaysville, UT, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

RESULTS

This study was conducted on 36 patients with confirmed complicated appendicitis randomly allocated (by alternation) into two groups 18 patients each, Group (A): patients underwent open appendectomy by gridiron incision at McBurney's point. Group (B): patients underwent laparoscopic appendectomy. The patient's ages ranged from 20→ 57 years with median age 30.5 years in Group A and 32 years in Group B and mean age 34.6 years in Group A and 35 years in Group B with no statistically significant difference between the two groups (P= 0.91) Table (1).

Table 1. Age characteristic in the 2 groups.

Age	(Group A) open (18patients)	(Group B) lap (18 patients)	(t) test	P value
Mean +SD	34.6±10.7	35±11.3		
Median	30.5	32	0.11	0.91
Range	20-55	20-57		



A comparison was done between Group (A) and Group (B) in the intraoperative findings, this study showed that 25% of patients had gangrenous appendix, 61.1% had perforated appendix with pus and 13.9% had acute appendicitis with adhesions with no statistically significant difference between the two groups. Figure (1)

Figure 1. Intraoperative findings of open cases and laparoscopic cases.

The operative time was significantly longer in the laparoscopic group (Group B) with mean time 84.6 minutes than open group (Group A) with mean time 54.2, *P* value was 0.0001. Figure (2)

Figure 2. Operative time in the 2 groups.

Intraoperative complications: In Group A (Open): 5 cases were met, Caecal serosal tears which were repaired primarily by absorbable sutures. In Group B (Lap): 3 cases were met, Bleeding from mesoappendix which was controlled by clips. Table (2)

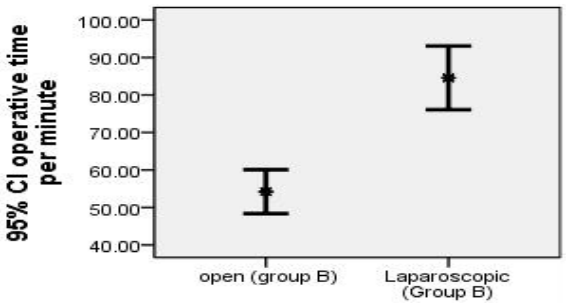


Table 2. Intraoperative complications

[f]p	(Group B) lap N (%)	(Group A) open N (%)	Total N (%)	Variables

0.045(S)	0 (0.0%)	5 (27.7%)	5 (13.8%)	Caecal serosal tears
0.23	3 (16.6%)	0 (0.0%)	3 (8.3%)	Bleeding

F= Fisher exact test (S) p<0.05 significant

This study showed that postoperative complications were higher in the OA group (38.9%) than LA group (16.7%), the result was statistically insignificant (P=0.14). Table (3)

Table 3. Overall postoperative complications

P value	(Group B) lap (18 patients)	(Group A) open (18 patients)	Group
0.14	3 (16.7%)	7(38.9%)	Complicated cases

χ 2 = Chi square test

Overall post-operative complications showed no significant difference between the 2 groups with P value =0.14. The post-operative wound infection was higher in the open group (A) than the laparoscopic group (B) but did not reach the significant difference, (33.3% infected in open cases and only 11.1% infected in laparoscopic cases) with *PV*=0.23. Also, there was no significant difference between Group A and Group B regarding pelvic abscess and fecal fistula. Figure (3)

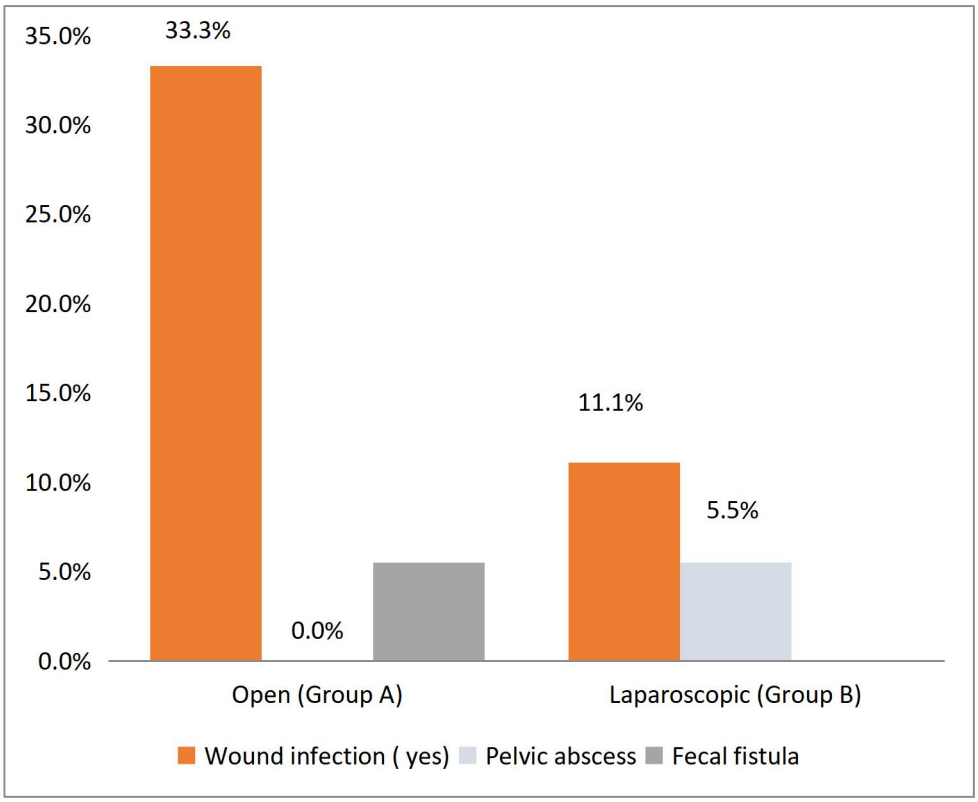


Figure 3. Comparison between postoperative complications in both groups.

Table 4. Hospital stay and time needed to return to work

P value	(Group B) lap (18 patients)	(Group A) open (18 patients	Parameter
			Hospital stay (days)
U=1.7	1.8±1.8	3±2.9	Mean ±SD
0.09	1	1	Median
	1-7	1-11	Range
			Return to normal daily activities (days)
U=3.7	4.9±1.9	8.8±3.7	Mean ±SD
0.0002	4.5	8	Median
	3-10	5-18	Range

U test =Mann-Whitney U test of significant

Post-operative hospital stays, and time needed to return to normal daily activities were lower in the laparoscopic group (B) than in the open group (A) with significant difference. *P Value* = 0.09 and 0.0002 respectively. Table (4).

Table 5. Time interval for analgesia needed and start of oral fluids

P value	(t) test	(Group B) lap (18 patients)	(Group A) open (18patients)	
				Time interval for analgesia needed (hours)
0.0001	10.5	17.1±3.1	8.1±1.7	Mean +SD
		16	8	Median

		12-24	6-12	Range
0.96	0.052	0.72±0.67 1 0-2	0.89±1.2 1 0-5	Time to start oral fluids (days) Mean +SD Median Range

Post-operative time interval for analgesia needed was significantly higher in the laparoscopic group (B) than in the open group (A) with t test 10.5 and P Value=0.0001. There was no significant difference between both groups regarding post-operative time needed to start oral fluids with Mann whitnney u test = 0.052 and P Value=0.96. Table (5).

DISCUSSION

In the present study, the patient's ages ranged from 20→ 57 years with median age 30.5 years in Group A and 32 years in Group B.

This came in agreement with Shakya et al. [8] who found that the mean age of the study participants was 33.2 (SD ± 19.4), and median age was 29 years. The highest incidence of complicated appendicitis is observed among 11 to 20 years (26.44%) of age group followed by 21 to 30 years (18.97%).

In the present study, 25% of patients had gangrenous appendix, 61.1% had perforated appendix with pus and 13.9% had acute appendicitis with adhesions with no statistically significant difference between the two groups.

This came in agreement with Wagh and Joshi, [9] who found that 61.6% of patients had perforated appendix while 36.6% had gangrenous appendix.

In the current study the operative time was significantly longer in the laparoscopic group (Group B) with mean time 84.6 minutes than open group (Group A) with mean time 54.2, (P value was 0.0001).

Although shorter operative time in LA was reported in some studies Fukami et al., [10] Yau et al., [11] Mohamed and Mahran[4], longer operating time was also reported in many older meta-analysis [2]. It appears that longer operation time is still a challenge for LA in CA. It can be due to that although laparoscopy for appendicitis can be learned quickly by surgeons, OA is a basic handicraft for them.

These heterogeneous results might be explained by different laparoscopic skill levels in the authors. What we found in our study population is that in the presence of perforation the operative times were synchronously extended in both groups.

In this study, laparoscopy was performed by surgeon experienced in laparoscopic approaches. A meta-analysis compared open and laparoscopic approach in complicated appendicitis; depending on the surgeon's experience there is no differences between laparoscopic and open approach but in developing countries due to lack of laparoscopic instruments and surgical experience adequate open procedure stated to be the method of choice [2].

In the present study intraoperative caecal serosal tears was found in 27.7% of OA patients while no cases had caecal serosal tears in LA. This came in agreement with Soltan et al. [12] who found that caecal serosal tears was more common in OA (10%) than LA (5%).

In the present study intraoperative bleeding was the more common in LA (16.6%) than in OA (0%) with no significant difference. This came in agreement with AlRumaih et al.[13] who found that a retroperitoneal bleeding is a fearsome complication after laparoscopic appendectomy. Also, Christensen et al. [14] found that complication and injuries to the intra-abdominal organs and major vessels after appendectomy are rare but have been documented.

In this study, although the overall postoperative complications were higher in the OA group (38.9%) than LA group (16.7%), the result was statistically insignificant (P=0.14).

Similarly, Katkhouda et al. [15] showed that there was no significant difference in the overall complication rates (18.5% in the LA group versus 17.1% in the OA group) (P = 1.00). Also, Long et al. [16] found that no significant difference regarding overall complications.

In this study, fecal fistula was observed in one patient in OA group. This came in agreement with Kocatas et al. [17] who found that enterocutaneous fistula was observed in one patient in OA group. Spontaneous closure of the fistula was waited without surgical intervention up to the 20th postoperative day.

Another study compared 42 patients who had laparoscopic appendectomy to 53 patients who had open appendectomy. Wound infection regarding skin was zero in laparoscopic group and 3 wound infections in open group[18].

Horvath et al. [19] found that surgical site infections (SSI) occurred exclusively in the OA group. All 38 patients with SSI of the OA group required bedside wound treatment. In 16 % of these patient's intravenous antibiotic treatment consisting of ciprofloxacin and metronidazole was commenced for at least 5 days. Furthermore, daily wound inspection and change of wound dressing were conducted.

In the present study, the return to normal daily activities was lower in the laparoscopic group than in the open group. This was comparable to the results of Wei et al. [20] as the patients who had laparoscopic appendectomy returned to work in a shorter time (there was significant difference with PV=0.0002). But, regarding fluid tolerance and return to normal diet, although occurred earlier in the laparoscopic group, the difference was insignificant (PV=0.96).

In all laparoscopic surgeries, the hospital stay after laparoscopic appendectomy was significantly lower than after open appendectomy in all of the reported studies. In a study done by Guller et al. [21] laparoscopic appendectomy was associated with shorter median hospital stay (laparoscopic appendectomy: 2.06 days, open appendectomy: 2.88 days, P < 0.0001).

Another study done by Yau et al.[11] revealed that mean hospital stay was 5 days and 6 days for LA and OA group respectively (P<0.001).

In the work of Alfredo et al. [22], the hospital stay was significantly lower in the laparoscopic group (mean hospital stay was 27.2 hours) compared to the open group (53.1 hours), (P=0.001).

A study done by Shirazi et al.[23] showed that the length of hospital stay ranged from 2 days to 9 days. The mean length of stay was significantly shorter after LA (3 days after LA, 5 days after OA, P < 0.0001).

All previous results of mentioned studies regarding hospital stay are comparable to this study as this study revealed that there was an increase in hospital stay in the open group (mean hospital stay was 3±2.9 days), than the laparoscopic group (1.8±1.8 days) but did reach significant difference, (PV=0.09).

In the present study, post-operative time interval for analgesia needed was significantly higher in the laparoscopic

group (B) than in the open group (A) with t test 10.5 P Value=0.0001.

This came in agreement with a study done by Long et al.[16] patients who had laparoscopic appendectomy required less parenteral analgesia than open-surgery patients (1.6 versus 2.2 days-worth; P <0.001 for both measures).

Also, Alfredo et al.[22], reported that the analgesia used was significantly higher in the open group compared to the laparoscopic group with P=0.001. All the previous results regarding the post-operative pain and need for analgesia can be compared to the present study as there were less post-operative pain and less need for analgesia in LA group. The difference was significant.

Similarly, in a study done by Long et al. [16] as patients who had laparoscopic appendectomy were able to return to a regular diet faster (1.6 versus 2.3 days, P = 0.002). However, there no significant differences were found with regard to time to return to work or school or to full activity.

Also, Kocatas et al. [17] found that the time to start soft diet was significantly less in LA group (p=0.001).

Horvath et al. [19] found that the conversion rate in the LA group was 0.86 % (n = 5/590 patients). In all cases impaired visualization of the right lower quadrant was the reason for conversion.

In another study on a series of 404 patients, no difference was observed in development of postoperative complications and mortality between those underwent to laparoscopic appendectomy compared to those that underwent to open surgery. Similarly, it was concluded that laparoscopic operation should be considered as a treatment of choice in CA[3].

Early reports centered on the use of the laparoscope to increase diagnostic accuracy and decrease the negative appendectomy rate which ranges in some series from 20 to 30%[15].

CONCLUSION

Laparoscopic appendectomy (LA) constitutes a safe and feasible procedure for the treatment of complicated appendicitis and can be the first choice with no increase in postoperative complications. However, the longer operation time is still a problem for laparoscopic technique despite the surgeons' increasing experience.

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