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RESEARCH ARTICLE

SURGICAL OUTCOMES OF PATIENTS UNDERGONE OPEN AND LAPAROSCOPIC APPENDECTOMY AT QILU HOSPITAL: A RETROSPECTIVE STUDY OF PATIENTS WITH OR WITHOUT HYPERTENSION

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ABSTRACT

Background: Despite the diagnostic and therapeutic advancement in medicine, appendicitis remains a clinical emergency and is one of the common causes for acute abdominal pain. Having chronic illness in patients with acute appendicitis may have direct or indirect effect on the outcomes. This is because hypertension and other cardiovascular disease such as CHF have known effects on cardiopulmonary physiology. For that reason we decided to evaluate the surgical outcomes in patients with hypertension in comparison to those without hypertension undergoing appendectomy. ***Objective***: comparison of the outcomes of LA and OA in hypertensive and non-hypertensive patients. ***Methodology***: A hospital-based retrospective study involving adult patients above 18 years who underwent appendectomy 2º appendicitis at Emergency Surgery Department at Qilu Hospital of Shandong University 2014 – 2018. Patient's data obtained were; age, sex, previous history of abdominal surgery, ASA risk score, pre-operative WBC and neutrophil count, radiological diagnosis, type of appendectomy, intra-operative diagnosis, use of post-operative analgesia, post-operative initiation of oral feeding, LOS, post-operative complication and mortality. Inclusion criteria were adult population above 18 years with a history of peri-umbilical abdominal pain, fever; Pre-operative diagnosis of appendicitis by Ultra-sound or CT scan (inflammatory phlegmon, gangrenous appendicitis, perforated appendicitis and appendiceal abscess) and history of hypertension. Exclusion criteria were patients below 18 years of age, patients who had appendix removed due to other causes and negative appendectomy, appendicitis history for > 7 days, pregnancy of > 3 months, presence of other chronic illness such as DM, IHD and/or CBD. Statistical Package for Social Science (SPSS) version 16 was used to analyse the data. Descriptive data was expressed as mean ±SD. Independent t-test and chi-square test were used to analyse the association of continuous and categorical variables, respectively. Univariate analysis was used to compare the outcomes of LA and OA in hypertensive and non-hypertensive patients. P-value <0.05 was considered statistical significant. ***Results***: The study involved 139 randomly selected patients who underwent appendectomy at Qilu Hospital between 2014 and 2018. The mean age was 42.2±15.657 years with a range of 18-82 years. Majority of the patients 62.6% were between 18-45 years, while only 11.5% aged 65 years and above. 54% were male. 27.3% (n=38) had history of hypertension. 84.2% underwent LA (n=117) whereas, 15.8% underwent OA (n=22). Regarding on the intra-operative diagnosis, 42.4% had acute phlegmon appendicitis (n=59), 15.1% had acute gangrenous appendicitis (n=21), 7.9% had perforated appendicitis (n=11) and 34.5% had appendiceal abscess (n=48). Post-operative complications occurred in 1.4% patients (n=2). One patient had IAA and the other patient had fat liquefaction. Non-hypertensive patients on OA group had the longest duration of operation 117.5±56.679 min. Among hypertensive patients, the duration of operation was longer in LA group 88.92±38.525 min than in OA group 82.08±33.538 min. This was statistically significant with p-value <0.05.The mean duration for analgesia use was 0.48±0.774 days. Hypertensive patients on OA group had longer mean duration of analgesia use 0.75±1.357 days than those who underwent LA 0.5±0.99 days. In non-hypertensive patients, LA group had the shortest duration of analgesia use 0.44±0.618 days than OA group 0.5±0.527 days, with p-value <0.05. Mean LOS was 8.09±4.051 days (4-28) days. Mean LOS was significantly longer in non-hypertensive OA patients 10.4±4.502 days and was found to be shorter in non-hypertensive LA patients 7.26±3.235 days. Among hypertensive patients, the mean LOS was longer in OA group 10.08±4.944 days than in LA group 9.15±5.213 days. P -value < 0.05. Apart from type of appendectomy and hypertensive status, we also found other factors associated with poor surgical outcomes. These include higher ASA risk score (ASA III), higher pre-operative WBC and having gangrenous appendicitis. ***Conclusion***: Despite the fact that pneumo-peritoneum is known to have effects on cardiopulmonary physiology our study showed that LA has protective effect in-terms of post-operative outcomes especially with duration of operation, and LOS in non-hypertensive on OA group whereas, longer duration of analgesia use was seen in hypertensive OA group. This indicates that laparoscopic appendectomy can be safely performed in hypertensive patients as it has better outcomes than OA. A part from hypertension and type of appendectomy we have also seen other factors associated with poor surgical outcomes in appendicitis patients; including higher ASA score, higher WBC and an intra-operative diagnosis of gangrenous appendicitis.

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INTRODUCTION

Despite diagnostic and therapeutic advancement in medicine, appendicitis remains a clinical emergency and is one of the more common causes of acute abdominal pain. No single sign, symptom, or diagnostic test accurately confirms the diagnosis of appendiceal inflammation in all cases, and the classic history of anorexia and peri-umbilical pain followed by nausea, right lower quadrant (RLQ) pain, and vomiting occurs in only 50% of cases (1). Incidence Rate of Acute Appendicitis is approximately 1 in 400 or 0.25% or 680,000 people in USA and the Lifetime risk of Acute Appendicitis: 8.6% risk for males, 6.7% for females. Worldwide, the three countries with the highest mortality rate from appendicitis in 2013 were Papua New Guinea (20.7 per 100,000), Solomon Islands (8.9 per 100000), and Vanuatu respectively (7.6 per 100000) (2,3). In Taiwan, China appendicitis had similar overall incidences, seasonality patterns, and declining trends compared to numerous previous studies. Compared to NP patients, LIP patients had a higher risk of appendicitis. The overall incidences of appendicitis, primary appendectomy, and perforated appendicitis were 107.76, 101.58, and 27.20 per 100,000 per year, respectively. The highest incidence of appendicitis was found in persons aged 15 to 29 years; males had higher rates of appendicitis than females at all ages except for 70 years and older. Appendicitis rates were 11.76 % higher in the summer than in the winter months. The overall incidence of appendicitis was 34.99 % higher in the LIP than in the normal population (NP), and the incidence of perforated appendicitis was 40.40 % higher in the LIP than in the NP(4).
Hypertension and DM are among the common comorbid conditions affecting elderly population. These diseases may have direct or indirect effect on the outcome of patients undergoing appendectomy. In laparoscopic surgery, abdominal cavity must be insufflated and expanded by a gas in order to facilitate and enlarge the work area. The gas is pumped into the abdominal cavity between visceral and parietal peritoneum which creates a pneumo-peritoneum. The physiological pressure in the abdominal cavity is a little higher than the atmospheric pressure, and therefore , even small increase in intra-abdominal pressure may have adverse effects on cardiac output, renal function, hepatic blood flow, respiratory mechanics and so forth. In turn this will cause sympathetic activation(5). As for this reason effect of LA in hypertensive patients have to be studied to determine the appropriate surgical procedure for this group of patients

Literature review

Comparison of LA and OA with socio-demographic characteristics: In a study to compare the outcomes between LA and OA in Canada, the odds of female patients undergoing LA were 1.26 times higher than odds of male patients (6). However, many studies show no difference in age and gender in patients undergoing LA and OA. In a study conducted by Katkhouda, the two groups LA and OA were similar with respect to sex and age. The mean age was 28 years (17-63) for OA and 29 years (18-71) for LA. With OA having a total of 134 patients (104 men, 30 women) and LA 113 patients (78 men, 35 women) (7). A retrospective study which was done in Italy also showed that there was no statistically significance in age group between LA and OA with mean age 29.66+-15.13 in OA and 27.75+_14.24 in LA. But there was a significant difference in gender between LA and OA. A number of male patients undergoing OA was higher compared to female patients (male:female 184:126), whereas a number of female patients undergoing LA was higher (male:female 121:162) (8).

Duration of surgery between LA and OA: In determining the value of LA in elderly patients who most of them had Hypertension, IHD and DM, operative time was prolonged in elderly patients 42.5 min versus 36.8 min in younger patients (9). A retrospective study which was conducted in Hongkong, China comparing the duration of surgery showed that laparoscopic appendectomy was associated with longer duration of operation 80 min (40 to 195) as compared OA which had a duration of 60min (25to 260) (10). Duration of operation was also found to be higher among patients undergoing LA. This was seen in a prospective study which was conducted in New Jersey involving 71 patients. Duration for LA was found to be 72 min while foe OA was 53 min which was statistically significant with no any trend of decreasing surgical time with the increasing experience in LA (11). During the 1 year of prospective randomized Trial in Texas the mean duration of surgery was 65 min for OA and 87 min for LA. LA being significantly higher compared to OA (12). Duration of surgery was significantly shorter in the open group but was longer in 2-port than in 3-port system. This was seen in a retrospective study of 2-port appendectomy and its comparison with OA and 3-port appendectomy which was conducted in India. The mean operating time was 43.94 min in OA, 61 min in 2-port and 59.65 min in 3-port system (13). Despite the longer operating time, LA is a useful treatment method in treating appendicitis. This is based on a prospective study conducted in Bazhong; China. In this study the operative time was longer in LA than in OA group (14). A study done in Pakistan comparing clinical outcomes of LA and OA also showed similar results with other studies showing OA with shorter operating time as compared to LA (54.9+-14.7) in LA and (13.6+-12.6)min in OA (15). Despite many studies showing longer operative time in LA group, only a few of them showed shorter operative time for LA group. In UK, a meta-analysis of the results showed a significantly shorter operative time in LA group compared to open group with a mean difference of 13.96 min. They also found that LA was associated with improved outcome compared to OA (16). Similar clinical comparative study in China showed LA being the effective method for appendectomy compared to OA. This was based on the results showing LA having shorter operative duration than OA (17). There also more of the studies in China which shows no difference in operating time between laparoscopic and open appendectomy. This was found by Zhangyan et al in in comparison and analysis between LA and OA for acute appendicitis (18). And by Chaohang C.et al on comparison study on LA and conventional appendectomy (19). More so, retrospective studies in China have shown similar results with no difference in operating time between laparoscopic and open appendectomy. This is based on the study done at Zunyi(20). And from a study done by Shi-jian et al in Shezhen(21).

Length of hospital stay between OA and LA: Laparoscopic approach was associated with a 17.5% decrease in overall duration of hospital stay than open approach among patients with congestive heart failure who underwent general surgery procedures in California USA; 11 days (6-17) in open group versus 5 days (2-11) in laparoscopic group (22). A study which was done in Taiwan to determine the outcome of laparoscopic cholecystectomy found that 0.74% of patients had cardiovascular disease and exhibited longer duration of

hospital stay than those without cardiovascular disease (23). Hospital stay was prolonged among elderly patients in whom 57.4% had comorbidities such as hypertension, DM and IHD. Duration of hospital stay was 4.8 days in elderly and 2.5 days in younger patients (9). In cases of diabetic patients, a nationwide cohort study showed that the LOS was significantly higher in OA patients in Taiwan, China (24). Data from the nationwide inpatient sample to determine the outcome and trends of LA in USA, found that LA was associated with shorter hospital stay. However, among those undergoing LA the longer hospital stay was 5 days or more and was found that appearance of the appendix (i.e gangrenous or perforated) and the position of the appendix (appendix behind the ileocecal junction) were the factors for longer hospital stay(25,26). LA provides better outcome than OA in elderly patients with shorter hospital stay than in patients undergoing OA. This was observed from study conducted in Taiwan, China and in Canada, respectively (27,28). a cross-sectional analysis of patients undergoing LA or OA from US inpatient sample from 1998 to 2009, LA was associated with decreased length of hospital stay, (4.44 days versus 7.86 days) the difference was statistically significant (29). In a single Institution study in Miami USA, a retrospective review was performed with a total of 244 cases, 137 being OA and 107 LA. The LOS was lower in LA group with mean LOS of 2 days versus 3 days for OA (30).

Initiation of oral feeding between LA and OA: The initiation of oral feeding is found to be earlier in LA than in OA group. This is based on 2 studies conducted in Guangzhou, China by Hong Bo Wei in 2009 and 2010. He found that the time to return to the general diet was shorter in LA group (20.2+-12.4 h) than in the OA group (36.5+-10 h); and the time of initiation of liquid diet in LA was 0.51 days earlier than in OA group respectively (31,32).

Ambulation between LA and OA: In a recent study conducted in China to determine the efficacy of emergency LA in treating complicated appendicitis was found that time to get out of bed in LA patients was earlier (1.3+-0.5 days) than in OA patients (2.5+-0.9 days) (33).

Hospital cost between LA and OA: In order to reduce the hospital cost patients with diabetes and cerebrovascular disease should rather be treated with LA than OA. OA was significantly associated with higher costs in these patients in Taiwan, China (24). Most of the studies to compare the hospital cost between LA and OA found that LA was associated with higher Hospital cost than OA in both non perforated and perforated appendicitis. With median cost of hospital cost of PKR 47121 in LA and PKR 39318 in OA in Pakistan and median operating room charges of $3191 in LA and 1514 OA and total hospital charges of $5430 in LA and $3673 in OA in USA (25,34,35). However one study comparing the outcome of LA and OA in management of uncomplicated and complicated appendicitis in USA showed that there is reduced in hospital cost for uncomplicated and complicated appendicitis, with this cost reduction being significantly reduced in patients with complicated appendicitis (12125+-14430 for LA and 17594+-28065 in OA) than in uncomplicated appendicitis (7825+-6009 for LA group and 7841+-13147 in OA group) (36). In a prospective randomized study the overall cost was greater in open group but not statistically significant (7227$ in OA, 6077$ in LA). However, the cost was higher for LA among patients with acute appendicitis (6189$ in LA and 5277$ in OA) and it was found to be lower among patients with perforated appendicitis and those who had normal appendix respectively ((7465$ in LA, 13670$ OA) and (5088$ LA and 5515$ in OA) (37). Despite many studies showing that LA is associated with higher hospital cost, some studies have shown that LA was associated with lower hospital cost in comparison with OA. In one of the studies showed that total hospital cost were lower in the LA group than in OA group ($43,339 versus $57,943 respectively) (38,39). Age and number of comorbidities had a greater impact on cost for OA patients than for LA patients. A nationwide population based study from a Taiwan's National Health Insurance program, LA mildly decreased LOS at the expense of higher costs for young patients, those without comorbities and in patients with uncomplicated appendicitis but the cost for OA was higher than those in LA in patients 65 years or older and in patients with comorbidities (40).

Postoperative complications between LA and OA: Pneumo-peritoneum with carbondioxide at 15mmHg during laparoscopy in healthy horses showed no adverse alteration in cardiopulmonary and haematological variables. There was no difference in adverse effect between carbondioxide insufflation group and those who underwent a procedure without insufflation (41). Another prospective controlled animal study found that peritoneal insufflation with carbondioxide to a pressure of 15mmHg elicited transient elevations of aortic pressure and carotid artery blood flow in pigs however, no systemic or renal hemodynamic changes with gasless laparoscopy (42). In a retrospective study in USA to determine the safety of laparoscopic approach over open approach for general surgery procedures in patients with heart failure found that the mortality was lower in those patients who underwent laparoscopic approach than those who underwent open approach 4.3% versus 11.3%. With the overall complication rate being higher in open group 42.3% than laparoscopic group 11.3% (22). In comparing the morbidity and mortality in patients with CVD, it was found that the morbidity and mortality in patients with CVD and those without CVD were similar. This was based on a retrospective study in patients who underwent laparoscopic cholecystectomy which was conducted in Taiwan, China (23). Another study to determine the value of LA in elderly patients found that there was no difference in postoperative complications between younger and older patients (9).

In a prospective study to compare the hemodynamic and pulmonary changes during open, carbondioxidepneumo-peritoneum and abdominal wall lifting cholecystectomy; it was found that there was slight impairment of cardiopulmonary function following induction of anaesthesia but normalized with time in open and abdominal wall lifting. However carbondioxide insufflation resulted in left and right sided filling pressure with significant cardiac index reduction. These cardiopulmonary alterations however were not critical because of the overall health of the patients enrolled in the study. These hemodynamic alteration are yet to be found in patients with cardiovascular diseases, particularly hypertensive patients (43). The association surgical procedure and the development of wound infection are controversial. Most of studies showed no association of LA with the development of SSI and IAA. In LA peritoneal irrigation was the only significant risk factor for the development of IAA in South Korea, while older age, larger BMI, higher ASA score showed association to SSI in one of the study in Germany whereas there were no association

to SSI in another study in USA (44–46). There was only one study in Hongkong, China that showed diabetic as the only risk factor for the development of PIAA in LA which was performed retrospectively. DM was also one among the factors associated with 30 day mortality among those patients requiring insulin therapy in Washington, USA.(47,48). Glucose control lowers the risk of wound infection in diabetics after open heart surgery. This was observed in one study in US where they found that the rate of deep sternal wound infection in DM patients was 1.7% versus 0.4% in non-diabetics. Among those infected DM patients the glucose level was higher in the first 2 post-operative days than non-infected patients (49).

In a study conducted by Katkhouda there was no mortality encountered, no significant difference in the overall complication rate between LA (18.5%) and OA (17.1%). Neither there was difference in infectious complications (5.3% versus 3%) nor difference in wound infection (6.2% versus 6.7%) among LA and OA patients respectively. There were 4 complications that required reoperation in LA group (3 post op bleeding due to injury to the inferior epigastric artery, appendiceal artery, enterocutenous fistula and cellulitis (7). However many studies showed that LA is associated with lower rate of morbidity and mortality as compared to OA. Except for IAA which is shown to be higher in LA group than OA group as it has been shown in some few studies. In a study done by Minutolo et al, the rate of postoperative complications was 2.95% in LA and 13.2% in OA. With 5 cases of wound infection all in OA group, 2 cases of IAA in OA group and 1 in LA group and mean duration of prolonged ileus being 1.2 days (1-4) in LA and 1.4 days (1-5) in OA (38). In a systematic review done by Bobby, both morbidity and mortality rates were found to be lower in LA group than in OA group. Complication rate occurred in 3545 out of 37661 cases in LA and 4091 out of 20064 cases in OA. With IAA being lower in LA group 1.2% and 2.8% in OA group. He also observed that LA in obese patients is associated with improved clinical outcomes (16). This is also a similar case in USA whereby morbidity and mortality is lower with the use of LA than OA. This was shown in a study conducted by Masoomi in Carlifonia USA, 2012. In non-perforated appendicitis a total of 32783 underwent appendectomy. 20301patients LA and 12482 patients underwent OA. The overall complication rate was significant higher in OA than LA group respectively (23.49% versus 15.82%). Majority of complication from the patients with non-perforated appendicitis were; pneumonia, acute renal failure, respiratory failure, DVT, ileus, abdominal abscess, wound infection, bowel obstruction, UTI. The mortality rate of was 0.39% in LA versus 1.31% in OA. More so, patients with perforated appendicitis had lower rate of complications , with similar complications as in non-perforated appendicitis except for MI/angina which was absent in non-perforated group. The rate of post-operative complications; hospital stay and mortality was also seen to be higher in AIDS patients than in non-AIDS patients (22.56%versus 10.36%); (4.9 versus 2.9 days) and (0.61 versus 0.16) respectively. However among AIDS patients, those who underwent LA had less complications compared to those who underwent OA. In patients with non-perforated appendicitis complication rate were 11.2% in LA versus 21.61% in OA; no mortality in LA and 2.7% in OA and LOS 3.22 days in LA versus 4.82 in OA which was also similar in perforated group (39,50). In China, a meta-analysis done by Xiaohang showed a 3.81% incidence of wound infection for LA with higher incidence in OA of 8.41% which was statistically significant, and post-operative ileus also being lower in LA group than OA group but not statistically significant. However, IAA and UTI appeared to be higher in patients who underwent LA but the difference was not statistically significant (51). Emergency LA in treating elderly patients with cancer was found to have advantage of low complication rates compared to OA. This was seen in a study conducted in Affiliated Huizhou Hospital of Sun Yat-Sun University in Guangdong province between September 2014 and August 2016 to determine the efficacy of emergency LA in treating complicated appendicitis. LA had lower chances of incisional infections (8.9% in LA and 28.8% in OA) and the incidence of complications and 30 day readmission rate was much lower in LA group than OA group (33). Acute appendicitis is the most common abdominal surgical emergency in the world with more impact to the people with low socioeconomic status. Open appendectomy has been widely used as the treatment for appendicitis. Recently laparoscopic appendectomy has been widely used as the safest treatment option for appendicitis with less complications and hospital stay. However there is little information in the treatment of choice among patients with hypertension or DM. Since we know that DM impairs wound healing and the effect of pneumo-peritoneum with systemic hemodynamics, this study aims in determining as to which surgical approach would be better for which group of patients. And thus prevent unnecessary complications. Therefore the current study will compare the outcome between open and laparoscopic appendectomy in diabetic and hypertensive patients which will be helpful in decision making during appendicitis management.

Rationale of the study: Currently the management of appendicitis is either open or laparoscopy; both have some of post-operative complications. This study will provide valuable information and evidence for the choice of type of appendectomy among patients with hypertension and its use in complicated appendicitis.

MATERIALS AND METHODS

Study design and study population: A hospital-based retrospective study involving adult patients above 18 years who underwent appendectomy secondary to appendicitis at Emergency Surgery Department at Qilu Hospital of Shandong University between 2014 – 2018.

Inclusion criteria

- Adult population above 18 years with a history of peri-umbilical abdominal pain, fever
- Pre-operative diagnosis of appendicitis by Ultra-sound or CT scan (inflammatory phlegmon, gangrenous appendicitis, perforated appendicitis and appendiceal abscess)
- Patients with a history of hypertension who underwent LA or OA

Exclusion criteria

- Patients below 18 years of age.
- Patients who had appendix removed due to other causes.
- Negative appendectomy.

- Appendicitis history of > 7 days
- Pregnancy >3 months
- Patients with other chronic illness such as DM, IHD and/or CBD

Data collection procedure: 139 cases were randomly selected. Data was obtained from patients' records stored in the computer. With the help of my Supervisor's Phd student, the patients' information were obtained which included; age, sex, previous history of abdominal surgery, ASA risk score, pre-operative WBC and neutrophil count, radiological diagnosis, type of appendectomy, intra-operative diagnosis, use of post-operative analgesia, post-operative initiation of oral feeding, LOS, post-operative complication and mortality.

Data management and statistical analysis: Statistical Package for Social Science (SPSS) version 16 was used to analyse the data. Independent t-test and chi-square test were used to analyse the association of continuous and categorical variables, respectively. Univariate analysis was used to compare the surgical outcomes between LA and OA in hypertensive and non-hypertensive patients. And descriptive data is expressed as mean±SD. P-value <0.05 was considered statistical significant.

Ethical consideration: Ethical clearance was obtained from ethical committee at Qilu Hospital after review and approval of the study. Data was obtained from patients' record hence it had no direct impact on patient's health. In order to protect patient's confidentiality Hospital Registration numbers were obtained instead of patient's names.

RESULTS

Socio-demographic characteristics and other patient's characteristics: The study involved 139 randomly selected patients who underwent appendectomy at Qilu Hospital between 2014 and 2018. The mean age was 42.2±15.657 years with a range of 18-82 years. Majority of the patients 62.6% were between 18-45 years, while only 11.5% aged 65 years and above. 54% were male. 27.3% (n=38) had history of hypertension. Majority of patients 84.2% underwent LA (n=117) whereas, 15.8% (n=22) underwent OA. Among those who underwent LA 18.7% had hypertension history and 65.5% were non-hypertensive; whereas, 8.6% of those who underwent OA had hypertension and 7.2% were non-hypertensive. And this was statistical significant with p-value <0.05. Regarding on the intra-operative diagnosis, 42.4% had acute phlegmon appendicitis (n=59), 15.1% had acute gangrenous appendicitis (n=21), 7.9% had perforated appendicitis (n=11) and 34.5% had appendiceal abscess (n=48). Post-operative complications occurred in 1.4% patients (n=2) whereby one patient had IAA and the other patient had fat liquefaction.

Comparison of surgical outcomes among hypertensive and non-hypertensive patients in relation to the type of appendectomy

Duration of operation: Duration of operation was longer in non-hypertensive patients who underwent OA 117.5±56.679 min. Among hypertensive patients, the duration of operation was longer in LA group 88.92±38.525 min than in OA group 82.08±33.538 min. this was statistically significant with p-value <0.05.

Table 1. Socio-demographic characteristics

	Frequency	Percent
Age		
18-45 years	87	62.6
46-64 years	36	25.9
65 years and above	16	11.5
Total	139	100.0
Gender		
Male	75	54.0
Female	64	46
Total	139	100.0
Hypertension status		
Hypertensive	38	27.3
Non-hypertensive	101	72.7
Total	139	100.0
Type of appendectomy		
OA	22	15.8
LA	117	84.2
Total	139	100.0
Intra-operative diagnosis		
Acute phlegmon appendicitis	59	42.4
Gangrenous appendicitis	21	15.1
Perforated appendicitis	11	7.9
Appendiceal abscess	48	34.5
Total	139	100.0
Post-operative complications		
Yes	2	1.4
No	137	98.6
Total	139	100.0
Post-operative analgesia use		
Yes	51	36.7
No	88	63.3
Total	139	100.0

Hypertension with type of appendectomy

Table 2. hypertension with type of appendectomy

	OA		LA		Total	
Hypertension status	%	n	%	n	%	n
Hypertensive	31.6	12	68.4	26	100	38
Non-hypertensive	9.9	10	90.1	91	100	101
Total	15.8	22	84.2	117	100	139

P-value = 0.002

Post-operative complications

Table 3. Post-operative complications

	Frequency	Percent
Post-operative complication		
Yes	2	1.4
No	137	98.6
Total	139	100

Type of complications

Table 4. Post-operative complications in hypertensive and non-hypertensive patients

	Hypertensive	Non-hypertensive	Total
No complications	27.0% (37)	73.0% (100)	100% (137)
IAA	0%	100% (1)	100% (1)
Fat liquefaction	100% (1)	0%	100% (1)
Total	27.3% (38)	72.7% (101)	100% (139)

Post-operative analgesia: 36.7% of patients were on post-operative analgesia. The mean duration for analgesia use was 0.48±0.774 days (0 – 3) days. Hypertensive patients who underwent OA had longer duration of analgesia use 0.75±1.357 days than those who underwent LA 0.5±0.99 days. In non-hypertensive patients, LA group had the shortest duration of analgesia use 0.44±0.618 days as compared to OA group 0.5±0.527 days, with p-value <0.05.

Post-operative outcomes

Table 5.

Outcomes	Type of appendectomy		Mean	SD	N	P-value
Duration of operation	OA	Hypertensive	82.08	33.538	12	0.002
		Non-hypertensive	117	56.679	10	
		Total	98.18	47.872	22	
	LA	Hypertensive	88.92	38.525	26	
		Non-hypertensive	73.69	27.11	91	
		Total	77.08	30.504	117	
Duration of analgesia use (days)	OA	Hypertensive	0.75	1.357	12	0.000
		Non-hypertensive	0.5	0.527	10	
		Total	0.64	1.049	22	
	LA	Hypertensive	0.5	0.99	26	
		Non-hypertensive	0.44	0.618	91	
		Total	0.45	0.713	117	
LOS	OA	Hypertensive	10.08	4.944	12	0.021
		Non-hypertensive	10.4	4.502	12	
		Total	10.23	4.639	22	
	LA	Hypertensive	9.15	5.213	26	
		Non-hypertensive	7.26	3.235	91	
		Total	7.68	3.821	117	
Post-operative feeding	OA	Hypertensive	3.25	0.622	12	0.273
		Non-hypertensive	3.4	1.265	10	
		Total	3.32	0.945	22	
	LA	Hypertensive	3.12	1.395	26	
		Non-hypertensive	2.73	1.146	91	
		Total	2.81	1.21	117	

Post-operative complications with type of appendectomy

Table 6. Type of complications with intra-operative diagnosis

	Acute phlegmon appendicitis	Gangrenous appendicitis	Perforated appendicitis	Appendiceal abscess	Total
Complications					
No complication	43.1% (59)	14.6% (20)	8% (11)	34.3% (47)	100% (137)
IAA	0%	0%	0%	100% (1)	100% (1)
Fat liquefaction	0%	100% (1)	0%	0%	100%
Total	42.4% (59)	15.1% (21)	7.9% (11)	34.5% (48)	100% (139)

Post-operative initiation of oral feeding: Post-operative initiation of feeding was delayed among OA patients with no hypertension 3.4±1.265 days whereas, it was earlier in non-hypertensive LA group 2.73±1.146 days; but this was not statistically significant (p=0.273).

Post-operative complications: 1.4% of patients developed post-operative complications (n=2), 1 patient from hypertensive group who developed fat liquefaction and the other patient from a non-hypertensive group who developed IAA (p-value >0.05). Both patients who had post-operative complications were from LA group. However, the p-value was not statistical significant.

LOS: Mean LOS was 8.09±4.051 days (4-28) days. Mean LOS was significantly longer in non-hypertensive OA patients 10.4±4.502 days and was found to be shorter in non-hypertensive LA patients 7.26±3.235 days. Among hypertensive patients, the mean LOS was longer in OA group 10.08±4.944 days than in LA group 9.15±5.213 days. P -value < 0.05.

Other factors associated with poor surgical outcomes

ASA risk score: ASA III patients had the longest mean duration of operation 100.83±21.775 min than ASA II 89.7±39.21min and ASA I 71.11±28.19 min (p-value=0.006). The mean duration of operation was significantly longer in ASA III non-hypertensive patients from OA group 135 min whereas, it was shorter in ASA I hypertensive patients who underwent OA 35 min. P - value 0.003. Post-operative initiation of oral feeding was delayed ASA III patients 3.67±1.506 days (p value=0.014). When comparing between hypertensive and non-hypertensive patients, oral feeding was delayed in non-hypertensive patients from OA group 6 days and it was earlier 2.5±0.707 days in non-hypertensive ASA III patients who underwent LA. However, this was not statistically significant with P value >0.05. ASA III patients had significantly longer mean hospital stay of 10±5.831 days followed by ASA II patients 9.23±5.179 days and ASA I patients had the shortest mean duration of hospital stay 6.99±2.118 days; p value=0.003. Non-hypertensive ASA III patients who underwent OA had the longest duration of hospital stay 21 days, whereas, non-hypertensive ASA III patients from LA group had the shortest mean duration of hospital stay of 6 days; p value = 0.025. Post-operative complications developed in 2 patients (n=2) both from ASA II group; p value >0.05.

Pre-operative WBCs: Post-operative initiation of oral feeding was delayed in hypertensive patients on LA group who had pre-operative WBCs count of >20X10^9/L cells 5.0±2.16 days; whereas, it was earlier 2 days in non-hypertensive LA group with WBC count of <3.5X10^9/L ; p value >0.05. Mean LOS was significantly longer in hypertensive LA group 15.0±8.602 days who had WBCs count >20X10^9/L cells; whereas, was shorter 6.89±2.986 days in non-hypertensive LA group with WBCs count between 3.5 – 9.5X10^9/L; p value = 0.015. Post-

operative complications developed in 2 patients with a WBC count of 9.6 – 20X10^9/L cells. P value >0.05.

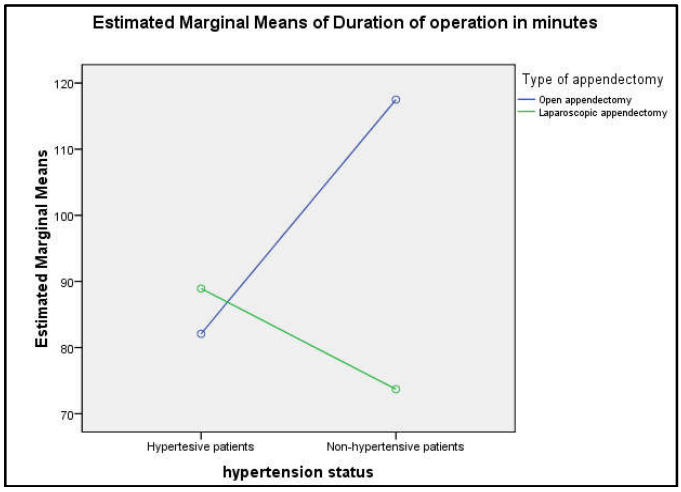

Chart1. Duration of operation

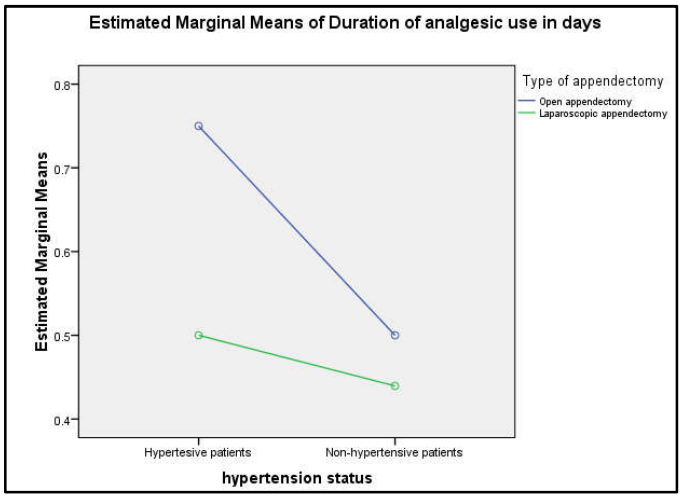

Chart 2. Duration of analgesia use

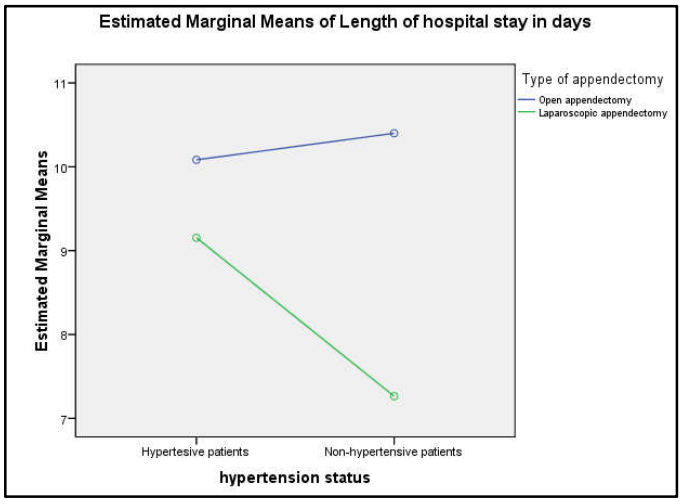

Chart 3. LOS

Pre-operative neutrophil count: There was delayed in initiation of oral feeding 4.0±1.414 days among non-hypertensive patients from OA group who had neutrophil count of >13X10^9 cells/L; whereas, oral feeding was earlier 2.43±0.746 days in non-hypertensive patients from LA group with neutrophil count between 1.8 – 6.3X10^{9}cells/L. However this was not statistically significant, p value > 0.05. The mean LOS was significantly longer 12.5±0.707 days among non-hypertensive patients with neutrophil count between 1.8 – 6.3X10^{9}cells/L who had OA. Mean LOS was shorter 6.14±1.459 days among non-hypertensive patients who had neutrophil count between 1.8 – 6.3X10^{9}cells/L from LA group; p value<0.05. 2 patients who developed post-operative complications, both had neutrophil count between 6.4 – 13X10^{9}cells/L; p value > 0.05.

Intra-operative diagnosis: The mean duration of operation was longer 150 min in non-hypertensive patients with gangrenous appendicitis who had open appendectomy and it was found to be shorter 68.75±23.494 min in non-hypertensive patients with appendiceal abscess who underwent LA; p value < 0.05. Post-operative initiation of oral feeding was delayed 5.0±1.0 days in non-hypertensive OA group with perforated appendicitis and was initiated earlier 2.33±0.577 days in non-hypertensive LA group who had perforated appendicitis. However, this was not statistically significant with p value being > 0.05. Hypertensive patients with gangrenous appendicitis who underwent OA had significantly longer mean duration of hospital stay 19±7.071 days; whereas, non-hypertensive patients with acute phlegmon appendicitis had the shortest mean duration of hospital stay 6.78±2.734 days; p value < 0.05. Among patients who developed post-operative complications, one who had a diagnosis of appendiceal abscess developed IAA and the other patient who had a diagnosis of gangrenous appendicitis developed fat liquefaction. P -value > 0.05. There was no mortality that occurred. Conversion from LA to OA occurred in 1 patient 0.7%. The reason for conversion was inadequate exposure due to adhesions. Therefore in this patient the type of appendectomy used in analysis was open appendectomy.

Conversion

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DISCUSSION

This was a clinical based study aimed at comparing the surgical outcomes between hypertensive and non-hypertensive patients. From our study the mean age was 42.2±15.657 (18 – 82) years, with majority of patients being males 54%. However the mean age from other studies were reported to be around 28 years (17-63) for OA and 29 years (18-71) for LA (7,8). Majority of female patients underwent LA (6,8). And in other studies there was no difference in LA and OA among male and female patients (7). However the mean ages from other studies were reported to be around 28 years (17-63) for OA and 29 years (18-71) for LA (7,8). Majority of male patients underwent LA 50% than female patients 41.3% whereas more female patients underwent OA than male patients (4.7% versus 4%) respectively. But the difference was not statistically significant (p value 0.379). Our study was different when compared to other studies which show that majority of female patients underwent LA (6,8). And in other studies there was no difference in LA and OA among male and female patients (7). From our study we found that poor post-operative surgical outcomes were common among non-hypertensive patients who underwent OA; however, among hypertensive patients, those who underwent OA had better outcomes than those in LA

group. Non-hypertensive patients on OA group had longer duration of operation 117±56.679 min versus non-hypertensive patients who underwent LA 73.69±27.1min1, whereas, duration of operation for hypertensive group was 88.92±38.525 min in LA versus 82.08±33.538 min in OA group. To my knowledge there is no study that has been done to determine the surgical outcomes in hypertensive patients. Generally, there are some studies that showed no difference in the duration of operation between LA and OA whereas; other studies shows that the duration of operation is longer in LA than OA group (52,53). Having other comorbidities is thought to have effect in duration of operation. In one study, the duration of operation was longer in elderly patients who also had other co-morbidities (9). However, the duration of operative is even longer with OA than LA. This is based on a meta-analysis to determine the outcomes of LA and OA among obese patients (54). 36.7% of patients were on post-operative analgesia with mean duration of 0.48±0.774 days. Open appendectomy is found to be significantly associated with longer duration of analgesia use with hypertensive patients having longer duration than non-hypertensive patients; hypertensive patients (0.75±1.357 days in OA versus 0.5±0.99 days in LA) and non-hypertensive patients (0.5±0.527 days in OA versus 0.44±0.618 days in LA). Although not statistically significant, oral feeding has been found to be late among non-hypertensive patients with OA than in those who underwent LA 3.4±1.265 days in OA versus 2.73±1.146 days. This is also similar with normal population with no chronic illness whereby the oral intake is delayed in OA 5.1 days whereas, it is earlier with LA 2.6 days (52).

The mean LOS was 8.09±4.051 days (4-28). Open appendectomy was associated with longer hospital stay than LA with non-hypertensive patients having longer hospital stay 10.4±4.502 days than hypertensive patients 10.08±4.944 days; whereas, for LA hypertensive patients had longer LOS 9.15±5.213 days and non-hypertensive group having LOS of 7.26±3.235. Generally, LA is been associated with shorter LOS than OA (52). This was also similar to other studies done whereby LOS was longer in DM patients 3 days than non-diabetic patients 1 day. However DM patients were more likely to have other comorbid conditions such as CKD, HTN, coronary artery disease, peripheral artery disease and COPD. LOS was longer not only in diabetic patients but also in elderly patients who were found to have comorbidities than in younger patients and in patients with sickle cell disease(9,55,56). In a study done in Taiwan, the LOS was longer for OA patients who had Cerebrovascular diseases and DM when compared to LA patients. This was also similar with another study whereby the LOS was longer in diabetic patients than non-diabetic patients and with OA the LOS was longer than in LA (24,57). The incidence for post-operative complication was 1.4%, (n=2) from LA group. 1patient who had no history of hypertension developed IAA and 1 patient with history of hypertension developed fat liquefaction. In our study the incidence of post-operative complication was lower when compared to other studies 23.1% (n=40) whereby 32 patients had wound infection and 10 patients had IAA. Pneumo-peritoneum has known effects on cardiopulmonary physiology, however, in patients with CHF Laparoscopic approach is found to have protective effect on mortality following colectomies, small bowel resection, hernia repair, appendectomies and splenectomise but there was no difference with other outcomes such as LOS and morbidity when compared with open approach (22). DM was the only risk factor associated with IAA and the overall morbidity was 28% among elderly above 60 years with one study showing the rate of IAA to be higher among OA obese patients(47,54,58). And in most studies done post-operative infection particularly SSI was encountered more frequently in DM patients than non-DM patients (55,57). Other post-operative complication included small bowel obstruction which was common with OA 34.95 per 10,000 person-years than LA 22.59 per 10,000 person-years with presence of comorbidities and complicated appendicitis being the factors associated with this complication (59).

Other factors associated with poor surgical outcomes: Apart from type of appendectomy and hypertensive status, we also found other factors associated with poor surgical outcomes. These include higher ASA risk score (ASA III), higher pre-operative WBC and having gangrenous appendicitis. Non-hypertensive patients with ASA III who underwent OA had significantly longer duration of operation 135 min and longer LOS of 21 days. LOS was significantly longer 15±8.602 days among hypertensive patients on LA group who had higher WBC of >20X10^9cells/L. The LOS was significantly longer 12.5±0.707 days in non-hypertensive patients with neutrophil count 1.8 – 6.3X10^9cells/L who underwent OA. Gangrenous appendicitis in non-hypertensive patients on OA group had the longest duration of operation 150 min and the LOS was significantly longer in hypertensive patients with gangrenous appendicitis on OA group 19±7.071 days. When comparing with other studies duration of operation was longer in LA group and elderly 68 years and above, which were similar to our result (60). Being treated in a public sectors, having perforated appendicitis and being elderly (68 years and above) were the factors associated with longer hospital stay (60–62). Factors associated with post-operative complications were; perforated appendicitis 75% than in patients with non-perforated appendicitis 16.2%, use of midline or paramedian incision and older age (68 years and above), ASA risk score ≥III (58,60,62–64). Moreso, appendiceal perforation is significantly associated with longer hospital stay, longer duration of operation, late initiation of diet, longer duration of analgesia use and higher incidence of post-operative complications (63,65). In patients with complicated appendicitis organ SSI was higher in LA than OA (6.3% versus 4.8%) (66). However not statistically significant, this was also similar to our study whereby both patients who had post-operative complications were from LA group.

Mortality: There was no mortality that occurred in our study. This was similar from a study done by Boris whereby no mortality occurred in elderly patients with comorbid conditions (9).There were some few studies that reported mortality, however the mortality was less than 3% in both of the studies (47,58,62). One study by Luncaetal had an overall mortality of 6.3% (63).

Conclusion

Acute appendicitis is one of the common emergence conditions at emergency surgery departments. Although it is common in young population, it can also occur in elderly population and in those with comorbidities such as hypertension. Despite the known effect of pneumo-peritoneum to the cardiopulmonary function in patients with cardiovascular diseases, our study has shown that LA is safe in hypertensive patients. The longer operation duration and longer hospital stay was associated with OA in non-hypertensive patients whereas, longer duration of

analgesia use was associated with OA in patients with hypertension. Other factors which were associated with poor surgical outcomes in non-hypertensive OA group were ASA III score, and having intra-operative diagnosis of gangrenous appendicitis whereas, higher WBC was associated with poor surgical outcomes in hypertensive patients in LA group. Since there was few hypertensive patients, the poor post-operative surgical outcomes observed in non-hypertensive patients could be due to smaller sample size.

Limitations: The study had several limitations, smaller sample size, and this was due to smaller number of hypertensive patients, especially those who underwent open appendectomy. And since it was a retrospective study, some information such as post-operative ambulation and operator surgical class were missing. For future studies, prospective study involving larger sample size should be done.

Conflicts of interest: The authors declare no conflict of interest

List of abbreviations

NP - Normal population
LIP - Low-income population
DM - Diabetes mellitus
LA - Laparoscopic appendectomy
OA - Open appendectomy
IHD - Ischemic heart disease
UK - United Kingdom
USA - United States of American
LOS - Length of stay
SSI - Surgical Site Infection
IAA - Intra-abdominal abscess
BMI - Body Mass Index
ASA - American Society of Anaesthesiologist
PIAA - Post-operative Intra-abdominal abscess
DVT - Deep venous thrombosis
UTI - Urinary Tract Infection**,**
MI - Myocardial infarction
AIDs - Acquired immune-deficiency syndrome
CT scan - Computed tomography scan
HTN - Hypertension
WBCs - White blood cells
CS - Caesarean section
CBD - Cerebrovascular disease
CKD - Chronic kidney disease
COPD - Chronic obstructive pulmonary disease
CHF - Congestive heart failure

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