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Retrospective Study

COVID-19 pandemic changed the management and outcomes of acute appendicitis in northern Beijing: A single-center study

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Abstract

BACKGROUND

Since the outbreak of the coronavirus disease 2019 (COVID-19) pandemic, outcomes and management of many diseases have been affected. Acute appendicitis is a common acute abdomen. The incidence rate is 0.05%-0.5%. Studies reported that the number of patients with appendicitis admitted to emergency department significantly decreased since the pandemic. People avoided going to the hospital for fear of being infected. Different countries have different epidemic prevention measures that result in different treatment outcomes. The Chinese government also published some temporary measures in order to prevent the outbreak.

AIM

To explore the changes in management and outcomes of acute appendicitis during the COVID-19 pandemic in the North of Beijing.

METHODS

Patients with acute appendicitis admitted to Beijing Tsinghua Changgung Hospital between February and June 2019 and February and June 2020 were retrospectively reviewed. Cases were grouped according to admission year. The demographic characteristics, present illnesses, medical history, symptoms and signs, comorbidities, blood test results, imaging data, appendix pathology, and treatment details were compared.

RESULTS

Overall, 74 patients received nonsurgical treatment and 113 patients underwent surgical treatment in group 2019, whereas 159 patients received nonsurgical treatment and 26 patients received surgical treatment in group 2020. Fever, thick appendix, nonsurgical management, and uncomplicated appendicitis (simple or

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supportive appendicitis) were more common in group 2020 ($P < 0.05$). Among the nonsurgical management cases, the neutrophil percentage, neutrophil-to-lymphocyte ratio, and recurrence rate were higher in group 2020 ($P < 0.05$). Among surgically managed cases, there were more cases with gastrointestinal symptoms, peritonitis, ascites in the image, and intraoperative adhesion or ascites in group 2020 ($P < 0.05$). The white blood cell count, time from diagnosis to surgery, surgical time, and intraoperative blood loss were higher in group 2020 ($P < 0.05$).

CONCLUSION

During the COVID-19 pandemic, patients suffering from acute appendicitis in Beijing tended to present with severe symptoms and opt for nonsurgical treatment. For patients who underwent surgical management, the operation was delayed and more difficult during the pandemic. Nevertheless, the hospital stay and the incidence of postsurgical complications did not change.

Key Words: COVID-19; Acute appendicitis; Case management; Treatment outcome; Antibiotic treatment; Laparoscopic appendectomy

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Core Tip: Our paper showed that patients suffering from acute appendicitis in the northern part of Beijing tended to present with severe symptoms and opt for non-surgical treatment during the coronavirus disease 2019 pandemic. For patients who underwent surgical treatment, the operation was delayed and was more difficult during the pandemic. Nevertheless, the hospital stay and the incidence of post-surgical complications did not change. We also found laparoscopic appendectomy was safe for patients followed by Chinese government temporary measures.

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INTRODUCTION

The World Health Organization declared a global coronavirus disease 2019 (COVID-19) pandemic on March, 2020. Then, the number of infected patients significantly increased. Currently, over 100 million patients have been infected worldwide. The first COVID-19 case in Beijing was confirmed in January, after which the pandemic reached its peak by the end of June 2020, with 922 confirmed cases.

Since the outbreak of the COVID-19 pandemic, the outcomes and management of many diseases have been affected. Acute appendicitis is a common acute abdomen. The incidence rate is 0.05%-0.5% [1,2]. A study conducted in Italy reported that the number of patients with appendicitis admitted to the emergency department (ER) has significantly decreased since the pandemic [3]. Another study conducted in Israel showed that weekly admissions decreased by 40.7% [4]. People were avoiding going to the hospital for fear of being infected. Consequently, the United Kingdom published new guidelines and changed the management of acute appendicitis [5]. The Chinese government also published several temporary measures to prevent the outbreak. All patients requiring admission were asked to perform blood tests for complete blood count (CBC), immunoglobulin (Ig) G, and IgM antibody. Chest computed tomography (CT) and swabs were also ordered.

Different countries have different epidemic prevention measures that result in different treatment outcomes. The aim of this research was to explore whether the COVID-19 pandemic changed the management and outcomes of acute appendicitis in Beijing.

MATERIALS AND METHODS

Case selection

Patients with acute appendicitis treated in Beijing Tsinghua Changgung Hospital from February to June 2019 and February to June 2020 were reviewed retrospectively. Cases treated in 2020 were categorized as group 2020, and cases treated in 2019 were categorized as group 2019. The diagnostic criteria for acute appendicitis including: The right lower quadrant abdominal pain; tenderness in the right lower quadrant, especially at the McBurney point; increased white blood cell count (WBC), c-reactive protein (CRP) level, or neutrophil percentage (N%); a swelling appendix was found by ultrasound or CT. The inclusion criteria were as follows: (1) Admitted with acute appendicitis; and (2) Older than 16 years and younger than 80 years. The exclusion criterion was that the patient was admitted with a periappendicular abscess. This paper was approved by the Beijing Tsinghua Changgung Hospital ethics committee (ID: 21039-6-01).

Management

All patients were treated surgically or nonsurgically according to their decisions. Some patients who needed surgical management selected nonsurgical management due to the fear of being infected during the pandemic.

IV antibiotics, which were given as nonsurgical management in the ER, included ertapenem 1 g + 0.9% normal saline (NS) 100 mL qd, ceftriaxone 2 g + 0.9% NS 100 mL qd, ornidazole 0.5 g q12 h, levofloxacin 0.5 g qd, and ornidazole 0.5 g q12 h. CBC and CRP were performed 3 d later. The patients were discharged with oral antibiotics for 3 d if their blood tests were near normal (WBC < $10 \times 10^9/L$, N% < 85%, and CRP < 50 mg/L). Otherwise, IV antibiotics were continued until the blood test reached the listed criteria above. Abdominal ultrasound or CT scans were performed if the CBC was elevated or the abdominal pain was more severe than before. Ultrasound- or CT-guided percutaneous puncture was performed if the imaging test suggested a periappendicular abscess.

Laparoscopic appendectomy was performed as surgical management. The patients were placed in the supine position and received general anesthesia. A 1 cm incision was made on the umbilicus. A 12–14 mmHg pneumoperitoneum was formed by inflation with carbon dioxide through a pneumoperitoneum needle. A 10-mm trocar was used to puncture the abdominal cavity, and the laparoscope came through it. Under laparoscopy, 1-cm and 0.5-cm small incisions were made at the anti-McBurney point and 3 cm on the pubic symphysis, and 10-mm and 5-mm trocars were placed, respectively. Laparoscopic instruments were used to find and resect the appendix. Hem-o-lok (Teleflex Medical, United States) occlusion was performed to close the root mesentery of the appendix. The appendix root was ligated with a 7# silk thread (Mersilk, Ethicon) or occluded with a Hem-o-lok at 0.5 cm from the root of the appendix. The appendix was removed by a fetching bag from the trocar in the left lower abdomen. The incision was sutured after the abdominal pelvic fluid was suctioned.

Ertapenem 1 g once daily or ceftriaxone 2 g once + metronidazole 0.5 g every 8 h daily were used as intravenous antibiotic treatment. The patients were discharged if the blood test results were near normal, the patient tolerated semiliquid food, had no fever or wound infection, and the pain was controlled.

Data collection and statistical analysis

Data collection: The following indicators were collected for patients receiving nonsurgical treatment: Age, sex, disease onset time, gastrointestinal symptoms, comorbidities, history of appendicitis, fever, peritonitis, WBC, CRP, N%, neutrophil-to-lymphocyte ratio (NLR), appendix diameter, appendicolith, ascites in imaging, uncomplicated appendicitis (simple or suppurative appendicitis) ratio, IV antibiotic types, antibiotic treatment days, conversion to operation rate and recurrence.

The following indicators of surgical cases were collected: Age, sex, disease onset time, gastrointestinal symptoms, comorbidities, history of appendicitis, fever, peritonitis, WBC, CRP, N%, NLR, appendix diameter, appendicolith, ascites in imaging, time from diagnosis to surgery, surgical time (defined as the time from skin incision to anesthesia intubation removed), intraoperative blood loss, intraoperative adhesions or ascites, appendix pathology, hospital stay, and postoperative complications.

Of 6 mo' followed up was performed *via* telephone call or in the outpatient department in the 2020 group, while cases in the 2019 group were followed up for 18

mo in the outpatient department or *via* telephone call after discharge.

Statistical analysis

SPSS 16.0 (IBM, United States) was used to analyze all results. T-test was used for continuous variables, while the chi-square test was used for the frequency data. A $P < 0.05$ indicated a statistically significant difference.

RESULTS

All case results

Overall, 159 patients received nonsurgical treatment and 26 patients received surgical treatment in 2020, whereas 74 patients received nonsurgical treatment and 113 patients received surgical treatment in 2019. Group 2020 comprised 95 male and 90 female patients aged 40.40 ± 14.90 years, while group 2019 comprised 83 male and 104 female patients aged 40.45 ± 15.66 years. A higher fever rate (64.5% *vs* 52.9%, $P = 0.02$), thicker appendix diameter (9.31 ± 4.05 mm *vs* 4.78 ± 4.20 mm, $P < 0.01$), higher rate of nonsurgical management (85.9% *vs* 39.6%, $P < 0.01$), and higher rate of uncomplicated appendicitis were observed (52.4% *vs* 64.2%, $P = 0.02$) in group 2020 than in group 2019. As shown in Table 1, no deaths were reported after follow-up. No operation team member was infected after follow-up.

Nonsurgical management case results

N% ($80.49 \pm 12.31\%$ *vs* $76.63 \pm 12.88\%$, $P = 0.01$), NLR (10.51 ± 9.95 *vs* 7.22 ± 6.33 , $P = 0.02$), and the rate of recurrence were higher (1.3% *vs* 21.6%, $P < 0.001$) in group 2020 than in group 2019 (Table 2).

Surgical management case results

There were more cases with gastrointestinal symptoms (80.8% *vs* 58.4%, $P = 0.03$) and peritonitis (96.2% *vs* 67.3%, $P < 0.01$) in group 2020 than in group 2019. Higher WBC (14.92 ± 4.39 *vs* 13.22 ± 3.72 , $P = 0.04$), a higher rate of ascites in the image (50% *vs* 25.7%, $P = 0.02$), longer time from diagnosis to surgery (32.44 ± 47.95 h *vs* 10.70 ± 8.77 h, $P < 0.01$), longer surgical time (87.35 ± 51.68 min *vs* 72.75 ± 38.25 min, $P = 0.02$), higher intraoperative blood loss (14.23 ± 14.74 mL *vs* 11.30 ± 6.83 mL, $P = 0.03$) and a higher rate of intraoperative adhesion or ascites (92.3% *vs* 67.3%, $P = 0.01$) were observed in group 2020 compared to group 2019, as shown in Table 3.

DISCUSSION

Beijing Tsinghua Changgung Hospital is one of the only two large hospitals in the northern part of Beijing, serving 700000 residents. Accordingly, our data represent the real-life situation in northern Beijing. Our study suggested that patients with acute appendicitis presented with more severe conditions at admission during the pandemic, and they preferred nonsurgical management. For patients who underwent surgical management, the operation was delayed and was more difficult during the pandemic. However, the hospital stay and the incidence of postsurgical complications did not change.

In the present study, the number of admitted patients did not decrease, which was inconsistent with previous studies[3,4]. Nevertheless, we found that the proportion of uncomplicated appendicitis was lower than that in the same period the previous year (52.4% *vs* 64.2%), which suggested that the morbidity of acute appendicitis did not change. A previous study reported that the appendix was thicker and that the inflammation around the appendix was more severe during the pandemic based on CT scans [6], which is consistent with our study results (9.31 ± 4.05 mm *vs* 4.78 ± 4.20 mm, $P < 0.01$). These findings suggested that patients feared becoming infected while in the hospital and that they preferred to stay at home until their symptoms became too serious to manage at home.

The 2020 WSES guidelines for acute appendicitis recommend that nonsurgical treatment should be the first choice for uncomplicated appendicitis[7], while surgery should be the first choice for complicated appendicitis (gangrene or perforated appendicitis). As patients did not want to spend a long time in the hospital because of the fear of becoming infected during the pandemic, many selected nonsurgical treatment[8]. Some doctors in other countries selected nonsurgical management for

Table 1 Comparison of characteristics between the two groups (mean \pm SD)

	Group 2020 (n = 185)	Group 2019 (n = 187)	P value
Sex, male, n (%)	95, 51.4%	83, 44.4%	0.18
Age (year)	40.40 \pm 14.90	40.45 \pm 15.66	0.70
Disease onset time (h)	36.78 \pm 57.05	33.27 \pm 34.92	0.18
Nausea, vomiting or diarrhea, n (%)	94, 50.8%	104, 55.6%	0.35
Peritonitis, n (%)	75, 40.5%	93, 49.7%	0.08
Comorbidities, n (%)	24, 13%	17, 9.1%	0.23
History of appendicitis, n (%)	30, 16.2%	28, 15%	0.74
Fever, n (%)	120, 64.5%	99, 52.9%	0.02
WBC (10^9 /L)	12.94 \pm 4.42	12.73 \pm 4.11	0.41
CRP (mg/L)	33.40 \pm 51.64	36.00 \pm 56.17	0.78
N%	80.92 \pm 11.91	80.72 \pm 10.69	0.58
NLR	10.56 \pm 9.58	9.60 \pm 8.17	0.32
Appendix diameter (mm)	9.31 \pm 4.05	4.78 \pm 4.20	< 0.01
Appendicolith, n (%)	65, 35.1%	68, 36.4%	0.81
Ascites in image, n (%)	43, 23.2%	45, 24.1%	0.85
Treatment, non-surgical treatment, n (%)	159, 85.9%	74, 39.6%	< 0.01
Uncomplicated appendicitis, n (%)	97, 52.4%	120, 64.2%	0.02

WBC: White blood cell count; CRP: C-reactive protein; NLR: Neutrophil-to-lymphocyte ratio.

most patients with acute appendicitis because they could not determine whether the patient was infected with COVID-19 before treatment[9]. A previous study showed that 74% of surgeons modified their practice to predominantly nonsurgical management, while 61% of patients selected nonsurgical management to decrease their time spent in the hospital[10]. A global survey also suggested that doctors preferred nonoperative management during the pandemic[11]. This study found that, after the pandemic, the proportion of nonsurgically managed cases of appendicitis in our hospital increased from 39.6% the previous year to 85.9%, which is consistent with the situation abroad. Further research on the outcome of nonsurgical treatment with complicated appendicitis should be performed in the future.

The NLR has been widely used to evaluate various malignant tumors as an indicator of immune status[12,13]. NLR has also been used as an indicator for the diagnosis and severity evaluation of acute appendicitis. Previous studies reported that the NLR could be used as an important parameter in the diagnosis of appendicitis[14, 15], while there was also a substantial correlation between the NLR and disease severity. This study demonstrated that patients who selected nonsurgical management during the pandemic presented with higher N% and NLR. We also detected some severe patients whose condition was more appropriate for surgical management but who underwent nonsurgical management during the nonpandemic period. This was consistent with the increased proportion of nonsurgical management during the pandemic observed in the present study. Nevertheless, there was no significant difference in the rates of conversion to surgery between groups, which indicated that the outcomes of IV antibiotic treatment were the same as those during the nonpandemic period.

Recurrence is an important problem of nonsurgical management. The APPAC study reported that the 1-year, 3-year, and 5-year recurrence rates of nonsurgical treatment were 27.3%, 35.2%, and 39.1%, respectively[16]. Our findings demonstrated a significant decrease in recurrence during the pandemic (1.3% *vs* 21.6%); however, bias was possible due to the short follow-up in group 2020.

Among surgically managed cases, our study demonstrated that patients presented with more gastrointestinal symptoms (80.8% *vs* 58.4%) and more severe physical signs during the pandemic period, especially peritonitis (96.2% *vs* 67.3%). Peritonitis emerges when periappendiceal exudation stimulates the parietal peritoneum, thus

Table 2 Comparison of characteristics and outcomes between the two groups with non-surgical management (mean \pm SD)

	Group 2020 (<i>n</i> = 159)	Group 2019 (<i>n</i> = 74)	<i>P</i> value
Sex, male, <i>n</i> (%)	85, 53.5%	36, 48.6%	0.49
Age (year)	40.03 \pm 15.12	40.50 \pm 17.10	0.77
Disease onset time (h)	35.24 \pm 54.86	39.89 \pm 48.44	0.16
Nausea, vomiting or diarrhea, <i>n</i> (%)	84, 52.8%	29, 39.2%	0.05
Peritonitis, <i>n</i> (%)	50, 31.4%	17, 23.0%	0.18
Comorbidities, <i>n</i> (%)	18, 11.3%	3, 4.1%	0.07
History of appendicitis, <i>n</i> (%)	26, 16.4%	11, 14.9%	0.77
Fever, <i>n</i> (%)	107, 67.3%	53, 71.6%	0.51
WBC (10^9 /L)	12.67 \pm 4.37	11.85 \pm 4.48	0.35
CRP (mg/L)	30.16 \pm 48.19	28.58 \pm 45.21	0.92
N%	80.49 \pm 12.31	76.63 \pm 12.88	0.01
NLR	10.51 \pm 9.95	7.22 \pm 6.33	0.02
Appendix diameter (mm)	10.13 \pm 3.34	9.84 \pm 2.24	0.10
Appendicolith, <i>n</i> (%)	53, 33.3%	21, 28.4%	0.45
Ascites in image, <i>n</i> (%)	30, 18.9%	16, 21.6%	0.62
Uncomplicated appendicitis, <i>n</i> (%)	84, 52.8%	42, 56.8%	0.58
IV antibiotics			0.40
Cephalosporin, <i>n</i> (%)	137, 86.2%	65, 87.8%	
Others, <i>n</i> (%)	9, 5.7%	6, 8.1%	
None, <i>n</i> (%)	13, 8.2%	3, 4.1%	
Antibiotic treatment days (d)	4.08 \pm 3.28	4.03 \pm 2.63	0.85
Convert to operation, <i>n</i> (%)	16, 10.1%	3, 4.1%	0.12
Recurrence, <i>n</i> (%)	2, 1.3%	16, 21.6%	< 0.001

WBC: White blood cell count; CRP: C-reactive protein; NLR: Neutrophil-to-lymphocyte ratio.

representing severe abdominal infection. Patients also presented with higher WBCs (14.92 ± 4.39 vs 13.22 ± 3.72), which was consistent with a previous study[8]. A global survey revealed that 56.1% of the study cases had more severe septic abdominal diseases during the pandemic, especially appendicitis and cholecystitis (41.8% and 40.2% of the study cases, respectively)[17].

To prevent COVID-19 infection among medical teams, the Chinese government ordered all patients to take a blood test for CBC, IgG, and IgM antibodies; chest CT; and swabs before admission. Although some foreign countries increased the CT scan rates[18], they did not require every patient to undergo all the tests before admission [19]. It took nearly 12 h to obtain the results of all of these tests and examinations in our hospital, which was why patients experienced a longer time from diagnosis to operation during the pandemic. A longer waiting time might lead to more severe ischemia of the appendix wall and an increased possibility of gangrene or perforation. A previous study reported that a time from onset to operation > 48 h, the rate of perforated appendicitis was 3.58 times that within 24 h[20]. Severe infection can lead to more severe intraoperative abdominal adhesions and ascites, thus increasing the difficulty of operation, prolonging the surgical time, and increasing the intraoperative blood loss, all of which were found in the present study. Some doctors are concerned that pneumoperitoneum may leak virus-contaminated gas from the trocar during laparoscopic surgery[5], while others are worried that electronic devices might aerosolize COVID-19, although there is no evidence for this. British guidelines recommended open surgery as the predominant procedure for acute appendicitis. The proportion of open surgeries significantly increased in the United Kingdom[19]. For the same reason, Italian doctors prefer open appendectomy without electronic devices

Table 3 Comparison of characteristics and outcomes between the two groups with surgical management (mean \pm SD)

	Group 2020 (<i>n</i> = 26)	Group 2019 (<i>n</i> = 113)	<i>P</i> value
Sex, male, <i>n</i> (%)	10, 38.5%	47, 41.6%	0.77
Age (year)	42.08 \pm 12.69	40.56 \pm 14.97	0.23
Disease onset time (h)	50.73 \pm 62.32	27.63 \pm 21.22	0.38
Nausea, vomiting or diarrhea, <i>n</i> (%)	21, 80.8%	66, 58.4%	0.03
Peritonitis, <i>n</i> (%)	25, 96.2%	76, 67.3%	< 0.01
Comorbidities, <i>n</i> (%)	6, 23.1%	14, 12.4%	0.29
History of appendicitis, <i>n</i> (%)	4, 15.4%	17, 15.0%	1.00
Fever, <i>n</i> (%)	13, 50%	46, 40.7%	0.39
WBC (10^9 /L)	14.92 \pm 4.39	13.22 \pm 3.72	0.04
CRP (mg/L)	63.35 \pm 74.51	38.72 \pm 58.94	0.11
N%	85.15 \pm 7.28	83.01 \pm 8.11	0.98
NLR (%)	12.30 \pm 7.46	10.75 \pm 8.66	0.58
Appendix diameter (mm)	12.29 \pm 4.94	10.75 \pm 2.89	0.18
Appendicolith, <i>n</i> (%)	12, 46.2%	47, 41.6%	0.67
Ascites in image, <i>n</i> (%)	13, 50%	29, 25.7%	0.02
Time from diagnosis to surgery (h)	32.44 \pm 47.95	10.70 \pm 8.77	< 0.01
Surgical time (min)	87.35 \pm 51.68	72.75 \pm 38.25	0.02
Blood loss (mL)	14.23 \pm 14.74	11.30 \pm 6.83	0.03
Intraoperative adhesion or ascites	24, 92.3%	76, 67.3%	0.01
Uncomplicated appendicitis, <i>n</i> (%)	13, 50%	78, 69%	0.07
Hospital stay (d)	5.31 \pm 3.53	4.37 \pm 2.19	0.31
Complications, <i>n</i> (%)	2, 7.7%	2, 1.8%	0.16

WBC: White blood cell count; CRP: C-reactive protein; NLR: Neutrophil-to-lymphocyte ratio.

[21]. However, the 2020 WSES guidelines recommended laparoscopic appendectomy as the first choice for complicated appendicitis[7]. Laparoscopic surgery leads to a shorter hospital stay and a lower rate of wound infection. In our study, laparoscopic appendectomy was the only operation used for surgical management of these patients. As all patients underwent a blood test for CBC, IgG and IgM antibodies and swabs before admission, the medical team did not perform the operation until negative results were obtained, thus putting at ease the medical team who did not have to worry about the possibility of COVID-19 infection during the operation. Some countries have used smoke evacuation systems with filters to evacuate surgical smoke during laparoscopic appendectomy[11], which will increase the ratio of minimally invasive surgery and bring the best benefits to patients.

According to a previous study, the incidence of postoperative complications during the pandemic was twice as high as that before the pandemic[22]. The authors suggested that the increased severity of appendicitis might be caused by a fear of admission. There was no significant difference in postoperative complication rates between groups in the present study, which might be related to a lower number of operation cases and short follow-up time during the pandemic or indirectly related to the proper government orders.

This study has several limitations. As this was a retrospective study, it was inevitably biased. This was a single-center study with a small sample size. The follow-up time during the pandemic was short. Therefore, the results need to be further confirmed by large case studies.

In summary, the proportion of cases using nonsurgical management for appendicitis in northern Beijing increased during the COVID-19 pandemic. The patients presented with more serious conditions. To prevent COVID-19 infection, a

more complex preoperative test and examination were adopted, which resulted in a longer preoperative waiting time and surgical time. Intraoperative blood loss increased. However, the complex preoperative examination was useful, as it screened the patients in need of laparoscopic appendectomy, ensured better postoperative outcomes, and did not significantly increase the postoperative complication rate.

CONCLUSION

During the COVID-19 pandemic, patients suffering from acute appendicitis in Beijing tended to present with severe symptoms and opt for non-surgical treatment. For patients who underwent surgical management, the operation was delayed and more difficult during the pandemic. The hospital stay and the incidence of post-surgical complications did not change. The complex preoperative examination can ensure the safety of laparoscopic appendectomy, which leads to a better postoperative outcomes.

ARTICLE HIGHLIGHTS

Research background

Since the outbreak of the coronavirus disease 2019 (COVID-19) pandemic, the outcomes and management of acute appendicitis have been affected. Different countries have different epidemic prevention measures that result in different treatment outcomes. The aim of this research was to explore whether the COVID-19 pandemic changed the management and outcomes of acute appendicitis in Beijing.

Research motivation

How did the COVID-19 pandemic change the management and outcomes of acute appendicitis in Beijing?

Research objectives

Explore the changes in management and outcomes of acute appendicitis during the COVID-19 pandemic in Beijing.

Research methods

Patients with acute appendicitis treated in Beijing Tsinghua Changgung Hospital from February to June 2019 and February to June 2020 were reviewed retrospectively. All patients were treated surgically or non-surgically according to their decisions. The demographics, symptoms, signs, laboratory parameters, imaging results, operation details, uncomplicated appendicitis rate, complications rate and recurrence rate were collected. SPSS 16.0 (IBM, United States) was used to analyze all results. T-test was used for continuous variables, while the chi-square test was used for the frequency data. A $P < 0.05$ indicated a statistically significant difference.

Research results

There were 74 patients who received non-surgical treatment and 113 patients who underwent surgical treatment in group 2019 vs 159 patients with non-surgical treatment and 26 patients with surgical treatment in group 2020. Higher fever rate, thicker appendix diameter, a higher rate of non-surgical management, and a higher rate of uncomplicated appendicitis were observed in group 2020 than in group 2019. Among the non-surgical management cases, the neutrophil percentage, neutrophil-to-lymphocyte ratio, and the recurrence rate were higher in group 2020. There were more cases with gastrointestinal symptoms and peritonitis in group 2020. Higher white blood cell count, a higher rate of ascites in the image, longer time from diagnosis to surgery, longer surgical time, higher intraoperative blood loss and a higher rate of intraoperative adhesion or ascites were observed in group 2020 compared to group 2019.

Research conclusions

During the COVID-19 pandemic, patients suffering from acute appendicitis in Beijing tended to present with severe symptoms and opt for non-surgical treatment. For patients who underwent surgical management, the operation was delayed and more difficult during the pandemic. The hospital stay and the incidence of post-surgical

complications did not change. The complex preoperative examination can ensure the safety of laparoscopic appendectomy, which leads to a better postoperative outcomes.

Research perspectives

This study has some limitations. As this was a retrospective study, it was inevitably biased. This was a single-center study with small sample size. The follow-up time during the pandemic was short. Therefore, the results need to be further confirmed by large case studies or RCT studies.

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