Incidence of Retrocaecal Acute Appendicitis at the Hospital Sultanah Nora Ismail (HSNI) Batu Pahat

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ABSTRACT

Background: A surgical audit study among Batu Pahat population was conducted in determining the commonest position of appendix in post appendectomy.

Methodology: This is a retrospective study. A total of 204 cases of patients underwent an appendectomy admitted to the surgical ward from January 2017 until January 2018 at Hospital Sultanah Nora Ismail (HSNI) were audited retrospectively.

Results: This findings showed different figures of ascendancy in gender among patients who underwent an appendectomy with females 58.8% and males 41.2%. The perforation rate was 40.7% and delay in diagnosis was found to be 19.1%. The perforated appendix had a significantly higher incidence in males with a correlation of p-value 0.04. Retrocaecal appendix (RA) remained the commonest position for patients who underwent an appendectomy with 26.9%. RA is associated with an increased incidence of perforation (p-value 0.01).

Conclusion: The position of appendix in our patients who underwent an appendectomy is parallel to the reports available globally in that it is retrocaecal followed by retroileal as the commonest position among residence of Batu Pahat.

KEYWORDS:
Appendix position, perforated appendix, negative appendicectomy

INTRODUCTION

Batu Pahat is the second largest city after Johor Bahru in the state of Johor with a population of more than 400,000 people. The district hospital, also known as Hospital Sultanah Nora Ismail (HSNI), has a busy surgical unit with about 6,000 admissions a year with a total of 1200 emergency surgeries. About 1/6 of emergency cases are related to appendicitis.

The appendix is a worm-like structure located at the base of the caecum whose function is unknown but thought to play a role in immune reaction. Based on Bollinger et al. (2007), it may be a "safe house" or "storage tank" for commensal bacteria. However, its removal leaves no apparent functional deficit.[1] In the early 1900s, Gladstone and Wakely made the first comprehensive study of the position of an appendix in which the study was done on 3,000 anatomic dissections where they described the post-caecal and retrocolic position as the commonest in their study.[2]

Global literature states that more than 65% of the anatomical positions of the appendix is retrocaecal position, followed by paracaecal and the other positions of the appendix in different percentages. The variation of incidences has been reported regarding the positions of the appendix due to variations in ethnicity, sex, age, obesity, and seasons of the year. Based on the ambiguous idea that appendicitis is an irreversible progressive disease that may lead to complications such as perforation, consequently the removal of the appendix is the gold standard of treatment.[3-7]

Various studies were done in African countries, the Middle East, and European countries, shows different patterns of the position of the appendix. A previous study in Africa showed a wide variance in the positions of the appendix in autopsies. One of the first reports of appendix position in 125 Nigerian autopsies from West Africa reported retrocaecal and pelvic positions of 38.4% and 31.2% respectively.[8] Apart from that, 103 Zambian cadavers from East Africa studied in 1979 showed that pelvic position was ahead of retrocaecal position in which the data showed 43.6% and 20.3% respectively.[9] Nevertheless, another study in Serbia region of Balkan in which is a part of Southeast Europe, carried out in 2008 by Dejanlic et al. who evaluated 65 patients who underwent an open appendectomy reported that pelvic is the commonest position with about 57% while paracaecal as the slightest position with 3.07%.[10] A study in Iranian Cadavers, a part of Middle East countries, showed the anatomical positions were pelvic, subcaecal, retroileal, retrocaecal, ectopic, and preileal by 55.8%, 19%, 12.5%, 7%, 4.2%, and 1.5% respectively.[11]

This variance of anatomy may face a challenge during appendectomy because it may require the extension of a transverse incision or additional muscle splitting during surgery. These may cause difficultly during surgery in which prolongs the operating time and may affect the cosmetic outcome. Therefore, the perception of these variations is important for preoperative planning. To the best of our knowledge, there is no study from South East Asian countries concerning the positions of the appendix. Thus, the purpose of the study is to identify the common appendix positions in Batu Pahat population.

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METHODOLOGY

This surgical audit study was carried out at the surgical ward of the HSNI from January 2017 to January 2018. The data was collected retrospectively in May 2020 from post-operative notes of the study subjects that underwent the appendectomies. Pre-operative diagnosis of an acute or perforated appendix was made by the hands of surgical Medical Officers (SMO) with, on average, 6 month very intensive experience and surgeons. The appendectomies for this study subjects was performed by SMO at HSNI.

All patients who underwent an open appendectomy from January 2017 to January 2018 in the department of general surgery HSNI were included with a total number of 204 cases of patients. A central hospital database, which tracked all appendectomy performed for the indication of acute appendicitis or perforated appendicitis, was used to identify the cohorts of patients. The data collected included demographic data, types of operation performed, pre- and post-operative diagnosis, and the positions of the appendix. Histopathological findings were included in the sample collection. The diagnostic error was calculated based on the number of appendices removed without evidence of inflammation in histology findings. The detection rate of missed diagnosis was calculated based on patients diagnosed preoperatively with acute appendicitis then changed to perforated appendix post-operatively. The relationship between retrocaecal appendix and inflamed appendicitis at intraoperative findings was compared using a chi-square on computer software which is SPSS version 22.0.

RESULTS

Out of the 204 patients underwent the appendectomy, there were 84 (41.2%) male and 120 (58.8%) female patients. Age and gender distribution of the patients are summarized in Table I. The male to female ratio was 1:1.4. The age ranged between 5-73 years. The majority of patients were between 11 - 20 years (32.8%). The mean age of presentation was 26.3 years, the standard deviation of ± 13.4 years, and the median age was 22 years. The racial distribution of patients underwent an appendectomy at HSNI comprised of Malays being 160 patients (78.9%), Chinese 14 patients (6.9%), Indians 3 patients (1.5%), and others including non-Malaysians being 27 patients (12.7%). Patients with perforated appendix was found to have a higher incidence in the Malay population i.e. 66 patients, compared to other races including Chinese 5 patients, and non-Malaysians being 12 patients.

Pre-operatively, out of 204 patients, 71.6% (146 patients) were diagnosed with acute appendicitis whereas 27.4% (56 patients) were diagnosed with a perforated appendicitis.

Post-operative diagnosis

The post-operative diagnosis was sub-categorized into Acute Appendicitis (AA) being 115 (56.4%), Perforated Appendix (PA) as 83 (40.7%), and Non-Inflamed Appendices (NIA) as 6 (2.9%). In 115 patients with AA, 6 cases were found with other pathologies such as Right Twisted Ovarian Cyst (1 case), Carcinoid tumour (2 cases), Appendicular mass (1 case), Volvulus of Meckel's Diverticulum (1 case), and Perforated Prepyloric Ulcer (1 case). In 83 patients with a PA, 45 cases were found as suppurative appendicitis. For NIA, most of the post-operative diagnosis related to gynaecological causes such as pelvic inflammatory disease (1 case), right ovarian teratoma (1 case), and white appendix found in 6 cases. A higher incidence of perforation was found in male patients with a p-value of 0.04. The detection rate of missed diagnosis in patients diagnosed preoperatively as AA then changed to PA post-operatively were 39 patients (19.1%).

Diagnosis accuracy based on histopathologic finding

Overall, a total of 13 patients had NIA removed, giving a diagnostic error rate of 6.4%. This diagnosis rate calculation is based on Lee et al. (1993), a study which was done in Hospital Kuala Lumpur.[12] The details of the pathological findings in these patients are presented in Tables II. Of the 204 patients, 13 NIA confirmed histopathologically, 6 patients were diagnosed with AA postoperatively with other pathological conditions stated in Table II, another 7 patients were diagnosed with acute appendicitis post-operatively. White appendices were mostly presented in female patients which accounted for 11 cases and the other 2 cases were male patients. Retrocaecal remained the highest incidence of negative appendectomy (5 cases).

Position appendices and its relation

The commonest position was the retro-caecal position in 55 patients (26.9%), followed by the retro-ileal position in 53 patients (26%). Other positions were less common: pelvic in 42 patients (20.6%), subcaecal in 30 patients (14.7%), preileal in 15 patients (7.4%), paracaecal in 8 patients (3.9%), and subileal in 1 patient (0.5%). The commonest anatomical location for females was retrocaecal position by 36 cases (17.6%) and for males was retroileal by 24 cases (11.8%). However, no anatomical position of the subileal was observed in males. Table 4 shows the distribution of the positions of appendicitis and ages. The commonest position in our study was retrocaecal that presented a range of age 21 - 30 years old with 24 cases (11.8%), followed by the retro-ileal position with a range of age 11 - 20 years old by 22 cases (10.8%).

As for the relation between the position of appendices and histological findings, it was observed that most of the PA were in pelvic position by 11 cases (5.4%), followed by retroileal by 9 cases (4.4%), retrocaecal by 7 cases (3.4%), subcaecal by 6 cases (2.9%), paracaecal by 3 cases (1.5%), and preileal by 2 cases (1%). Most of the RA were presented with acute appendicitis with a value of 43 cases (21.1%). As shown in Table V, there is a significant relationship between the position of appendices and histological findings of a perforated appendix (p-value 0.007 i.e. < 0.05). Using the same value of Pearson's Chi-square towards gender and race, it also shows a significant p-value < 0.05. However, there is no relationship between position and age group with a p-value of 0.219.

DISCUSSION

Acute appendicitis is the commonest acute abdominal emergency in Malaysia. At the HSNI, it accounts for 17% of the total of 1200 emergency operations in the department of General Surgery. As reported in most publications, appendicitis is most frequently seen in young people. Persons

Table I: Distribution of age and gender of patients underwent appendectomy

Age (Years)	Gender		Total Count (%)
	Female	Male	
1-10	9	6	15 (7.4%)
11-20	43	24	67 (32.8%)
21-30	37	26	63 (30.9%)
31-40	13	11	24 (11.8%)
41-50	11	10	21 (10.3%)
51-60	6	6	12 (5.9%)
61-70	1	-	1 (0.5%)
71-80	-	1	1 (0.5%)
Grand Total	120	84	204 (100.0%)

Table II: Pathological characteristics of 204 patients who underwent the appendectomy for presumptive diagnosis of acute appendicitis

Distribution of patients according to histopathologic findings	n (%)
Positive appendectomy	191 (93.6%)
Acute appendicitis	102 (50%)
Acute appendicitis with impacted faecolith	11 (5.4%)
Acute suppurative appendicitis	36 (17.6%)
Acute suppurative appendicitis with perforation	38 (18.6%)
Unusual histopathological findings	4 (2%)
Carcinoid Tumour	1
Partial atresia	1
Fibrous obliteration	1
Villous adenoma	1
Negative appendectomy	
Other pathological condition without appendicitis	13 (6.4%)
Right twisted fallopian tube cyst	4 (2%)
Meckel diverticulitis	1
Pelvic inflammatory disease	1
Right ovarian teratoma	1
Distribution of patients with negative appendectomy according to age range	
12 - 20 y	3 (1.5%)
21 - 30 y	7 (3.4%)
31 - 40 y	3 (1.5%)

Table III: Results of preoperative clinical findings of the perforated appendix with HPE confirmed and sensitivity and specificity for the diagnosis of the perforated appendix

RESULT	Perforated appendix (HPE confirmed)	Non-Perforated appendix (HPE confirmed)
Pre-operative clinical diagnosis		
Perforated appendix	24	32
Non-Perforated appendix	14	134

* Sensitivity: 24/38 (63.2%), Specificity: 134/166 (80.7%), Positive predictive value: 24/56 (43%), Negative predictive value: 134/148 (90.5%)

Table IV: Association between positions of appendix and age

Age (Years)	Position							Total Count of Subject
	Paracaecal	Pelvic	Preileal	Retrocaecal	Retroileal	Subcaecal	Subileal	
1-10	1	3	-	6	3	2	-	15
11-20	2	16	5	11	22	11	-	67
21-30	2	11	4	24	16	6	-	63
31-40	2	5	-	9	4	3	1	24
41-50	1	3	2	3	6	6	-	21
51-60	-	3	4	1	2	2	-	12
61-70	-	-	-	1	-	-	-	1
71-80	-	1	-	-	-	-	-	1
Grand Total	**8**	**42**	**15**	**55**	**53**	**30**	**1**	**204**

Table V: Distribution of the cases based on the position of the appendix

Histological findings	Position							Total Count of Subject
	Paracaecal	Pelvic	Preileal	Retrocaecal	Retroileal	Subcaecal	Subileal	
Acute Appendicitis	5	28	13	43	41	22	1	117
Perforated Appendix	3	11	2	7	9	6	-	74
Non-Inflammed Appendicitis	0	3	0	5	3	2	-	13
Grand Total	8	42	15	55	53	30	1	204

of any age may be affected, with the highest incidence occurring during the second and third decades of life. In our study, the mean age of patients was 26.3 yrs. In this study, appendicitis occurred more frequently in females than in males, with a female-to-male ratio of 1.4:1 (58.8% females and 41.2% males), peaked in the 11-20-year age group (n:67, 32.8%). Unlike other studies, our study showed a difference in terms of gender dominance. Primatesta et al. (1994) showed a similarity with our findings concerning the greater number in female cases.[13]

A total of 104 cases (51%) out of the 204 total cases for pre-operative diagnosis matched with the post-operative for acute appendicitis and perforated appendix as 44 cases (21.6%). In contrast, 39 perforations were not diagnosed until after the operation, giving a detection rate of only 19.1%. This study showed that the sensitivity and specificity were 63.2% and 80.7% respectively. Based on a study done in Turkey by Cüneyt Kırkıl et al. (2013) and Konan et al. (2011), sensitivity and specificity values should be higher than 80%.[14,15] We calculated the sensitivity and specificity value based on histologically proved cases shown in Table III. The results showed that sensitivity was lower than 80% and thus, it does not have enough sensitivity. The results showed that the specificities of acute appendicitis were 80.7%. In addition, the results showed that if the patients were not diagnosed with perforated appendix, the perforated appendices will be negative in a larger number of patients. The positive predictive value was 42.9% whereas the negative predictive value was 90.5%.

As for our study, emergency appendectomy with normal appendix was more common in females and the average age of 26-year-old, as 11 (5.4%) out of 13 (6.4%) patients in this study were young females, similar to the findings of Primatesta and Moeed Iqbal et al. (1994 and 2000).[13,16] As reported in most studies, females contribute to most of the negative appendectomies due to the female anatomical and physiological differences that result in many differentials diagnosing of acute abdomen.[17,18] In our opinion, this group of young female patients of whom the diagnosis of acute appendicitis was not clear, should be admitted, monitored by serial examination, imaging, and diagnostic laparoscopy if available. This approach will lead to a decline in negative appendectomies. Zeilke et al. (1998)[19] has expressed similar views. Commonly encountered pathologies include ovarian torsion, haemorrhagic ovarian cyst, pelvic inflammatory disease, and ectopic pregnancy.

The groups that have difficulties in the diagnosis of acute appendicitis are children, young females, elderly of both genders, and pregnant ladies.[20] Apart from clinical assessments, imaging such as ultrasound or CT scan may be a benefit for these groups to reduce the rate of negative appendectomy and unnecessary exposure of surgical complications in atypical presentation for elderly in which appendicular mass or malignancy is suspected. However, in Malaysia, especially in the district hospitals, imaging is not recommended as a routine investigation to diagnose acute appendicitis where the clinical assessment is suggestive of acute appendicitis. If a patient is clinically diagnosed with acute appendicitis, they do not need to proceed with further investigations. Patients with acute appendicitis are still being managed without imaging with acceptable rates of negative appendicectomies and perforations.[21] However, based on Seetahal et al. and Marudanayagam et al. (2011 and 2006), the reported rates of histology-proven negative cases following appendectomy have ranged between 9.2% and 35%. Besides, the rates of negative cases are particularly high for women in the childbearing years.[22,23] The rate of negative appendectomy found in this current study (6.4%) is low compared to that in the published reports. This eventually shows our good clinical skills to diagnose an acute abdomen condition is proven by our low negative appendectomy rate. We hope in the future, careful decisions with the help of advanced technology should be made especially in patients where difficulties occur in diagnosing in order to create a harmonious health care environment.

In our study, the commonest type of appendix position was the retro-caecal position which was found in 55 patients (26.9%), followed by a retro-ileal position, in 53 patients (26%) and the lowest was subileal position in 0.5% of the total 204 cases. This finding was similar to the classic work of Wakeley (1933), which reported that the retrocaecal is the commonest position. Various studies taken from outside of Malaysia including the African countries, Middle East, European countries, and Hong Kong showed a different pattern of the position of the appendix. A study that is similar to our study is a study from West Africa done by Varshney et al. (1996) contrasting with other studies wherein the majority of appendices were located anteriorly or in pelvic positions. A study in Iranian Cadavers, apart from Middle East countries by Tofighi et al. (2013) stated that these differences may be due to many factors which include genetics, race, or ethnicity and lifestyle factors like nutritional regimens in determining the position of the appendix.[24] Nevertheless, retrocaecal appendices remain the most common position in females (n:36, 17.65%) and in males, while the commonest position was retro-ileal (n:24, 11.76%). As stated above, appendicitis is usually presented in the 21-30-year age group whereby the commonest appendix position was retrocaecal position (n:24, 11.76%), followed by retro-ileal position (n:22, 10.78%) at 11 - 20 years age group. This is shown in Table IV based on the association between the position of appendix and age among the studied people.

In the patients presented with acute appendicitis, most of the intraoperative findings were documented as retrocaecal as a

position of appendices (n:43, 21.08%). However, in the patients presented with a perforated appendicitis, the pelvic position remained the most position documented in the intraoperative notes. Clinically, in retrocaecal appendicitis, it is difficult to elicit tenderness on palpation in the right iliac region and even deep pressure may fail to elicit tenderness because the caecum, distended with gas, prevents the pressure exerted by the palpating hand from reaching the inflamed appendix, so it has been termed "silent appendicitis".[25] Retrocecal appendix has also been postulated to have high chances of gangrenous complications because their blood supply is more prone to kinking and more liable to inflammation when fixed retrocaecally.[26]

There are several limitations to this study. Our retrospective analysis of the suspected appendicitis who underwent appendectomy did not include the history and clinical examination to value the diagnosis that was made. This particular analysis can, therefore, not be compared to the published reports, and we are limited to the establishment of the diagnosis. To overcome this, a prospective rather than retrospective study, following up patients with suspected appendicitis who appendectomy may be required. For the purpose of statistical analysis, we classified each diagnosis into an acute or perforated group by evaluating the context and the wording of the report. Another limitation is the time-lapse from the diagnosis to the operation. However, it was rather disappointing to find that perforated appendix was not operated on earlier when compared to non-perforated cases. Delayed surgery could be due to the long operation theatre list. Limited operation time in theatres occur in district hospitals as surgeons are sharing one slot with other three departments including orthopaedics, obstetrics, and gynaecology. Furthermore, the diagnosis and surgeries were carried out by medical officers and there might be some errors in documentation of the position and initial diagnosis. Thus, we hope that this study will be as our future reference undertakings that would ameliorate the general surgery services in HSNI.

The initial approach of this audit focusing on the position of appendices as to the best of our knowledge, in Malaysia, we hardly found a study of position appendices in the Malaysian population. However, this audit was a single-centred and did not include the general population in Malaysia. We hope that this study will be a fore-runner for other studies.

CONCLUSION

The position of appendices in our study of 204 patients who underwent the appendectomy reflects the global reports that shows retrocaecal, retroileal followed by pelvic, as the commonest position among Batu Pahat population. The diagnosis of acute appendicitis was clinical. In equivocal cases, diagnostic error rate could be reduced if repeated examinations were performed and added imaging might be beneficial until more definitive signs were obtained before proceeding to do the operation. The audit began with an aim and this study also revealed some demographic features of acute appendicitis in our locality as well as highlighted the factors that could be useful in auditing clinical judgments. We agree that there is a need to improve the collection of clinical data, which will consequently improve the quality of care and management of the operated patients.

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REFERENCES

1. Bollinger RR, Barbas AS, BushEL, LinSS, Parker W. Biofilms in the large bowel suggest an apparent function of the human vermiform appendix. Journal of Theoretical Biology 2007; 249(4): 826-31.
2. Standing S, Ellis H, Healy JC, Johnson D, Williams A, Collins P. Alimentary System. 39th edition. New York, NY, USA: Churchill Livingstone; Gray's anatomy; 2005; 1189-90.
3. Wei PL, Chen CS, Keller JJ, Lin HC. Monthly variation in acute appendicitis incidence: a 10-year nationwide population-based study. Journal of Surgical Research 2012; 178: 670-6.
4. Oguntola AS, Adeoti ML, Oyemolade TA. Appendicitis: trends in incidence, age, sex, and seasonal variations in South-Western Nigeria. Annals of African Medicine 2010; 9: 213-7.
5. Petroianu A, Oliveira-Neto JE, Alberti LR. Comparative incidence of acute appendicitis in a mixed population, related to skin color. Arquivos Gastroenterol journal 2004; 41: 24-6.
6. Brink CF, Prinsloo H, van der Poel JS. The seasonal incidence of acute appendicitis. South African Medical Journal 1985; 68: 156-8.
7. Blanco FC, Sandler AD, Nadler EP. Increased incidence of perforated appendicitis in children with obesity. Clinical Paediatrics (Phila) 2012; 51: 928-32.
8. Varshney S, Jhonson CD, Rangnekar GV. Retrocaecal appendix appears to be less prone to infection. British Journal of Surgery 1996; 83: 223-4.
9. Wakeley CPG. The position of vermiform appendix as ascertained by the analysis of 10,000 cases. Journal of Anatomy 1933; 67: 277-83.
10. Denjalid A, Delic J, Delic-Custendil S, Muminagid S. Variations in position and place of formation of appendix vermiformis found in the course of open appendectomy. Medical Archives 2009; 63(2): 100-1.
11. Tofighi H, Taghadosi-Nejad F, Abbaspour A, Behnoush B, Salimi A, Dabiran S et al. The Anatomical Position of Appendix in Iranian Cadavers. International Journal of Medical Toxicology and Forensic Medicine 2013; 3(4): 126-30.
12. HY Lee, P Jayalakshmi, SH Syed Naori. Acute Appendicitis - The University Hospital Experience, Med J Malaysia Vol 48 No 1 March 1993.
13. Primatesta P, Goldcare MJ. Appendicectomy for acute appendicitis and for other conditions: an epidemiological stud. Int J Epidemiol 1994; 23: 155-60.
14. Cüneyt Kırkıl, Koray Karabulut, Erhan Aygen, Yavuz Selim Ilhan, Mesut Yur, Kenan Binnetoğlu et al. Appendicitis scores may be useful in reducing the costs of treatment for right lower quadrant pain. Ulus Travma Acil Cerrahi Derg 2013; 19(1): 13-9.
15. Konan A, Hayran M, Kılıç YA, Karakoç D, Kaynaroğlu V. Scoring systems in the diagnosis of acute appendicitis in the elderly. Ulus Travma Acil Cerrahi Derg 2011; 17(5): 396-400.

16. M.l. Qureshi and K.M. Durrani. Surgical Audit of Acute Appendicitis, Proceedings S.Z.P.G.M.I vol: 14(1) 2000; pp. 7-11.
17. Chandrasegaram MD, Rothwell LA, An EI, Miller RJ. Pathologies of the appendix: a 10-year review of 4670 appendicectomy specimens. ANZ J Surg 2012; 82(11): 844-7.
18. Yara F. Alhamdani, Hisham A. Rizk, Mohammed R. Algethami, Asma M. Algarawi, Roia H. Albadawi, Sofana N. Faqih et al. Negative Appendectomy Rate and Risk Factors That Influence Improper Diagnosis at King Abdulaziz University Hospital, Mater Sociomed. 2018; 30(3): 215-20.
19. Zeilke A, Hasse C, Sitter H, Rothmund M. Influence of ultrasound on clinical decision making in acute appendicitis: A prospective study. Eur J Surg 1998; 164: 201-9.
20. Blab E, Kohlhuber U, Tillawi S, Schweitzer M, Stangl G, Ogris E et al. Advancements in the diagnosis of acute appendicitis in children and adolescents. Eur J Pediatr Surg 2004; 14(6): 404-9.
21. Lionel I Wijesuriya. Imaging As An Aid To The Diagnosis Of Acute Appendicitis, Malays Fam Physician 2007; 2(3): 106-9.
22. Seetahal SA, Bolorunduro OB, Sookdeo TC, Oyetunji TA, Greene WR, Frederick W. Negative appendectomy: a 10-year review of a nationally representative sample. Am J Surg 2011; 201(4): 433-7.
23. Marudanayagam R, Williams GT, Rees BI. Review of the pathological results of 2660 appendicectomy specimens. J Gastroenterol 2006; 41(8): 745-9.
24. Shen GK, Wong R, Daller J, Melcer S, Tsen A, Awtrey S et al. Does the retrocaecal position of the vermiform appendix alter the clinical course of acute appendicitis? A prospective analysis. Arch Surg 1991; 126: 569-70.
25. I. Wani. "K-sign in retrocaecal appendicitis: a case series," Cases Journal, vol. 2, no. 10. 2009, article 157.
26. N. Williams, C. Bulstrode, P. R. O'Connell. Bailey & Love's Short Practice of Surgery, Arnold, London, UK, 25th edn, 2004; chapter 67.