

Diagnosis and Outcomes of Appendicitis Complicating Pregnancy in a Tertiary Care Centre-A 10 year Experience

VAIBHAV LONDHE, BEULAH ROOPAVATHANA, DIPTI LONDHE, ANU EAPEN, HESY YS, JIJI ELIZABETH MATHEWS

ABSTRACT

Introduction: Appendicitis in pregnancy is rare and its diagnosis is a challenge as the clinical presentation may be altered in pregnancy. Early diagnosis of appendicitis is vital for a favourable pregnancy outcome.

Aim: To study clinical features, radiological findings, surgical, histopathological and pregnancy outcomes in cases of acute appendicitis complicating pregnancy.

Materials and Methods: This retrospective study was conducted in Christian Medical College and Hospital, a Tertiary Care Centre in the Department of Obstetrics and Gynaecology, Tamil Nadu, India. We reviewed the medical records and computerized database of a large tertiary care center between January 2007 and December 2016 and retrieved 34 cases of appendicitis complicating pregnancy. During this period there were 1,23,938 deliveries in the Department of Obstetrics and Gynaecology and a total of 632 women had undergone appendectomy, in the Department of Surgery. The details of the demography, clinical presentation, lab investigations, imaging, surgical findings, treatment, pathology and pregnancy outcomes were assessed and collated from case notes. Standard clinical, radiological and laboratory diagnostic criteria were

used to establish the diagnosis of appendicitis.

Categorical variables were summarised as frequencies and percentages. Quantitative variables were summarised as mean and standard deviation for normally distributed variable or median and IQR for skewed variables. Diagnostic accuracy were given with 95% confidence interval.

Results: Mean gestational age at diagnosis was 18 weeks. Mean duration between onset of pain to admission was 1.77 ± 1.08 days. The average MANTRELS score comprising of symptoms, signs and laboratory findings was 5. Ultrasound imaging was done for all cases. Thirty two women underwent surgery. Two women were managed conservatively. Thirty one women had histopathological findings of the appendix. The sensitivity of ultrasound was 87% (95% CI: 66.4% - 97.2%), and specificity was 100%. The positive predictive value was 100% and negative predictive value was 40%.

Conclusion: Clinical judgment complemented with ultrasound imaging is optimal in diagnosis of appendicitis. Patients presented within one to two days of abdominal pain at a mean gestational age of 18 weeks. Most women had appendectomy within 2.5 days of onset of symptoms with favourable perinatal outcome.

Keywords: Abortion, Inflammation, Leucocytosis, MANTREL score, Right iliac fossa pain, Term pregnancy

INTRODUCTION

Diagnosing appendicitis in pregnant women is a challenge as it is rare and the presentation is non-specific. Pregnant women especially in the third trimester are less likely to develop appendicitis as compared to non pregnant women [1,2]. A population based study of over 7000 cases [2] of appendicitis in pregnancy showed a more severe clinical course in pregnancy with all the complications being more common when appendicitis was managed conservatively. Current

literature [2,3] has suggested that conservative management and delayed intervention is detrimental to both mother and foetus. Therefore, early recognition would become vital.

Classical signs and symptoms can be masked by the physiological and anatomical changes of pregnancy. Clinical assessment complemented with radiological findings would be the logical way of ensuring early diagnosis and intervention. The hallmark of the clinical presentation in appendicitis is abdominal pain which traditionally starts at the periumbilical region and

then migrates to the right lower quadrant. This is followed by nausea, vomiting and sometimes fever. In pregnancy the abdominal pain may be primarily on the right side but more in the middle or upper part of the abdomen due to the upward shift in the position of the appendix especially in the second and third trimester of pregnancy [4]. The gravid uterus may obscure rebound tenderness by preventing the proximity of the parietal peritoneum and omentum to the appendix. In the last decade, imaging has played a vital role in complimenting signs and symptoms for improved diagnosis of appendicitis in pregnancy. However, the gravid uterus could also interfere with visualizing the appendix on ultrasound especially in the third trimester of pregnancy [5]. Imaging is particularly useful in making an early, accurate diagnosis of acute appendicitis thereby reducing the negative appendicectomy rate [6].

Ultrasound is the initial preferred modality as it is safe, cheap and easily available.

CT has been shown to be an accurate modality for the diagnosis of acute appendicitis however it carries a risk of radiation induced teratogenesis and carcinogenesis [7].

MRI is a useful modality in the evaluation of acute appendicitis in pregnancy, when ultrasound findings are inconclusive. MRI evaluation involves the use of T1 and T2-weighted images. Use of gadolinium is not routinely recommended [8]. An appendiceal diameter of greater than 7 mm, an appendiceal wall thickness greater than 2 mm with high signal intensity luminal contents of T2 weighted images are the MRI criteria for diagnosis [8]. In specific conditions, where MRI is not feasible, use of CT with dose reduction techniques would be required.

Appendicitis is managed either conservatively or by surgery. Laparotomy or laparoscopy is performed either under spinal anaesthesia or general anaesthesia.

When the inflammation is limited to the mucosa or submucosa, the specimen may appear grossly normal. Sometimes, an excised appendix in the clinical setting of acute appendicitis is grossly and histologically normal, even after evaluation of the complete specimen. This may be because it is practice for women even with a negative laparotomy to undergo an appendicectomy, to prevent appendicitis and re-laparotomy in the future [9]. Thus, management of a case of appendicitis is by a multidisciplinary approach with the involvement of the obstetrician, surgeon and radiologist, with the pathologists confirming the diagnosis. Early diagnosis with the help of correct radiological tool is important for prompt diagnoses and management. It is also important for every tertiary centre to audit its performance to improve patient care. Hence, there was a need to study the clinical features, radiological findings, surgical, histopathology and pregnancy outcomes of all cases of acute appendicitis in the last 10 years in our institution.

MATERIALS AND METHODS

This was a retrospective study of all cases of appendicitis complicating pregnancy. All cases of appendicitis complicating pregnancy were retrieved from the medical records and computerized database of 10 years in a large tertiary care center. Approval was obtained from the Institutional Review Board (IRB) [IRB Min No:10457 (Retro) on 14.12.2016]. Since it was a chart review, we did not obtain consent from the patients. The inclusion criteria were, all cases of appendicitis complicating pregnancy irrespective of period of gestation or the mode of management. All cases in the postpartum period were excluded. Cases with incomplete data were also excluded.

We obtained 34 such cases between January 2007 and December 2016. During this period there were 1,23,938 deliveries in the Department of Obstetrics and Gynaecology and about 632 women had appendicectomy done in the department of Surgery. The details of the demography, clinical presentation, lab investigations, imaging, surgical findings, treatment, pathology and pregnancy outcomes were assessed and collated from case notes. The Alvarado score [Table/Fig-1] or Mantrels score at a cut point of 5 was also used to diagnose appendicitis [10].

Symptoms	Migration	1
	Anorexia-acetone	1
	Nausea-vomiting	1
Signs	Tenderness in right lower quadrant	2
	Rebound pain	1
	Elevation of temperature	1
Laboratory	Leucocytosis	2
	Shift to the left	1
Total		10

[Table/Fig-1]: Mnemonic for the diagnostic score of acute appendicitis: MANTRELS [10].

We took a cut off of 11,000 instead of 10,000 as described by Alfred Alvarado [10] in non-pregnant patients to foster in the physiological leucocytosis of pregnancy. On ultrasound, the technique of graded compression along caecal border was used to demonstrate a non compressible appendix and a width exceeding 6 mm was taken as incidence of appendicitis. Presence of fluid in the right iliac fossa, probe tenderness and evidence of peri-appendiceal inflammation was also used to diagnose appendicitis. Absence of dilated appendix was taken as a negative study. When the appendix was not visualized and if there was probe tenderness or presence of fluid and inflammation, the diagnosis was labeled as not clear. CT criteria for diagnosis of acute appendicitis were similar to ultrasound using appendicular thickening

greater than 6 mm in diameter or/and the presence of peri-appendiceal inflammation. An appendiceal diameter of greater than 7 mm, with wall thickness greater than 2 mm with high signal intensity luminal contents on T2 weighted images were the MRI criteria used for diagnosis [8].

Details of the histopathological examination of the specimen were available for 31 cases. Inflammation, serosal involvement, presence of gangrene, lymphoid hyperplasia and submucosal fibrosis were studied.

STATISTICAL ANALYSIS

Categorical variables were summarised as frequencies and percentages. Quantitative variables were summarised as mean and standard deviation for normally distributed variable or median and IQR for skewed variables. Diagnostic accuracy was given with 95% confidence interval.

RESULTS

The mean age of these women was 25 years [Table/Fig-2]. The mean gestational age at diagnosis was 18 weeks. Women presented to the tertiary centre between half a day to 4 days after the onset of pain with a mean duration of 1.77 ± 1.08 days. Majority of women had right iliac fossa pain 24/34 (70.5%) and tenderness in the right iliac fossa 25/34 (73.5%) but guarding and rebound was seen only in 20 of the 34 (58.82%) women included. Radiation of pain was seen only in 23.5% of women. The mean MANTREL Score [10] was 5. MANTREL score of 5 or more was seen in 71% of the cases. Leucocytosis of >10,000 was seen in 26 women >11,000 in 23 women and >14,000 in 19 women. Ultrasound imaging [Table/Fig-3] was diagnostic in 22 cases, not conclusive in 5 cases and was negative in 5 cases. Two women did not have imaging. Only

Baseline Characteristics	n (%)
Age (years) *	24.82 (4.72)
GA (weeks) *	18 (4.72)
Duration of pain (days) *	1.77 (1.08)
Right iliac fossa pain (Yes)	24 (70.5)
Pain – Radiation (Yes)	8 (23.5)
Nausea/Vomiting (Yes)	29 (85.29)
Tenderness in Rt iliac fossa	25 (73.5)
↑ Temperature	10 (29.41)
Leucocytosis	23 (67.65)
Shift to the left	5 (14.71)
Guarding and rebound in the right iliac fossa	20 (58.82)
MANTRELS Score (≥ 5 appendicitis possible)*	5.74 (1.94)
Admission to Surgery(days) †	0.50 (0.50, 1.00)
Symptoms to Surgery(days) †	2.00 (1.50, 3.50)

[Table/Fig-2]: Demography, Clinical and Lab. Findings.

Mean (SD)

† - Median (Inter Quartile Range - IQR) for skewed variables

one woman had an MRI. None of the women had a CT-scan. A peristaltic non compressible tubular blind structure ranging from 7 mm to 16 mm with fluid in the right iliac fossa was the most consistent finding. The mean diameter of the tubular structure was 9.7 (SD 2.7). In the 5 women that had a negative ultrasound study, all the features suggestive of appendicitis were absent. In the 5 women in whom the ultrasound findings were inconclusive, the appendix was not visualized. However, they had either fluid in the right iliac fossa or probe tenderness. Most of the women (27/34) had an open laparotomy [Table/Fig-4], five women had laparoscopic appendectomy and two women were managed conservatively. 19 women had surgery done under general anaesthesia, 13 women under spinal anaesthesia. Histopathological findings were available for only 31 cases [Table/Fig-5]. The appendix was perforated in 8/32 (23.5%) cases. Histopathology showed evidence of inflammation in 26/31 women and among them serosal involvement was seen in 25/31 cases and gangrene in three (9.7%) women, lymphoid hyperplasia in five (16.1%)

Ultrasound Diagnosis	n (%)
Positive for appendicitis	22 (68.70)
Negative for appendicitis	5 (14.70)
Appendix not visualized/ diagnosis not clear	5 (14.70)
Not done	2 (5.8)
Details of Radiological Findings	n (%)
Size* (mm)	9.7 (2.7)
Presence of Fluid	12 (36.4)
Probe tenderness	13 (39.4)
Inflammation	11 (33.3)

[Table/Fig-3]: Radiological findings.

* - Mean (SD)

Management	n (%)
Laparotomy	27 (80)
Laparoscopy	5 (14.7)
Conservative Management	2 (5.8)
Spinal Anaesthesia	13 (41)
General Anaesthesia	19 (59)

[Table/Fig-4]: Surgery and anaesthesia.

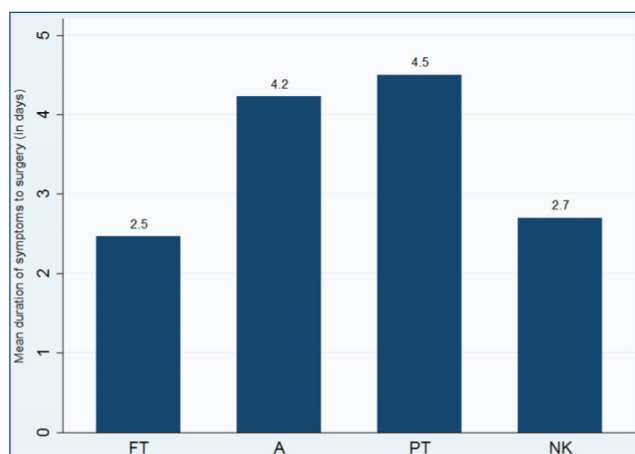
Pathological Findings	n (%)
Inflammation	26 (83.8)
Serosal involvement	25 (80.6)
Gangrene	3 (9.7)
Lymphoid hyperplasia	5 (16.1)
Submucosal Fibrosis	2 (6.4)

[Table/Fig-5]: Details of pathology.

women and submucosal fibrosis in two (6.4%) women. Thus, five women had no histological evidence of appendicitis. These women with a negative laparotomy had a MANTREL score ranging between 5 to 7. All these women had either a negative screen or diagnosis was not clear on ultrasound. Most women delivered at full term 23/34 (67.6%) [Table/Fig-6], four women had abortion, one had preterm labour and pregnancy outcomes were unknown for 6/34 (17.65%) cases. Shorter duration between onset of symptom and surgery was associated with favourable obstetric outcome [Table/Fig-7].

Outcome of Pregnancy	n (%)
Full Term	23 (67.6)
Preterm	1 (2.94)
Abortion	4 (11.76)
Unknown	6 (17.65)

[Table/Fig-6]: Pregnancy outcomes.



[Table/Fig-7]: Association between mean duration of onset of symptoms and surgery with pregnancy outcomes.

*FT – Full Term, A – Abortion, PT – Preterm, NK – Not Known

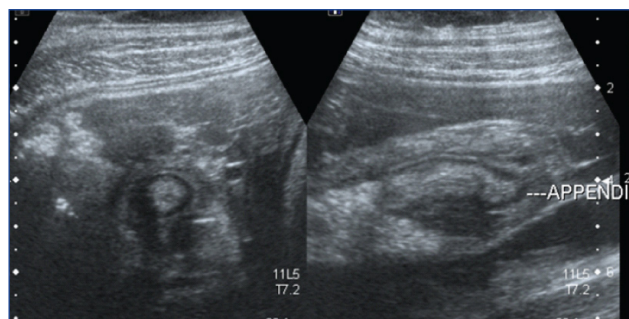
Ultrasound Diagnosis	Pathology - Positive	Pathology - Negative	Total
Present	20	0	20
Absent	3	2	5
Total	23	2	25

[Table/Fig-8]: Sensitivity and Specificity of ultrasound examination for appendicitis.

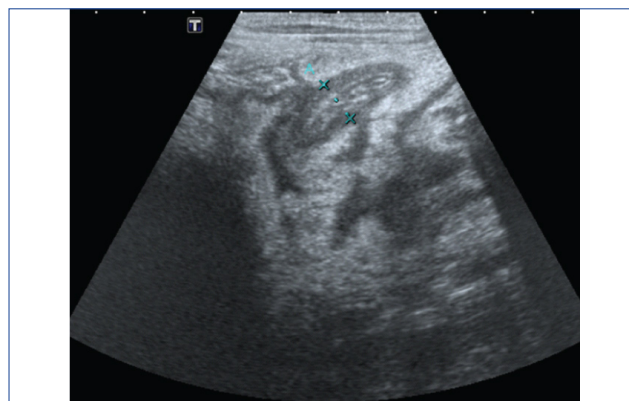
*Sensitivity = 87% (95% CI: 66.4% - 97.2%); Specificity= 100% (95% CI: 15.8% - 100%); Positive predictive value = 100% (95% CI: 83.2% - 100%); Negative predictive value = 40% (95% CI: 5.3% - 85.3%)

Out of the 22 women who were diagnosed as appendicitis by ultrasound, one was managed conservatively. Out of the 21 that were managed with appendicectomy, histopathology was available for 20 cases. All 20 women positive for appendicitis on ultrasound had evidence of appendicitis on histopathology.

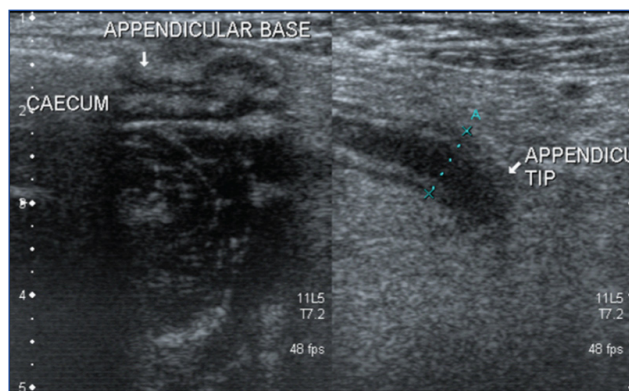
Out of the 5 women who were negative for appendicitis on ultrasound, 2 were negative for appendicitis on histopathology and 3 were positive for appendicitis. Out of the 5 women whose appendix was not visualized, one was managed conservatively, while four had appendicectomy. Three of them had normal appendix on histopathology and one had evidence of appendicitis. Thus, the sensitivity of ultrasound was 87% (95% CI: 66.4%-97.2%), and specificity was 100% (95% CI: 15.8%-100%). The positive predictive value was 100% (95% CI: 83.2%-100%) and negative predictive value was 40% (95% CI: 5.3%-85.3%) [Table/Fig-8-12].



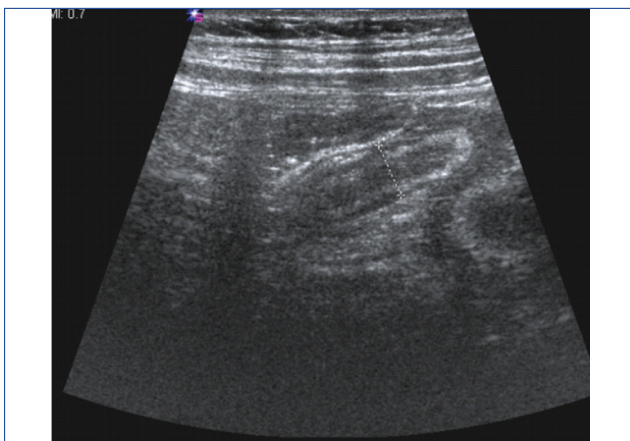
[Table/Fig-9]: Appendix seen as a blind ending tubular structure in the right iliac fossa with thickened wall.



[Table/Fig-10]: Appendix seen as a blind ending tubular structure in the right iliac fossa with thickened wall.



[Table/Fig-11]: Appendix seen as a blind ending tubular structure in the right iliac fossa with thickened wall.



[Table/Fig-12]: Appendix seen as a blind ending tubular structure in the right iliac fossa with thickened wall.

DISCUSSION

The incidence of appendicitis in our retrospective study was much lower than that quoted by most other studies [1,2]. This may be because all the cases of appendicitis were not identified from the database as computerization of clinical records was done mainly in the last 5 years. Moreover, since appendectomy is a simple surgery, it may have been performed in a primary or secondary care facility itself. However, the findings in our study were similar to most other studies [2,11]. A combination of clinical and ultrasound findings was used for diagnosis of appendicitis and only one case required an MRI. CT-scan was not used for diagnosis of any of the cases. The mean gestation age at diagnosis was 18 weeks as seen in many other series. Contrary to the long held belief [4], the right iliac fossa pain and tenderness in the right iliac fossa remain the most consistent finding in our study as was seen in other studies [12]. Nausea and vomiting was the other common symptom. Fever was an unusual finding and this is probably because women presented to us as early as 1-2 days after onset of pain. However, leukocytosis at a cutoff value of 11,000 was seen in almost 67.6% (23/34) of cases. The mean leucocyte count in women with proven appendicitis and in those with histologically normal appendices were 16,400 cells/ μ L and 14,000 cells/ μ L respectively in one other study [12].

History, clinical examination and lab tests to obtain the MANTREL score [Table/Fig-1] at a cut-off value of 5 was useful in 71% of cases. The mean MANTREL score in our series was 5.74 (1.94) and this was similar to that seen in the original study [10] in non-pregnant women. However, the MANTRELs score in the women with negative laparotomy ranged from 5 to 7 and so its use in pregnancy could be questionable. The MANTRELs score has not been studied extensively in pregnancy.

Ultrasound was useful in diagnosing 62.8% of cases in our

study and the diagnosis in the rest of the cases was based on clinical judgement. Thus, the sensitivity of ultrasound was 87% and specificity was 100% in this study and is comparable with the results of a previous review [13]. We did not use CT-scan in any of our cases. A meta-analysis by Hlibczuk V et al., showed a pooled sensitivity of 93% and pooled specificity of 96% of non contrast CT, in diagnosis of acute appendicitis in the non obstetric population [14]. Although, dose limiting techniques are available, guidelines from the American College of Radiology Appropriateness Criteria 2007 suggest that ultrasound and MRI are more appropriate techniques than CT for the evaluation of right lower quadrant pain in a pregnant woman to avoid ionizing radiation from CT [15].

In a multicentre retrospective study of MRI in pregnant patients with acute appendicitis, MRI had overall sensitivity, specificity and accuracy of 96.8%, 99.2% and 99% respectively [16].

Uneventful term delivery that went up to term was seen in almost 67.6% of cases and this may be because the mean duration from admission to surgery was as short as half a day. Our study as suggested by others [2,3] showed favourable outcomes when the duration from onset of pain to surgery was short. Only five women had appendectomy done by laparoscopy. Both, general or spinal anaesthesia were administered for surgery. The negative laparotomy in our study was 5/32 and this is similar to the 20% rate described in an earlier study [12].

LIMITATION

The limitation of our study is that it was a retrospective analysis of all cases. The number of cases was only 34. It is possible that some of the cases especially, the cases where the appendix was left behind in a negative laparotomy were not identified by us. Cases were identified from both medical records and the computerized clinical records. However, computerization was done only for 5 years. Therefore, there was a possibility that some of the cases were not found by us.

CONCLUSION

This retrospective study from a large tertiary centre of a developing country is important because it has confirmed that early diagnosis and treatment is paramount for optimum pregnancy outcomes. Pregnant women presented within 1-2 days of onset of pain at a mean gestation of 18 weeks. Our study did not find the MANTRELs score to be useful in pregnancy. It has also showed that the use of ultrasound complement clinical suspicion, with a low threshold for surgical management is sufficient for optimal results. We needed MRI in only one case and CT-scan was not used. Our study has shown that positive predictive value of ultrasound is as high as 100%. Therefore, acute appendicitis can be managed in most low resource settings even without a CT-scan and MRI facility.

However, management with multidisciplinary discussion with input from surgeon, radiologist and obstetrician would go a long way in optimal management. Strong clinical suspicion complemented with findings of ultrasound is optimum in ensuring early diagnosis and surgery thereby, preventing adverse pregnancy outcomes.

REFERENCES

- [1] Andersson RE, Lambe M. Incidence of appendicitis during pregnancy. *International Journal of Epidemiology*. 2001;30(6):1281-85.
- [2] Abbasi N, Patenaude V, Abenham HA. Management and outcomes of acute appendicitis in pregnancy-population based study of over 7000 cases. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2014;121(12):1509-14.
- [3] Vasireddy A, Atkinson S, Shennan A, Bewley S. Surgical management of appendicitis remains best option during pregnancy. *BMJ*. 2012;344:e3575.
- [4] Baer JL, Feis RA, Arens RA. Appendicitis in pregnancy with changes in position and axis of the normal appendix in pregnancy. *J Am Med Ass*. 1975;46(6):655-62.
- [5] Lehnert BE, Gross JA, Linnau KF, Moshiri M. Utility of ultrasound for evaluating the appendix during the second and third trimester of pregnancy. *Emerg Radiol*. 2012;19:293.
- [6] Rapp EJ, Naim F, Kadivar K, Davarpanah A, Cornfeld D. Integrating MR imaging into the clinical workup of pregnant patients suspected of having appendicitis is associated with a lower negative laparotomy rate: single-institution study. *Radiology*. 2013;267(1):137-44.
- [7] Forsted DH, Kalbhen CL. CT of pregnant women for urinary tract calculi, pulmonary thromboembolism, and acute appendicitis. *AJR*. 2002;178:1285.
- [8] Kanal E, Barkovich AJ, Bell C, Borgstede JP. ACR guidance document for safe MR practices. *AJR*. 2007;188:1447-74.
- [9] Neto F, Amorim MM, Nóbrega BM. Acute appendicitis in pregnancy: literature review. *Revista da Associação Médica Brasileira*. 2015;61(2):170-77.
- [10] Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann Emerg Med*. 1986;15(5):557-64.
- [11] Spalluto LB, Woodfield CA, De Benedectis CM, Lazarus E. MR Imaging evaluation of abdominal pain during pregnancy: appendicitis and other nonobstetric causes. *Radiographics*. 2012;32(2):317-34.
- [12] Mourad J, Elliott JP, Erickson L, Lisboa L. Appendicitis in pregnancy: new information that contradicts long-held clinical beliefs. *Am J Obstet Gynecol*. 2000;182(5):1027-29.
- [13] Williams R, Shaw J. Ultrasound scanning in the diagnosis of acute appendicitis in pregnancy. *Emerg Med J*. 2007;24(5):359-60.
- [14] Hlibczuk V, Dattaro JA, Jin Z, Falzon L, Brown MD. Diagnostic accuracy of noncontrast computed tomography for appendicitis in adults: a systematic review. *Ann Emerg Med*. 2010;55(1):51-59.e1.
- [15] Bree RL, Rosen MP, Foley WD. Expert Panel on Gastrointestinal Imaging. American College of Radiology Appropriateness Criteria. Right lower quadrant pain. 2007. http://www.acr.org/SecondaryMainMenuCategories/quality_safety/app_criteria.aspx.
- [16] Burke LM, Bashir MR, Miller FH, Siegelman ES, et al. Magnetic resonance imaging of acute appendicitis in pregnancy : a 5-year multiinstitutional study. *Am J Obstet Gynecol*. 2015;213:693.e1-6.

AUTHOR(S):

1. Dr. Vaibhav Londhe
2. Dr. Beulah Roopavathana
3. Dr. Dipti Londhe
4. Dr. Anu Eapen
5. Dr. Hepsy YS
6. Dr. Jiji Elizabeth Mathews

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Obstetrics and Gynaecology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.
2. Assistant Professor, Department of Surgery, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.
3. Assistant Professor, Department of Pathology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.
4. Professor, Department of Radiology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.

5. Senior Demonstrator, Department of Biostatistics, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.
6. Professor, Department of Obstetrics and Gynaecology, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Jiji Elizabeth Mathews,
Professor and HOU-5, Department of Obstetrics and Gynaecology, 7th Floor, ISSCC Building,
Christian Medical College and Hospital,
Vellore-632004, Tamil Nadu, India.
E-mail: coronistrial@yahoo.co.in

FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Publishing: Oct 01, 2017