

## EFFECTIVENESS OF ADJUVANT USE OF POSTERIOR MANUAL COMPRESSION WITH GRADED COMPRESSION IN THE SONOGRAPHIC DIAGNOSIS OF ACUTE APPENDICITIS

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### ABSTRACT

#### BACKGROUND

Diagnosing appendicitis by Graded Compression Ultrasonogram is a difficult task because of limiting factors such as operator-dependent technique, retrocaecal location of the appendix and patient obesity. Posterior manual compression technique visualizes the appendix better in the Grey-scale Ultrasonogram.

The Aim of this study is to determine the accuracy of ultrasound in detecting or excluding acute appendicitis and to evaluate the usefulness of the adjuvant use of posterior manual compression technique in visualization of the appendix and in the diagnosis of acute appendicitis

#### MATERIALS AND METHODS

This prospective study involved a total of 240 patients in all age groups and both sexes. All these patients underwent USG for suspected appendicitis. Ultrasonography was performed with transverse and longitudinal graded compression sonography. If the appendix is not visualized on graded compression sonography, posterior manual compression technique was used to further improve the detection of appendix.

#### RESULTS

The vermiform appendix was visualized in 185 patients (77.1%) out of 240 patients with graded compression alone. 55 out of 240 patients whose appendix could not be visualized by graded compression alone were subjected to both graded followed by posterior manual compression technique among that Appendix was visualized in 43 patients on posterior manual compression technique amounting to 78.2% of cases, Appendix could not be visualized in the remaining 12 patients (21.8%) out of 55.

#### CONCLUSION

Combined method of graded compression with posterior manual compression technique is better than the graded compression technique alone in diagnostic accuracy and detection rate of the vermiform appendix.

#### KEYWORDS

Appendicitis, Ultra Sonogram, Posterior Manual Compression.

**HOW TO CITE THIS ARTICLE:** Senthilnathan V, Gnanavelraja C, Arimapamagan A. et al. Effectiveness of adjuvant use of posterior manual compression with graded compression in the sonographic diagnosis of acute appendicitis. J. Evid. Based Med. Healthc. 2018; 5(6), 504-508. DOI:10.18410/jebmh/2018/102

#### BACKGROUND

The vermiform appendix is the smallest vestigial part of gastro intestinal tract. This contributes to the most common surgical emergencies in the world. The Sonographic visualization of the appendix is the sole indicator for diagnosing appendicitis.<sup>1</sup> The major factors contributing to continued high negative appendectomy rate have been the non specificity of clinical findings and lack of

a readily available technique allowing direct visualization of the appendix and identification of specific diagnostic features of appendicitis.<sup>2</sup> The most frequent causes for the decreasing quality of sonography imaging using a high frequency linear transducer in detection of vermiform appendix are poorly compressible right lower quadrant bowel structures and poor definition of the posterior aspects of the right colon in the obese or muscular body habitus as well as a retrocaecal appendiceal location in which the pertinent structures were located off the depth of view of the sonogram. Posterior manual compression technique using the left hand has been shown to reduce number of low quality sonography images. Posterior manual compression technique visualizes the appendix better in the Grey scale Ultrasonogram.<sup>3</sup>

*Financial or Other, Competing Interest: None.*

*Submission 04-01-2018, Peer Review 06-01-2018,*

*Acceptance 22-01-2018, Published 31-01-2018.*

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*DOI: 10.18410/jebmh/2018/102*



#### Aims-

The purpose of this study is to determine the accuracy of ultrasound in detecting or excluding acute appendicitis and

to evaluate the usefulness of the adjuvant use of posterior manual compression technique in visualization of the appendix and in the diagnosis of acute appendicitis.

**MATERIALS AND METHODS**

This prospective study involved a total of 240 patients in all age groups and both sexes (Figure 1). The mean age of patients in whom graded compression used alone was 26.8 years mean age of patients in whom graded followed by posterior manual compression used was 33.9 years (Table 1). All these patients underwent USG for suspected appendicitis. Pregnant patients were excluded from the study because posterior manual compression technique is not possible.

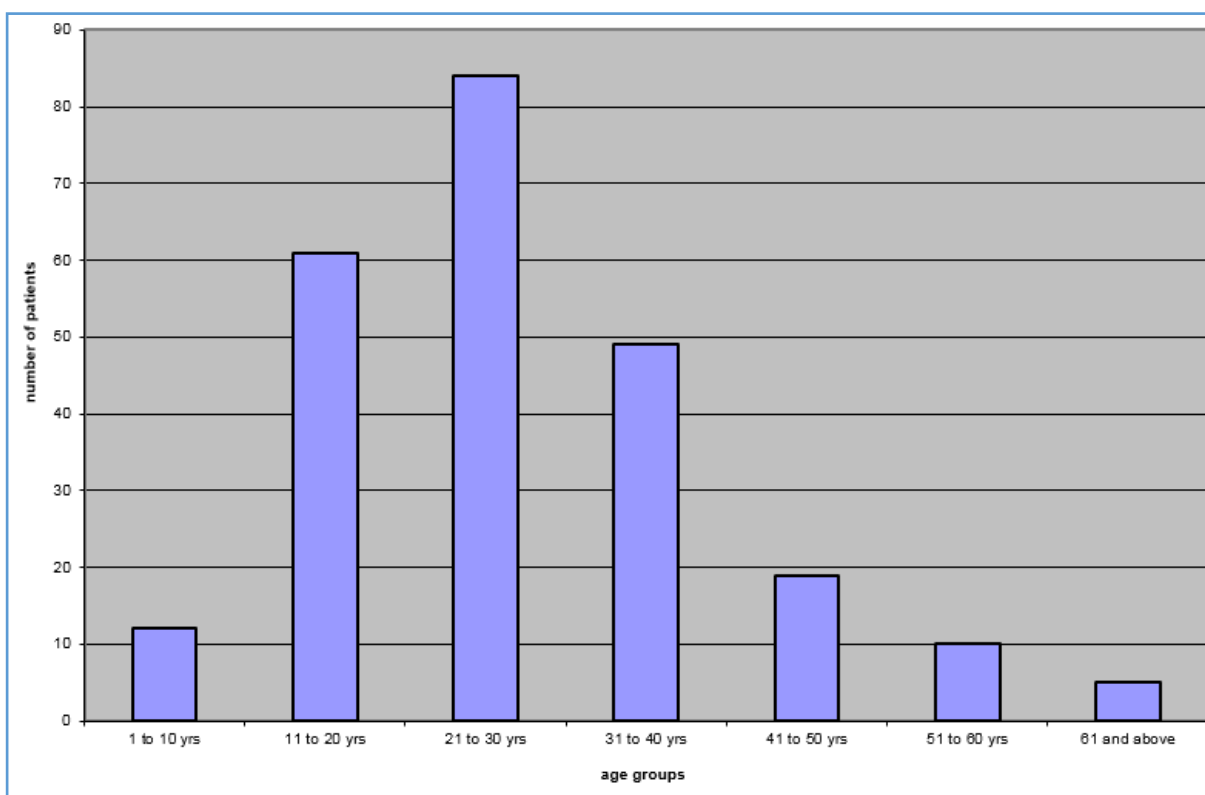
Ultrasonography was performed for all the patients included in the study using 5 MHz – 10 MHz linear transducer (TOSHIBA Just vision 400). All studies were done with transverse and longitudinal graded compression sonography. Graded compression sonography described by Puylaert is composed of anterior forced compression used to reduce the abdominal cavity between the transducer and the intra-abdominal pathology.<sup>1</sup> If the appendix is not visualized on graded compression sonography, posterior manual compression technique was used to further improve the detection of appendix. Posterior manual compression technique is composed of forced extrinsic compression of the opposite side of right lower quadrant in the anterior or anteromedial direction using four fingers of the left hand, thereby allowing the compression of posterior aspects of caecum or pericaecal space with or without anteromedial displacement of right lower quadrant

bowel structures onto the psoas muscle which helps in obtaining sufficient depth with high frequency probe and good spatial resolution<sup>4</sup> (Figure 2). Terminal ileum, ileocaecal valve, caecal pole and orifice of vermiform appendix were visualized during all the examinations. Axial appendiceal sections were imaged to differentiate the appendix from other compressible bowel loops. Establishment of sonographic diagnosis of acute appendicitis is based on the presence of a blind ending tubular structure of luminal diameter >6 mm, non-compressibility, aperistalsis and periappendiceal inflammation (Figure 3). A criterion for normal appendix was presence of blind ending tube with normal luminal diameter, compressibility and peristalsis. The diagnostic accuracy and the detection rate of appendix, sensitivity, specificity, positive and negative predictive values of both the sonographic techniques were calculated and compared.

**RESULTS**

Method used	Number of Cases	Mean Age	Std. Deviation
Graded compression	185	26.81	13.640
Graded followed by posterior compression	55	33.91	11.716

**Table 1. Age Distribution in Both Methods**



**Figure 1. Age Distribution of the Study Sample**

Sl. No.	Features	Probabilities for acute Appendicitis with Single use of graded Compression Sonography	Diagnostic accuracy for acute Appendicitis after Posterior manual Compression with graded Compression
		Results	Results
1.	Detection rate of vermiform appendix	185/240 = 77.08%	228/240 = 95%
2.	Cases of sonographic diagnosis of acute appendicitis	147/185 = 79.5%	173/240=72.08%
3.	True-positive results	133	159
4.	False-positive results	1	1
5.	True-negative results	9	9
6.	False – negative results	1	1
7.	Sensitivity	99.3%	99.4%
8.	Specificity	90%	91.7%
9.	Positive predictive value	99.3%	99.4%
10.	Negative-predictive value	90%	91.7%
11.	Diagnostic accuracy	82.55%	98.9%

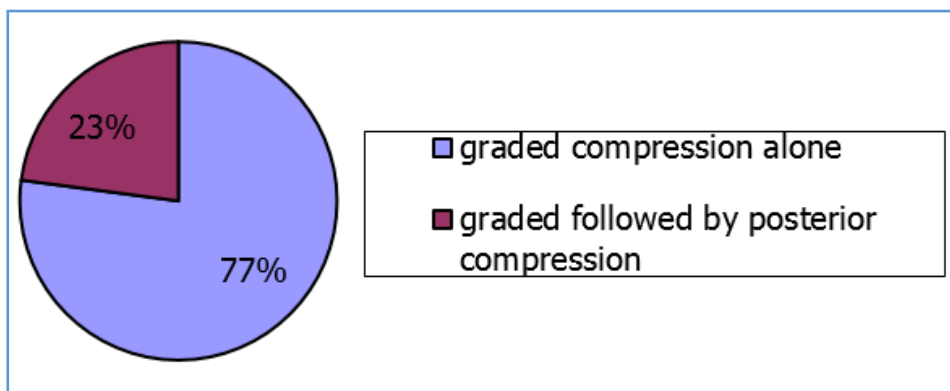
**Table 2. Statistical Comparison of Both Methods**



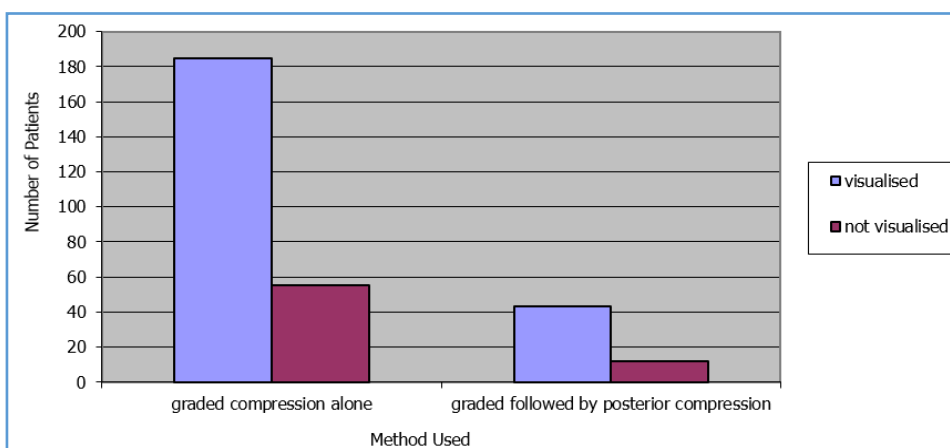
**Figure 2. Shows Anterior Graded Compression Sonography with Adjuvant use of Posterior Manual Compression Technique**



**Figure 3. Shows Visible Thickened Appendix by Posterior Manual Compression**



**Figure 4. Ultrasound Technique Used**



**Figure 5. Visualisation of Appendix by Graded and Posterior Compression Techniques**

## RESULTS

In our study, only graded compression was used in 77.1% of patients, graded followed by posterior manual compression technique was used in 22.9% of patients (Figure 4). In the total study population 139 were males and 101 were females. The technique of graded compression alone was applied in 63.2% of males and 36.8% of females whereas graded followed by posterior manual compression method was used in 40% of males and 60% of females. The vermiform appendix was visualized in 185 patients (77.1%) with graded compression alone. Appendix could not be visualized in the remaining 55 patients (22.9%) with this technique. 55 out of 240 patients whose appendix could not be visualized by graded compression alone were subjected to both graded followed by posterior manual compression technique among that Appendix was visualized in 43 patients on posterior manual compression technique amounting to 78.2% of cases, Appendix could not be visualized in the remaining 12 patients amounting to 21.8% (Figure 5). The detection rate of vermiform appendix by graded followed by posterior compression technique is higher (95%) than with graded compression alone (77.08%). Similarly, the graded followed by posterior manual compression technique is found to have a diagnostic accuracy of 98.9% which is higher than that of graded compression sonography alone (82.55%). Sensitivity, specificity, positive predictive value, negative predictive value in graded followed by posterior manual compression technique were 99.4%, 91.7%, 99.4%, 91.7% compare to graded compression sonography were 99.3%, 90%, 99.3%, 90% (Table 2).

## DISCUSSION

Though many investigative modalities are available for diagnosing acute appendicitis, ultrasound is the most widely available and cost-effective method. Graded compression sonography is a commonly using non-invasive imaging modality in right lower abdominal pathology. In 1986 Julien B.C.M. Puylaert described the value of graded compression sonography in the evaluation of 60 consecutive patients suspected of having acute appendicitis. In 25 (89%) of 28 patients, appendicitis was confirmed. The inflamed appendix was visualized by ultrasound. Perforation was predictable in six of seven patients. In 32 patients without appendicitis, it was not visualized. Puylaert's initial reports of success in diagnosis of acute appendicitis with compression sonography depended solely on visualization of the inflamed appendix, a blind ending aperistaltic tube arising from the tip of the caecum.<sup>1</sup> Monzer M. Abu Yousef et al, 1987 conducted a study on 68 patients with an equivocal clinical diagnosis of acute appendicitis. Ultrasonographic technique was found to be accurate in the diagnosis of acute appendicitis with a specificity of 95%, sensitivity of 80% and an accuracy of 90%. This study for the first time demonstrated the normal appendix using high-resolution sonography.<sup>5</sup> In 1992, Michel Rioux performed a prospective study of 170 patients

with suspected appendicitis to assess the value of sonography in detecting the normal and abnormal appendix. The sensitivity, specificity and accuracy of sonography was 93%, 94% and 94% respectively; positive predictive value was 86% whereas the negative predictive value was 98%.<sup>6</sup> Carlos J. Sivits et al, 1992 conducted a study including 180 paediatric patients with suspected appendicitis who were prospectively examined with graded compression ultrasonography to assess the sensitivity, specificity and accuracy of graded compression ultrasound in the diagnosis of appendicitis in children and to compare those results with results of clinical assessment in the diagnosis of this disorder. USG had a sensitivity of 100%; specificity of 97%, and accuracy of 97% in the two groups.<sup>7</sup> Gody SK et al, 1993 studied 98 children (42 boys and 56 girls, age range 2 to 12 years, mean age 8 years) with clinical signs and symptoms of acute appendicitis by means of ultrasound examination. Of the 82 patients who did not have appendicitis, ultrasound was negative in 68 with a specificity of 94%, the overall diagnostic accuracy was 91.8%. Acute appendicitis was diagnosed using ultrasound with a sensitivity of 85% and specificity of 94%, thus showing the same accuracy in children as has been reported in adults.<sup>8</sup> Wong ML et al, 1994 performed graded compression abdominal ultrasound examination which was 95% accurate far exceeding that reported for other imaging modalities. The sensitivity was 86%, the specificity was 98% and the positive and negative predictive values were 96% and 94%. A positive sonogram made the likelihood of acute appendicitis 50 times greater compared with the pretest clinical impression. In addition, the use of ultrasound permitted identification of other pathological conditions that manifest similar symptoms and signs. The authors concluded that with proper experience ultrasound can be extremely useful in assisting the surgeon to markedly reduce the number of unnecessary appendectomy procedures, without increasing the risk of perforation.<sup>9</sup> Somella L et al, 2000 in a study conducted on 183 patients, retrospectively found that graded compression ultrasound offered undeniable advantages using a non-invasive, low cost technique with a specificity of around 80% and a sensitivity between 85 and 95%.<sup>10</sup> The diagnostic accuracy, detection rate for the vermiform appendix, sensitivity, specificity, positive and negative predictive values for the diagnosis of acute appendicitis after the use of graded compression sonography alone in our study were almost equal to the previous studies.<sup>5-10</sup>

Lee et al<sup>3</sup> conducted a prospective study on patients referred for acute appendicitis by applying posterior manual compression technique. If the probabilities of Lee et al study with the use of graded compression alone were considered, the diagnostic accuracy, detection rate for vermiform appendix, sensitivity, specificity, positive and negative predictive values were 95%, 85%, 94%, 96%, 97% and 93% respectively, in our study the diagnostic accuracy, detection rate for vermiform appendix, sensitivity, specificity, positive and negative predictive values were 82.5%, 77.08%, 99.3%, 90%, 99.3% and 90%

respectively. When Lee et al used the posterior manual compression along with the graded compression, diagnostic accuracy, detection rate, sensitivity, specificity, positive and negative predictive values were 97%, 95%, 97%, 96%, 97% and 97%. In our study when we used the posterior manual compression along with the graded compression, diagnostic accuracy, detection rate, sensitivity, specificity, positive and negative predictive values were 98.9%, 95%, 99.4%, 91.7%, 99.4% and 91.7% which is almost similar to the previous study conducted by Lee et al. Which shows that graded compression sonography with adjuvant use of posterior manual compression gives better visualization of appendix and diagnosing appendicitis easier.

#### Limitations of our study

1. Pregnant women could not be included in this study because posterior manual compression technique could not be applied.
2. Appendices in the pelvis could not be visualized by applying posterior manual compression method because they are present below the level of iliac crest, thereby being subject to bony interference.

#### CONCLUSION

Combined method of graded compression with posterior manual compression technique is better than the graded compression technique alone in detection rate of the vermiform appendix, sensitivity, specificity, predictive values and diagnostic accuracy.

In conclusion, the adjuvant use of posterior manual compression with graded compression technique helps the anterior and posterior simultaneous compression of the right lower quadrant and increases the spatial resolution which helps in identifying the appendix without great difficulty.

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