

## Role of color Doppler imaging in borderline size appendix-Simple method to improve specificity for appendicitis.

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### Abstract:

#### Aims and objective:

To differentiate between the normal appendix from inflamed appendix on color Doppler imaging. Continuous intramural vascular signal measuring at least 3mm on color Doppler imaging is highly specific for appendicitis in borderline-size appendix.

#### Materials and method:

#### Equipment and Method:

All patients were scanned with a single ultrasound machine and 9–15-MHz transducers (GE Healthcare).

#### Study design:

Prospective study

#### Sample size:

50 patients referred to radiology dept with possible appendicitis from 2015 to 2017.

#### Source of the data:

Patients coming to the department of radio diagnosis at SSIMS & RC Davangere with a clinical history of pain and tenderness in RIF and all patients who had undergone graded-compression sonography for possible appendicitis and whose appendices were of diagnostically borderline size (6–8 mm maximum outer diameter).

#### Results:

Of the 50 patients, 17 had type 1 flow (of whom 3 had appendicitis); 13 had type 2 flow (of whom 11 had appendicitis); and 20 had absent flow (of whom 5 had appendicitis).

#### Conclusion:

Graded-compression US remains our first-line method in the evaluation of patients referred with clinically suspected acute appendicitis.

Type II flow (Continuous linear or curvilinear flow >3mm) within the wall of the appendix is highly specific, yet insensitive, for appendicitis in borderline sized appendix.

Type I flow (Punctuate dispersed signal) is neither sensitive nor specific for appendicitis and can be seen normal appendix.

### Introduction:

Appendicitis is one of the most common causes of abdominal pain of adult patients referred to the emergency department that requires prompt surgical intervention to minimize morbidity and mortality. Appendectomy is the most frequent emergent surgery performed worldwide<sup>[1, 2]</sup>.

Graded-compression sonography is the screening method of choice at our institution for imaging of suspected appendicitis.

The protocol includes long- and short-axis gray scale and color Doppler images of the appendix, obtained as static images.

Intramural vascular flow on color Doppler images was classified as

- Absent blood flow (Figure-1, 2).
- Type 1 (Figure-3, only Punctate and dispersed signal)
- Type 2 (Figure-4, 5. Continuous linear or curvilinear signal measuring at least 3.0 mm in long- or short-axis views).

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**Equipment and Method:**

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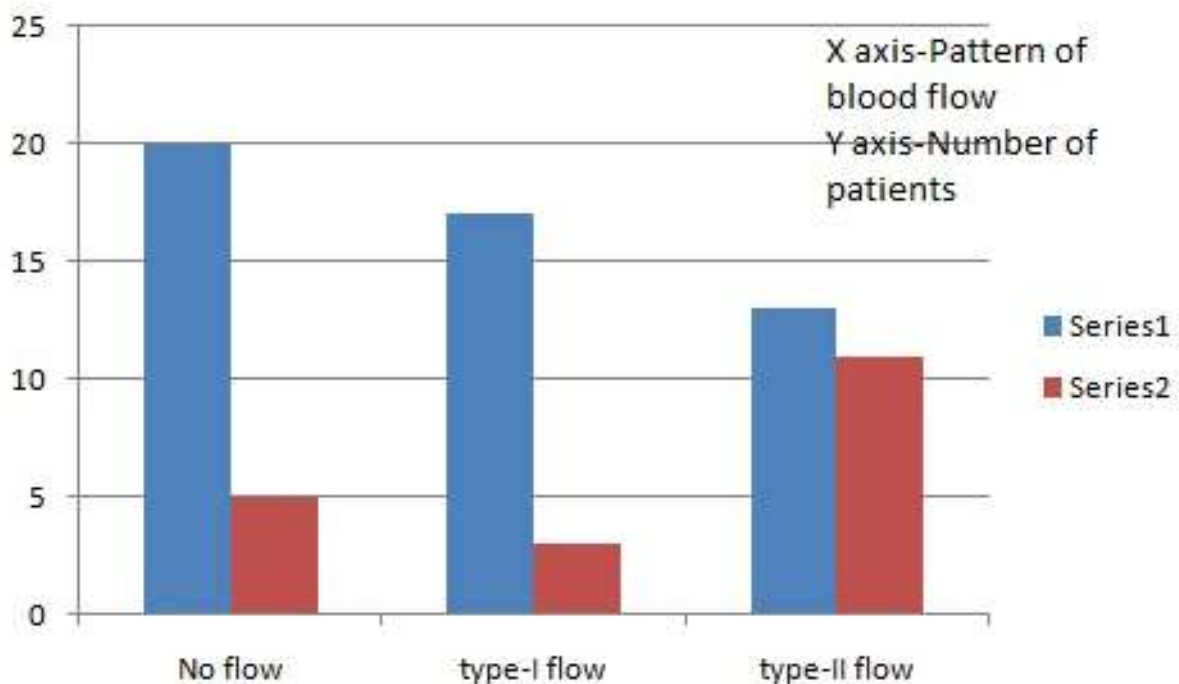
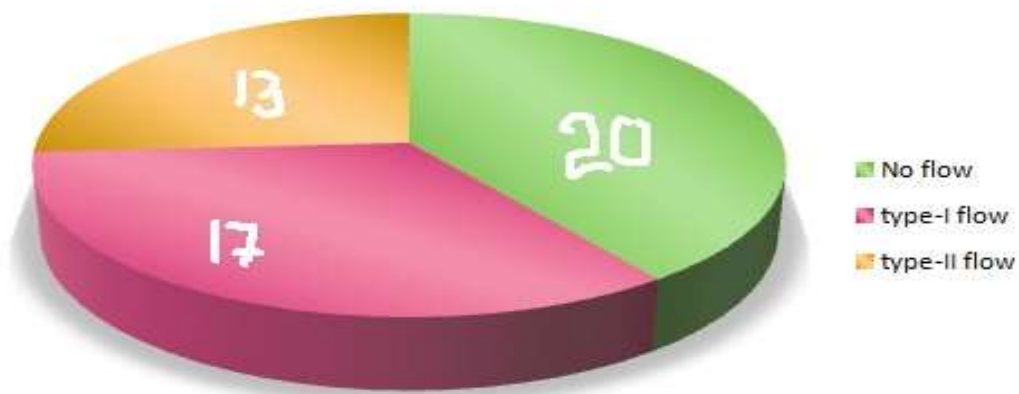
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**Appendicitis as Indicated by Appendiceal Intramural Colour Doppler Flow Patterns**



## Appendicitis as Indicated by Appendiceal Intramural Color Doppler Flow Patterns:

Parameter	Absent Flow	Type 1 Flow	Type 2 Flow
Total patients(50)	20(40%)	17(35%)	13(25%)
Sensitivity	28%	14%	57.1%,
Specificity	52%	52	94.9%,
Accuracy	46%	38%	80%

### Discussion:

Ultrasonography is most frequently used imaging modality, It was first introduced by Puylaert in 1986, who described the “graded compression” technique for better visualize the inflamed appendix<sup>[3]</sup> by using the graded compression technique,

A linear high-frequency transducer is placed on the right lower quadrant and pressure is applied gradually while imaging, displacing overlying gas-filled loops of bowel loops. Ultrasonography is safe (including during pregnancy) and relatively low-cost, and can be performed quickly and repeatedly, using portable equipment.

Ultrasonographic findings of acute appendicitis includes- Most important criteria is noncompressible appendices with a maximum outer diameter of less than 6 mm are generally considered normal, and those with a maximum outer diameter of greater than 8 mm are highly likely to have appendicitis<sup>[5-8]</sup>.

Other additive findings are peri appendicular inflammatory fat stranding, and echogenic appendicoliths. The inflamed appendix is less likely than the normal appendix to contain luminal air<sup>[4]</sup>.

In comparison to Computed tomography ultrasonography is inferior and has low sensitivity and low positive predictive values. But recently color Doppler and power Doppler examination of appendix has proven to be useful adjunct to improve the sensitivity by demonstrating increased flow in inflamed appendix<sup>[9,10]</sup>.

Appendices with intermediate maximum outer diameters (i.e., in the range of 6–8 mm) constitute a specifically problematic “borderline” category of appendicitis. Criteria such as an abnormal appendiceal color Doppler signal are helpful in establishing the diagnosis<sup>[10-12]</sup>.

Blood flow in the normal appendiceal wall was undetectable, therefore, any identifiable flow was considered to represent hyperaemia indicative of appendicitis. But with subsequent advancements in ultrasound technology intramural flow became visible in some normal appendices.

### Arterial anatomy of the appendix:

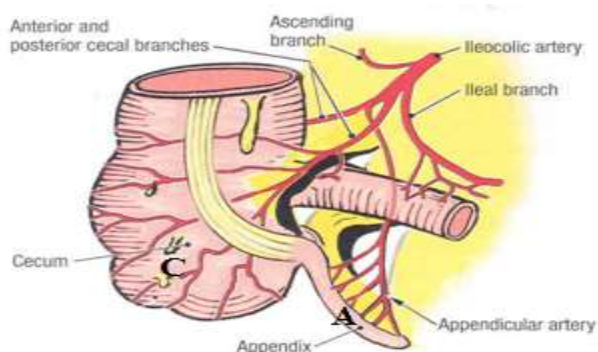
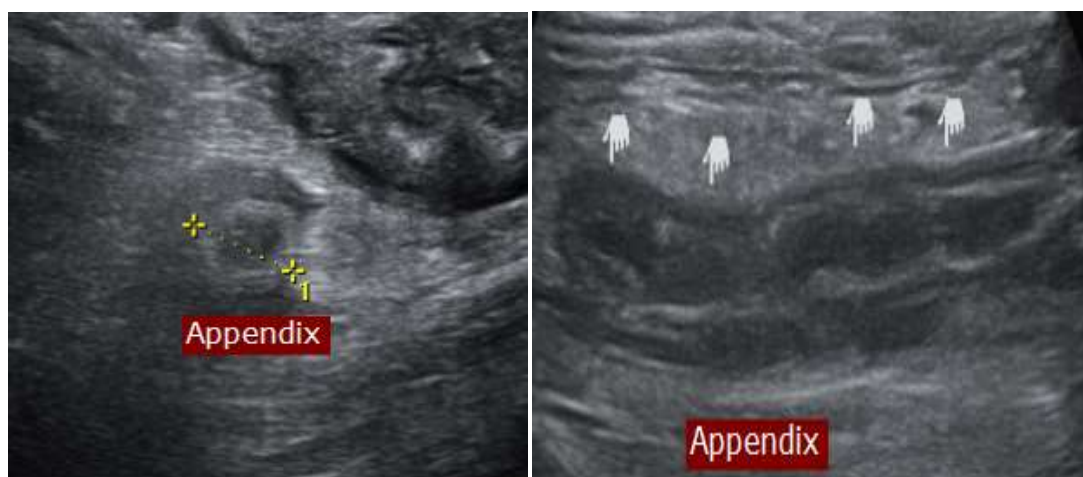


Figure-A

Appendicular artery traverses the mesoappendix and gives off multiple arcades that course within the appendiceal wall as the vasa recta. A indicates appendix; and C, Caecum.

**Figure-1.**

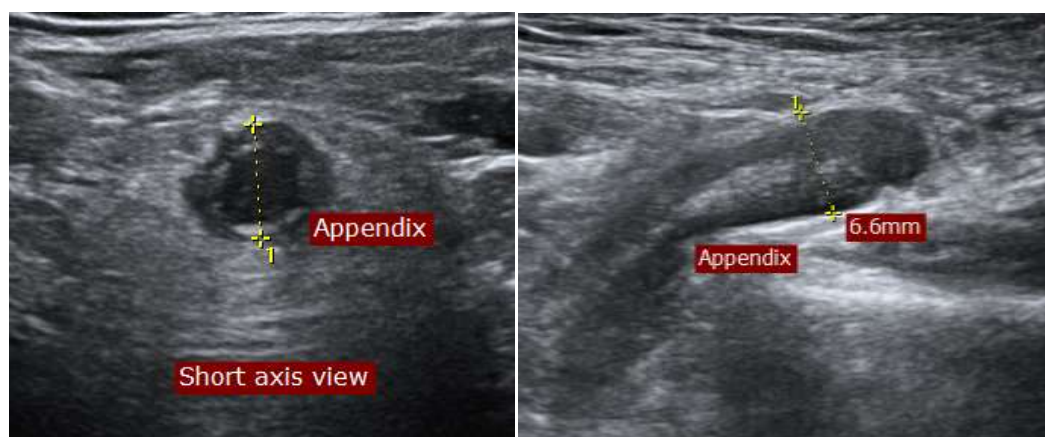


(A).

(B).

**Figure-1: Short axis (A) and long-axis (B) USG images of the appendix (arrows) shows enlarged, non compressible appendix with peri appendicular inflammatory changes.**

**Figure-2**

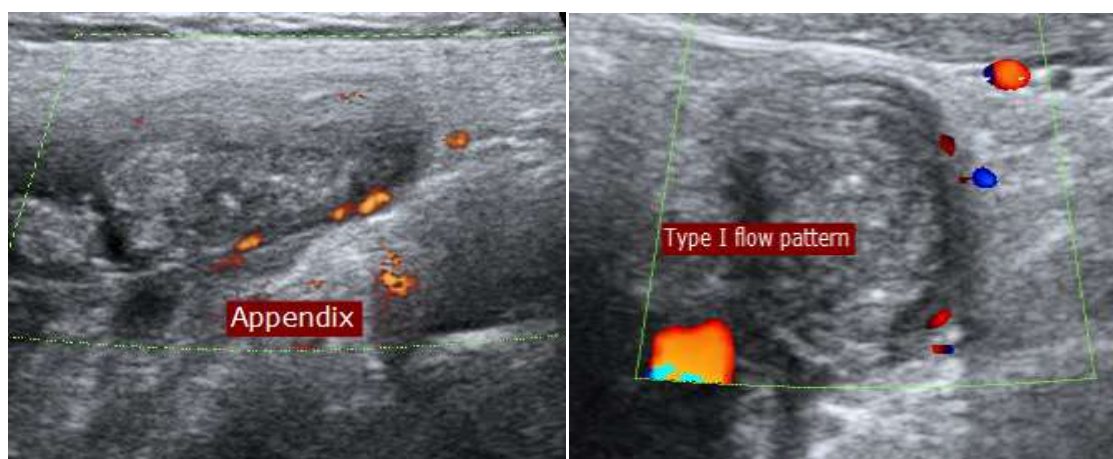


(A).

(B).

**Figure-2: Short axis (A) and long-axis (B) USG images of the borderline sized appendix with minimal peri appendicular inflammatory changes.**

**Figure-3**

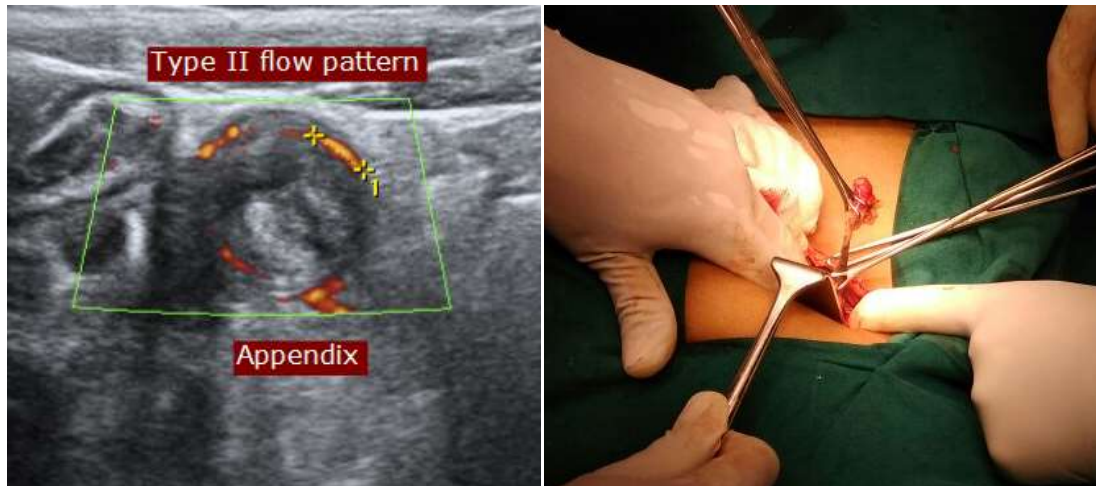


(A).

(B).

**Figure-3:** 25 year old male with h/o pain abdomen who had type 1 intramural flow. **A**, 25year-old male patient with histopathologically proven lymphoid hyperplasia and no evidence of acute appendicitis. Long-axis color Doppler image of the appendix shows multiple dispersed punctate signal foci (long arrow). The lumen of the appendix is filled with echogenic stool. Thickening of the hypoechoic lamina propria is shown, consistent with lymphoid hyperplasia. **B**, Same patient as in A, with a short-axis color Doppler image showing multiple punctate dispersed signal foci.

**Figure-4**

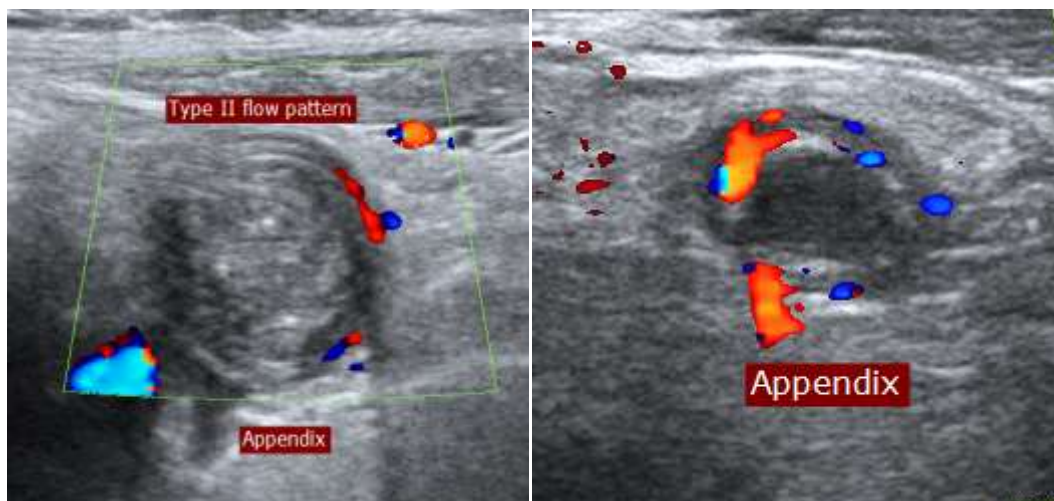


(A).

(B).

**Figure-4,** 40 year old male patient with histopathologically proven appendicitis. Short axis (A) power Doppler images shows curvilinear signal of greater than 3 mm in length. (B) Intra operative image of same patient showed inflamed appendix.

**Figure-5**

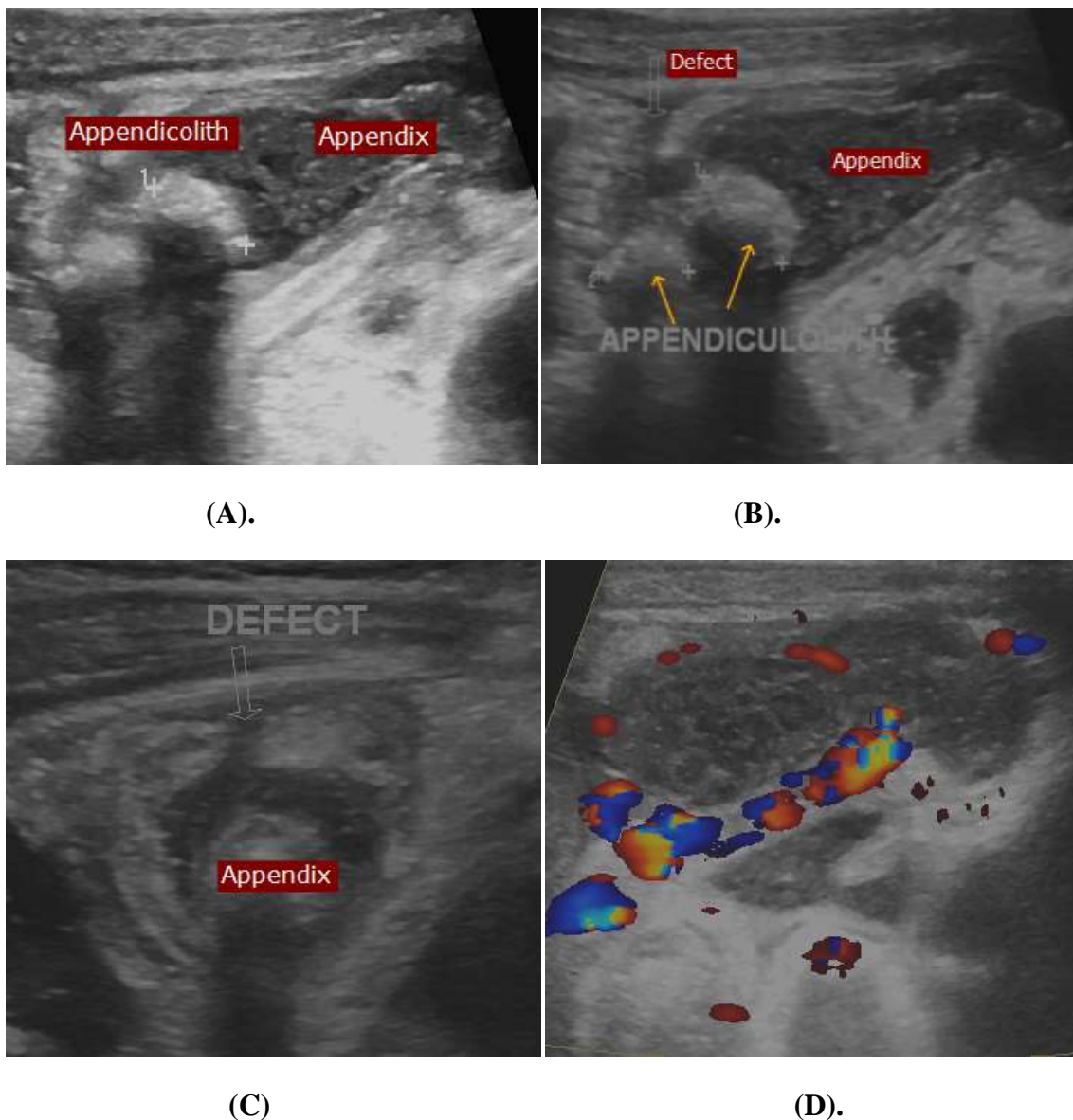


(C)

(D).

**Figure-5,** 25 year old male patient with histopathologically proven appendicitis. (C, D) Color Doppler image shows a curvilinear signal of greater than 3 mm in length, originating from an arcade vessel within the mesoappendix.

**Figure-6**



**Figure-6,** 4year old child with histopathologically proven appendicitis. Long axis(A,B) and short axis (C) USG image shows enlarged appendix with appendicoliths and defect in the wall of the appendix(Arrow) and peri appendicular inflammatory changes.(D) color Doppler image shows curvilinear signal of greater than 3 mm in length, originating from an arcade vessel within the mesoappendix.

**Conclusion:**

Graded-compression US remains our first-line method in the evaluation of patients referred with clinically suspected acute appendicitis.

Type II flow (Continuous linear or curvilinear flow >3mm) within the wall of the appendix is highly specific, yet insensitive, for appendicitis in borderline sized appendix.

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**References:**

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