



Is B-Flow USG superior to Color Doppler USG for evaluating blood flow patterns in ovarian torsion?



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ABSTRACT

Objective: Ovarian torsion is an uncommon gynecological emergency that most often affects women of reproductive age. Its signs and symptoms are similar to those of other abdominal conditions, which make its differential diagnosis challenging. Color Doppler (Doppler USG) and B-flow ultrasonography (B-flow USG) are used for the differential diagnosis of ovarian torsion, and in this study, we aimed to evaluate these two techniques, validate B-flow USG as the gold standard non invasive diagnostic tool in the early phase of an ovarian torsion, and show that the B-flow USG is superior to the color Doppler USG.

Materials and methods: Sixteen rabbits of the same age and weight were separated into 2 subgroups of 8. In Group I (sham group), right ovaries were fixated, and in Group II (torsion group), right ovaries underwent 720° torsion in a counterclockwise direction. At 1 h and 2 h of ischemia, both ovaries were measured by the two techniques, and an additional measurement was taken at 24 h to determine any changes in the left ovary due to the right ovary ischemia. Volume flow, peak systolic velocity (PSV), end diastolic velocity (EDV), resistive index (RI) and pulsatility index (PI) measurements were taken both with color Doppler USG (using a 12 MHz linear probe, General Electric Medical Systems Logic 7, Milwaukee, USA) and with B-flow USG.

Results: The right Doppler RI and PI values at 1 h were significantly higher than the right B-flow values ($p < 0.05$). The difference between the left B-flow RI and PI values and the left Doppler values at 1 h was not significant ($p > 0.05$), nor was the difference between the right B-flow RI value at 2 h and the right Doppler RI value at 2 h ($p > 0.05$). The right B-flow PI value at 2 h was statistically different from the right Doppler PI value at 2 h ($p < 0.05$), although the differences between the left B-flow RI and PI values at 1 h and 2 h and the left Doppler RI and PI values were not ($p > 0.05$). However, there was a significant difference between the RI values at 24 h ($p < 0.05$).

Conclusions: In this study, the decrease in blood reperfusion at 1 h measured by B-flow USG was apparently higher than that measured by Doppler USG. However, by the end of 2 h, the measurements were equal (see Fig. 3 and 4). In conclusion, B-flow USG reveals the decrease in the blood flow more distinctly in the early phase. Moreover, B-flow Doppler USG is more reliable and advantageous than color Doppler USG because it provides a more accurate preoperative evaluation of the unilateral and contralateral preoperative adnexial structures, and allows for a better assessment of blood flow in the ovarian torsion.

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Ovarian torsion is an uncommon gynecological emergency that constitutes approximately 2.7% of the gynecologic complaints in reproductive age women [1,2]. The most common causes of ovarian torsion, which occurs as a result of the rotation of the pedicle of the ovarian tissue, are inflammation and trauma [3]. Ovarian torsion often presents with nonspecific symptoms, including abdominal pain, cramps, moodiness, loss of appetite and hot flashes [1,4]. Because of these nonspecific symptoms, the differential diagnosis of the disease from other abdominal conditions is challenging. Previous studies have reported that

exploratory laparotomy, which is often performed based on conservative diagnostic methods, has a 56% false diagnosis rate [4]. Many studies have reported that a precise diagnosis can only be made by visual diagnosis during an invasive laparoscopy or laparotomy [1]. With the recent advances in the technology, the use of non invasive diagnostic tools is mandatory. In addition, it is very important to evaluate the pedicle blood flow and blood wall structure for the diagnosis of the disease in order to prevent unnecessary surgery. While color Doppler USG has been widely used for the differential diagnosis of ovarian torsion for the last 2 years, the recently introduced B-flow ultrasonographic imaging system appears to overcome the difficulties in the evaluation of blood flow and wall thickness. B-flow is a new technique that extends

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the resolution, frame rate and dynamic range of B-mode to simultaneously image blood flow and tissue [5,6].

In this study, we aimed to demonstrate the advantages of non invasive of B-flow USG over color Doppler USG for the diagnosis of ovarian torsion and for the definition of treatment strategies.

1. Materials and methods

After obtaining ethical approval from the local ethics committee, this study was conducted in Giresun University with 16 female New Zealand white rabbits of the same age and weight that were divided into two equal groups of 8 rabbits each. In Group I (the sham group), the right ovaries were fixated and evaluated by the same radiologist, using both color Doppler USG and B-flow USG. In Group II (the torsion group), right ovaries underwent 720° torsion in a counter-clockwise direction, thereby forming a model for 1 h and 2 h ischemic torsion, which was then evaluated by the same radiologist using both color Doppler USG and B-flow USG after 1 h and 2 h. The left ovaries were subjected to simultaneous measurements, which were also evaluated after 24 h to determine any changes that might have been induced by the right ovary ischemia.

2. Surgical procedure

Prior to the procedure, the abdominal area of each animal was cleaned and shaved. After the muscle relaxation occurred (induced by Fentanyl 0.2 mg/mL + fluanisone 10 mg/mL (Hipnorm®) + diazepam 0.3 mL

combination), the rabbits were laid on their backs, and a median lower abdominal incision was made in sterile technique. The ovaries and adnexial structures were fixated. Hipnorm (0.1 mL/kg intramuscular) was used for anesthesia maintenance at 30 min intervals.

3. Radiological examination

For the purpose of radiological examination, after the right ovary torsion, blood vessel diameters of right and left ovaries were measured (12 MHz linear probe, General Electric Medical Systems Logic 7, Milwaukee, USA), and color Doppler USG and B-flow USG imaging were performed for the evaluation of reperfusion. Using both techniques, volume flow, PSV (peak systolic velocity), EDV (end diastolic velocity), RI (resistive index) and PI (pulsatility index) values were recorded. Ovarian tissue and adnexial structures were assessed by B mode gray scale imaging. RI and PI were calculated with the following formulas, respectively: $RI = (PSV - EDV)/PSV$ and $PI = (PSV - EDV)/\text{mean velocity}$. The sonographic diagnosis of torsion is not straightforward in clinical practice. Due to the variable degree of torsion, findings on Doppler imaging are not steady. In Figs. 1 and 2, the comparative sonographic images of torsed/non-torsed ovaries with B-flow and color Doppler are provided.

4. Statistical analysis

All data were analyzed using SPSS 20.0 software. The software was used to obtain frequency and percentage distributions of the variables.

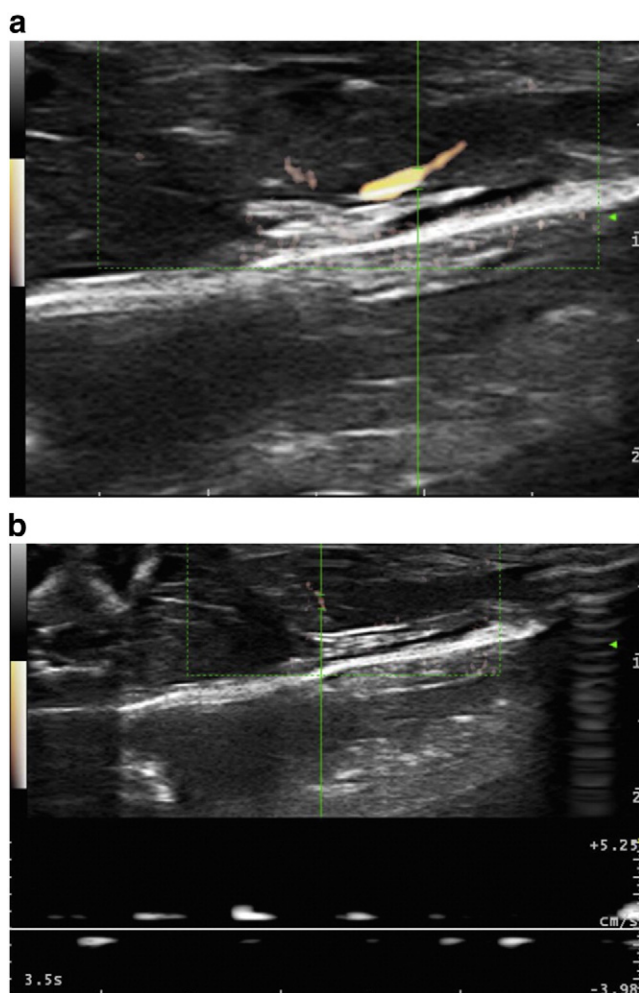


Fig. 1. a Non-torsed ovaries with B-flow. b Torsed ovaries with B-flow.

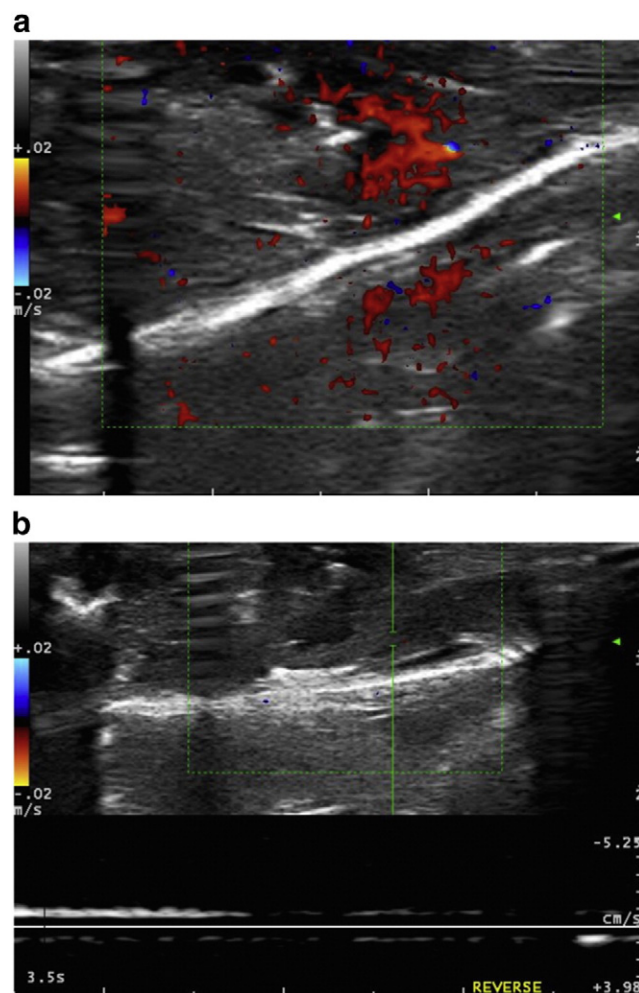


Fig. 2. a Non-torsed ovaries with Color Doppler. b Torsed ovaries with Color Doppler.

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