International Journal of Current Research and Review
DOI: http://dx.doi.org/10.31782/IJCRR.2020.135140

Research Article

IJCRR
Section: Healthcare
Sci. Journal Impact Factor: 6.1 (2018)
ICV: 90.90 (2018)
Scopus

Role of High Resolution Ultrasonography and Color Doppler in Evaluating and Distinguishing the Type of Inguinal Hernia

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ABSTRACT

Purpose: This study was carried out to assess the accuracy of ultrasonography in diagnosing and distinguishing the type of inguinal hernia, so that its use could be justified in the imaging of occult hernia or equivocal clinical examination findings.

Patients and Methods: This study included 64 patients with symptoms suggestive of inguinalhernia that prospectively underwent a blinded sonography examination of the inguinal region and found to have inguinal hernia on sonography as well, and who could be followed up till the surgical exploration. The findings of combined physical examination and high resolution ultrasonography were correlated with the intraoperative (surgical) findings.

Results: Sixty-four patients with symptoms of either groin pain or palpable groin bulge underwent ultrasonography of bilateral groin region. Of these patients, 6 went on to have bilateral inguinal hernia repair bringing the study total to 70 groins.The sensitivity of physical examination for indirect inguinal hernia in this study was 82.22% with 72% specificity and 84.09% positive predictive value and 69.23% negative predictive value. The hernial sac and the Inferior Epigastric Artery were successfully identified on every color Doppler sonography examination. The sensitivity of color Doppler ultrasonography for indirect inguinal hernia was 93.33%, the specificity was 80%, the positive predictive value was 89.36% and the negative predictive value was 86.96%. The overall accuracy of clinical examination in identifying the type of hernia correctly (direct vs indirect) was 78.57% while that of ultrasonography examination was 88.57%.

Conclusion: This study concludes that ultrasound with color Doppler sonography can accurately diagnose inguinal hernias and its type which justifies its use in the assessment of occult inguinal hernia and thereby allowing improved treatment planning.

Key Words: Groin, Inguinal Hernia, Color Doppler Ultrasonography, Inferior Epigastric Artery (IEA).

INTRODUCTION

Ultrasonography is an effective and established modality in diagnostic imaging.It is continuing to evolve further with the advent of newer clinical applications and the innovations in ultrasound technology. Ultrasonography has long been established as a reliable tool for diagnosing groin pathologies and demonstrates reasonable sensitivity and specificity as a non-invasive modality for the detection of groin hernias.[1]

In addition to all its advantages, color Doppler mode of ultrasonography enables assessment of vascular structures and blood flow and in assessing other complications associated with inguinal hernia.[1] In addition to its advantage of being non-invasive, ultrasonography allows dynamic examination of the groin.[2]

Diagnosing the type of inguinal hernia is important as evidence shows that direct inguinal hernia carries the only one-tenth risk of incarceration as that of indirect inguinal hernia.[1] Prevention and relief of incarceration and patient discomfort are the two main reasons for surgical intervention in cases of inguinal hernia. There is a higher risk of postoperative complications in elderly patients and so surgeons may not be keen to operate on elderly, asymptomatic patients with direct inguinal hernia to avoid the complications and associated morbidity.[1] Therefore, an exact preoperative distinction

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ISSN: 2231-2196 (Print) **ISSN:** 0975-5241 (Online)

Received: 08.06.2020 **Revised:** 30.06.2020 **Accepted:** 13.07.2020 **Published:** 21.07.2020

between direct and indirect inguinal hernia enables better planning of surgical treatment and overall outcome.[1]

This study was therefore conducted to demonstrate the role and accuracyof ultrasonography in evaluating and distinguishing the types of inguinalhernia.

PATIENTS ANDMETHODS

Patients

The present study was conducted in the Dept. of Radiology and Dept. of Surgery at Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre Hingana, Nagpur in collaboration with Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Wardha, India.

A total of 64 patients (irrespective of age and gender) with symptoms of either groin pain or palpable groin bulge were evaluated with ultrasonography between August 2016 and July2017. Of these, 6 patients were found to have bilateral inguinal hernias bringing the study total to 70 hernias. Prior to inclusion in the study, an informed, written consent was obtained from all patients. Patients with a femoral hernia and those who could not be followed-up until surgical exploration were excluded from the study.

Material

Ultrasonogram: Siemens Acuson X500.

High frequency Linear Array Transducer (5-10 MHz).

Physical examination

A physical examination of the groin region was performed in every patient with the patient standing and the physician seated facing the patient.[3] The groin area is examined in an oblique position with the patient, first at rest, and then while coughing. In order to differentiate between direct and indirect inguinal hernias, the coughing test was performed by introducing the forefinger into the inguinal canal through the superficial inguinal ring. An impulse transmitted to the fingertip was perceived as a sign of indirect inguinal hernia; if along the side of the fingertip, it was considered to be a sign of a direct inguinal hernia. The findings of physical examination were recorded and color Doppler sonography was then performed.

Color Doppler Ultrasonography

A high frequency linear transducer was used for sonography. An image of the inguinal canal was acquired along its longitudinal axis. The inguinal ligament was seen as a linear echogenic structure deep in relation to the subcutaneous fat blending with the deep fascia. Several hyper and hypoechoic linear structures, representing vessels, nerves, and cords were noted within the canal deep to the ligament. The canal was assessed with the patient at rest and during straining, coughing, and performing a slow and controlled Valsalva maneuver while maintaining light transducer pressure.

The criterion used for the ultrasonographic diagnosis of inguinal hernia consisted of the presence of a hernia sac along with its contents or a defect of the fascia with accompanying bulge on the Valsalva maneuver.[1] In some instances, the patient was reassessed in the standing position to confirm the signs. After identifying the hernial sac, the inferior epigastric artery was next identified.

The rectus abdominis muscle (lateral border), internal oblique muscle, transversus abdominis muscle, iliopsoas muscle, the os pubis, and the iliac and femoral vessels were the landmarks used to assist with orientation while locating the inferior epigastric artery.

The inferior epigastric artery is the most important anatomical landmark for the evaluation of groin on sonography. There is usually a vein running along either side of the artery (three vessels). The inferior epigastric vesselsoriginate from the external iliac artery and vein just superior to the inguinal ligament, curve in a 90-degree angle and pass anteromedially, piercing the back of the anterior abdominal wall. After crossing the medial border of the deep inguinal ring, they perforate the transversalis fascia and ascend between the rectus abdominis muscle and the posterior rectus sheath. The diameter of the inferior epigastric artery near its origin is approximately 3 mm.[1,4]

The findings of both physical examination and ultrasound examination were correlated with the intraoperative (surgical) findings and the hernia was categorized into direct or indirect type.

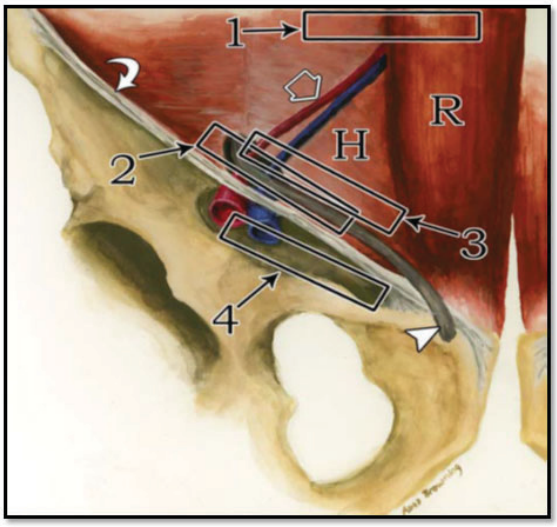

Figure 1: Illustration of man's right inguinal region from anterior view[5].

It depicts the position of the transducer to assess for spigelian hernia (1) which is an anterior abdominal wall hernia, indirect inguinal hernia (2), direct inguinal hernia (3), and femoral hernia (4). Locations of inguinal ligament (*curved arrow*), rectus abdominis muscle (R), lateral boundary of Hesselbach's triangle (H) defined by inferior epigastric artery (*open arrow*), and spermatic cord (*arrowhead*) are mentioned.

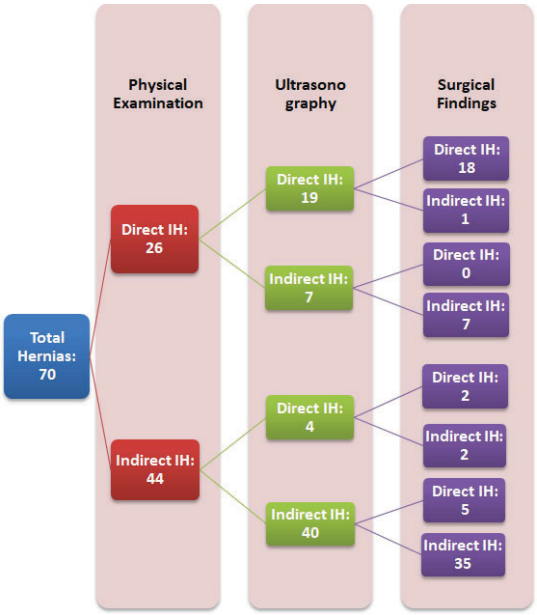

Figure 2: Grey scale and color flow image over the right rectus abdominis muscle in the infraumbilical region showing the inferior epigastric vessels (arrow) between the rectus sheath and posterior border of rectus abdominis muscle.

RESULTS

Out of 64 patients, 58 were males and 6 were females, aged between 1 and 83 years (mean± SD, 48.48±21.82 years). In 58 patients, unilateral hernias were diagnosed while 6 patients had bilateral hernias yielding a total of 70 hernias (n=70).

Intraoperative (Surgical) findings

Among the 70 hernias, 45 were indirect hernia and 25 were direct hernia.

Physical examination

Among the 70 hernias, 44 were identified as indirect hernia, of which 37 were confirmed by intraoperative findings (7 were diagnosed as direct hernia) and 26 were identified as a direct hernia, of which 18 were confirmed by intraoperative findings while 8 were diagnosed as an indirect hernia (Table 1). Analysis of the collected data showed 82.22% sensitivity, 72% specificity, the positive predictive value of 84.09%, and negative predictive value of 69.23% of physical examination for the diagnosis of indirect inguinal hernia.

Table 1: Results of physical examination for diagnosing the type of inguinal hernia.

Clinical Diagnosis	Surgical findings		
	Indirect inguinal hernia	Directinguinal hernia	Total
Indirect linguinal hernia	37	07	44
Direct inguinal hernia	8	18	26
Total	45	25	70

Color Doppler Ultrasonography

In this study, the authors were able to identify the hernial sac and the IEA in all patients. Among the 70 hernias, 47 were identified as indirect hernias and 23 as direct hernias. The findings of color Doppler sonography correlated with that of physical examination in 40 indirect hernias and 19 direct hernias.

Of the 47 indirect inguinal hernias detected by color Doppler sonography, 42 were confirmed on surgery while in 5 cases direct inguinal hernia was found. Twenty out of 23 direct hernias detected on color Doppler sonography were confirmed on surgery while 3 hernias were of direct type (Table 2). As per these values, color Doppler ultrasonography shows the sensitivity of 93.33%, the specificity of 80%, the positive predictive value of 89.36%, and negative predictive value of 86.96% for diagnosing indirect inguinal hernia. The sensitivity and specificity for diagnosing direct inguinal hernia were 80% and 93.33%, respectively.

Table 2: Results of ultrasonography for diagnosing the type of inguinal hernia.

Ultrasound Diagnosis	Surgical Findings		
	Indirect IH	Direct IH	Total
Indirect IH	42	5	47
Direct IH	3	20	23
Total	45	25	70

Table 3: Combined results of both physical examination and ultrasonography compared with surgical findings in diagnosing the type of inguinal hernia.

Clinical Diagnosis	Ultrasonography		Total%
	Correct diagnosis	Missed Diagnosis	
Correct diagnosis	53	2	55(78.57%)
Missed diagnosis	9	6	15 (21. 43%)
Total	62 (88.57%)	8 (11.43%)	70 (100%)

Out of 70 hernias, the type of hernia was correctly diagnosed on both clinical examination and ultrasonography in 53 instances. In the 2 instances, only clinical examination could identify the type of hernia correctly whereas in 9 instances only ultrasonography could identify the type of hernia correctly. In the remaining 6 hernias, both physical examination and ultrasonography wrongly predicted the hernia type. Thus, on physical examination, the hernia type was correctly identified in 55 (78.57%) hernias whereas, on ultrasonography, the type of hernia could be correctly identified in 62 (88.57%) instances.

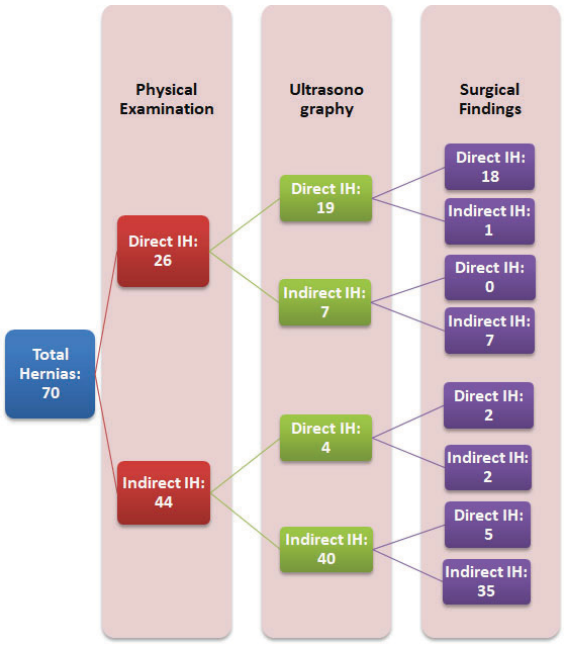

Figure 3: Combined Physical examination and Ultrasonography results of type of inguinal hernia

Indirect Inguinal Hernia (Long-axis view)

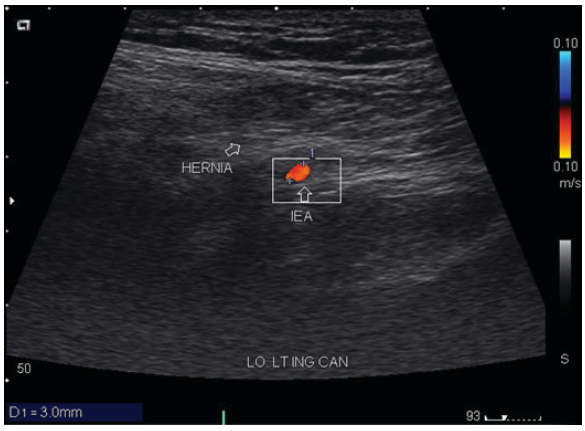

Figure 4: Long-axis image of indirect inguinal herniacontaining fat. The hernia is arising superior to the inferior epigastric artery (IEA).

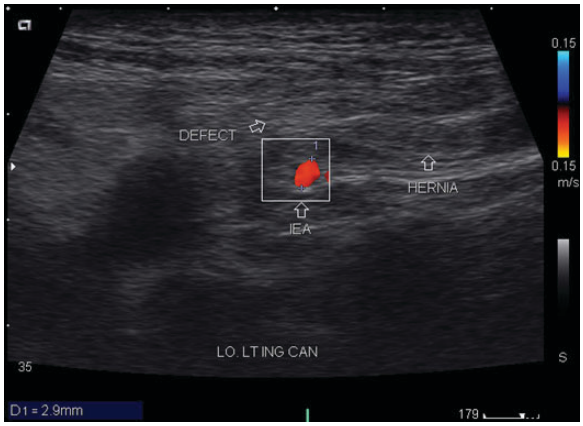

Figure 5: Long-axis image of indirect inguinal hernia containing omental fat. The hernial sac is arising superior to inferior epigastric artery (IEA).

Indirect Inguinal Hernia (Short–axis/Transverse view)

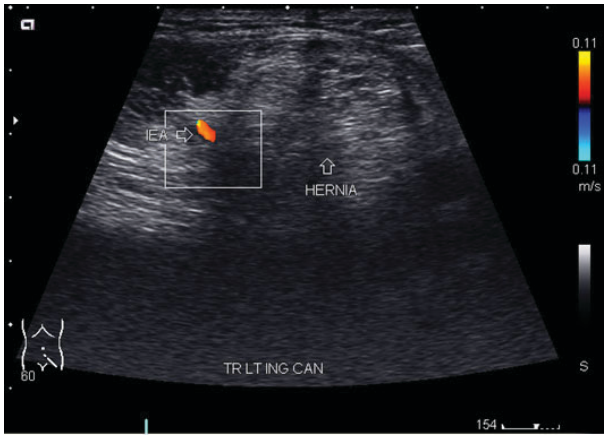

Figure 6: Short-axis (transverse) image of left indirect inguinal hernia containing bowel loops. The hernial sac is antero-lateral to the inferior epigastric artery (IEA).

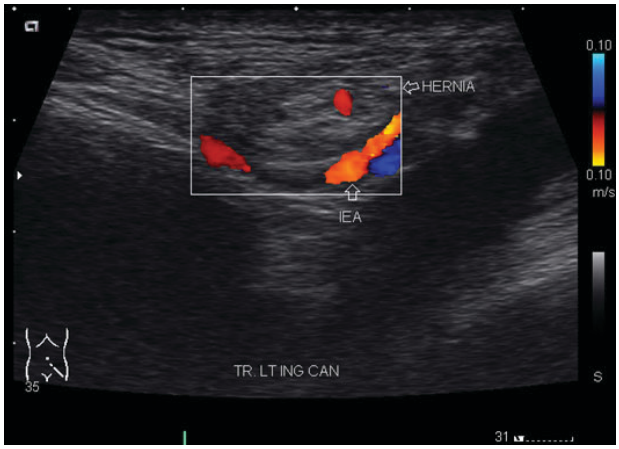

Figure 7: Short-axis (transverse) image of indirect inguinal herniacontaining omental fat. The sac is passing superior to inferior epigastric artery (IEA).

Direct Inguinal Hernia (Long-axis view)

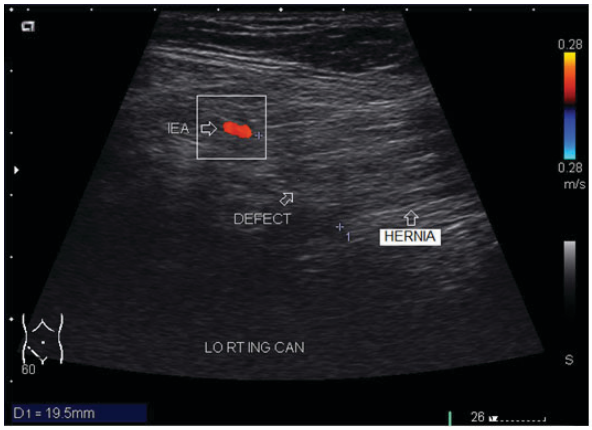

Figure 8: Long-axis image of direct inguinal hernia containing omental fat. The sac is arising inferior to IEA.

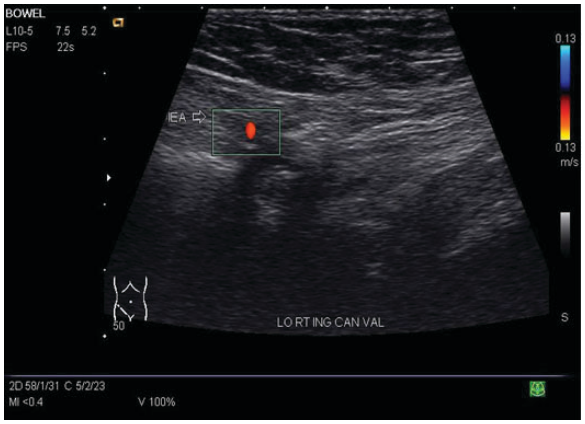

Figure 9: Long-axis image of direct inguinal hernia during Valsalva maneuver containing bowel loops. The sac is arising inferior to IEA.

Direct Inguinal Hernia (Short (transverse)-axis view)

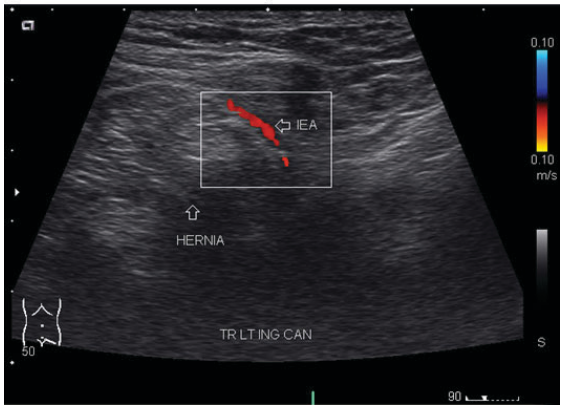

Figure 10: Short-axis image of left direct inguinal hernia containing bowel loop. The hernial sac is medial to the IEA.

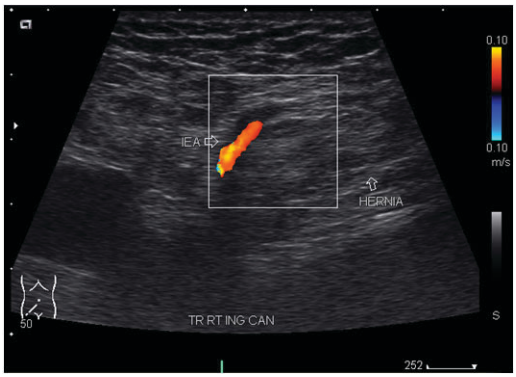

Figure 11: Short-axis image of right direct inguinal hernia containing omental fat. The hernial sac is medial to IEA.

DISCUSSION

Till recently, physical examination of the inguinal canal with a cough test was the only non-invasive way other than ultrasonography which could identify the type of inguinal hernia preoperatively. In a study by Korenkov M et al.[1] the sensitivity and specificity of physical examination for diagnosing direct inguinal hernia was 75% and 100% respectively. In the present study, the sensitivity and specificity of physical examination for diagnosing direct inguinal hernias was 72% and 82.22% respectively and that for indirect inguinal hernias was 82.22% and 72% respectively.

Of the 70 hernias, 43 had omentum as its content while 27 had bowel loops as its contents. Both direct and indirect inguinal hernias had omentum as its content more often than bowel loops. On ultrasonography, the hernia can be hyperechoic if omental fat is the content, anechoic if the sac contains only fluid and of mixed echogenicity due to air within bowel loops causing reverberations artefacts.[6]Ultrasonography has another advantage of real-time visualization of peristalsis in bowel loops.[6]

As the Inferior epigastric artery is used as a conduit in coronary artery bypass surgery, its Color Doppler ultrasonography is frequently done in cardiovascular surgery since the early 1990s.[3] But the role of Color Doppler ultrasonography to differentiate the type of inguinal hernia by identifying the inferior epigastric artery is recently being studied.

On Color Doppler ultrasonography, the hernia sac and the inferior epigastric artery could be identified in all 70 hernias although it was technically difficult in few cases. The inferior epigastric artery (IEA) may disappear while performing Valsalva maneuver as vascular structures are sensitive to motion during color Doppler imaging. This problem was more profound with hernias containing bowel loops.

Sixty-one hernias were found to be uncomplicated. The occurrence of complications in inguinal hernia was more common in indirect type as compared to direct type. The most

common complication was incarceration, found in 4 cases, the other complications being obstruction and strangulation.

The sensitivity and specificity of ultrasonography in detecting direct inguinal hernias in this study was 80% and 93.33% respectively, which are comparable with the other studies-Korenkov M et al.[1] (sensitivity 90%, specificity 86%), Babkova IV et al.[7] (sensitivity 71.1%), Bradley M et al.[8] (sensitivity 86%, specificity 97%).

When compared with the surgical findings, physical examination correctly predicted the hernia type in 55 out of 70 instances; whereas ultrasonography correctly predicted the hernia type in 62 out of 70 instances in the present study. Therefore, the overall accuracy of physical examination was 78.57% and that of ultrasonography was 88.57%.

CONCLUSION

Ultrasonography along with color Doppler sonography can help to assess the contents and complications associated with inguinal hernias. Furthermore, ultrasonography provides a higher degree of correlation with the intraoperative findings than physical examination in evaluating and differentiating the types of inguinal hernia which can help in deciding the treatment strategy. We, therefore, propose that color Doppler sonography should be routinely used.

Acknowledgement: Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Conflict of interest: Nil

Financial support: Nil

REFERENCES

1. Korenkov M, Paul A, Troidl H. Color duplex sonography: diagnostic tool in the differentiation of inguinal hernias. J Ultrasound Med. 1999 Aug; 18(8):565-568.
2. Alam A, Nice C, Uberoi R. The accuracy of ultrasound in the diagnosis of clinically occult groin hernias in adults. Eur Radiol. 2005 Dec; 15(12):2457-2461.
3. Amerson JR. Inguinal Canal and Hernia Examination. In: Walker HK, Hall WD, Hurst JW, editors. Clinical Methods: The History, Physical, and Laboratory Examinations. 3rd ed. Boston: Butterworths; 1990. Chapter 96. p.484-485.
4. Yoong P, Duffy S, Marshall TJ. The inguinal and femoral canals: A practical step-by-step approach to accurate sonographic assessment. Indian J Radiol Imaging. 2013 Oct-Dec; 23(4): 391-395.
5. Jamadar DA, Jacobson JA, Morag Y, Girish G, Ebrahim F, Gest T, et al. Sonography of inguinal region hernias. AJR Am J Roentgenol. 2006 Jul; 187(1):185-190.
6. Yang DM, Kim HC, Lim JW, Jin W, Ryu CW, Kim GY, et al. Sonographic findings of groin masses. J Ultrasound Med. 2007 May; 26(5):605-614.
7. Babkova IV, Bozhko VV. Ultrasound assessment in diagnosis of uncomplicated inguinal hernia. Khirurgiia (Mosk). 1999; (2):46-50.
8. Bradley M, Morgan D, Pentlow B, Roe A. The groin hernia—an ultrasound diagnosis? Ann R Coll Surg Engl. 2003 May; 85(3):178-180.