Original article:

Comparative study of high resolusion ultrasonography and magnetic resonance imaging in diagnosing traumatic knee injuries & pathologies

Dr. Rakesh Gujjar*, Dr. R. P. Bansal, Dr. Sandeep

Postgraduate student, Dept. of Radio-diagnosis, NIMS Medical College, Jaipur , Rajasthan
Dr. R. P. Bansal, Professor & HOD, Dept. Of Radio-diagnosis, NIMS medical College, Jaipur , Rajasthan
Dr. Sandeep Rao, Assistant Professor, Dept. Of Radio-diagnosis, NIMS Medical college, Jaipur, Rajasthan
*Corresponding author: Dr. Rakesh Gujjar

Abstract

Introduction: The purpose of this study was to evaluate & compare the sensitivity, specificity and accuracy of high resolution sonography in diagnosing the traumatic knee injuries & pathologies.

Materials and Methods: 90 cases with history of knee injury and symptoms of other knee pathologies, who were referred to department of radiology for HRUS or MRI were subjected to study. The age ranges from 10-70 yrs with exclusion of patients having metallic implants or any post-operative history. Prior to MRI and HRUS, a detailed history, clinical and local examination was done. HRUS was performed by using GE VOLUSON 730 PRO machine with high frequency probe (7-10 mHz) and MRI was performed on Siemens Magnetom C 0.3 Tesla machine using specific knee coil and standard protocol consisting of PDFS in axial, sagittal and coronal planes, T2W in sagittal plane and T1W sagittal plane were taken.

Results : The study revealed that the mean accuracy and specificity of high resolution HRUS in the diagnosis of both meniscal and cruciate injury is nearly equal to that of MRI. However, sensitivity of HRUS is lower compared to MRI. Therefore, it is preferable to use high resolution ultrasound as a preliminary investigation for diagnosis of various knee injuries & pathologies. For other pathologies like cystic lesions, hemangiomas etc. both HRUS and MRI had similar diagnostic accuracy, though few cases were missed on HRUS in our study.

Conclusions : If there is a patient with complaints of knee pain, limitation of joint movements with suspicion of meniscal injuries, cruciate ligament injuries or any other soft tissue pathologies around knee, we recommend with high resolution ultrasound examination as primary screening tool. MRI can be reserved for those cases where HRUS is equivocal, patients condition is not improving and preoperatively for detailed assessment.

Key words : HRUS, Knee pathologies, Knee ache, Cystic lesions

Introduction

Knee joint is the largest & most complex joint of the body. Because of lack of bony support, the stability of the knee joint is highly dependent on its supporting ligamentous structures. The vulnerability of the knee, to direct trauma makes knee injuries very common throughout life. Advances in technology, with high frequency ultrasound transducers, power doppler ultrasound and magnetic resonance imaging results in more accurate diagnosis of various knee injuries and pathologies.

Knee injuries are common in sports related activities. The most common causes of knee pain and disability are tears in medial or lateral menisci. Approximately two-thirds of all derangements of the knee joint are due to lesions or degenerative changes of the Menisci

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[1,2,3]. Other causes include degenerative joint conditions, infections, inflammatory conditions, and congenital lesions[4]. Preliminary clinical examination is most important for the diagnosis of knee injuries and various pathologies, although painful stress examinations are not always accurate in the acute phase of the injury. For this reason, imaging plays an important role in exact diagnosis of various pathologies or injuries and their grading. *High Resolution ultrasonography (HRUS)* is a sensitive method for diagnosis of knee injuries & other pathologies. It is non-invasive, freely available, well accepted by patients, affordable and provides dynamic evaluation in real time[5]. It is very helpful technique to obtain a clear anatomical overview of the superficial structures around the bones.

Injured ligaments appear swollen with mixed echogenicity. Ultrasound shows synovial thickening and effusion in inflammatory arthropathy and erosions of the articular surface in degenerative arthritis. Joint effusions, synovial thickening, bursal fluid collections, intra-articular loose bodies, ganglion cysts, ligament and tendon tears, tendonitis and occult fractures can be diagnosed by HRUS. Power Doppler is also done wherever it is required. With experience, HRUS is a time-efficient and economical imaging tool for assessment of the knee.

MRI in the 1980s, MRI has revolutionized cross sectional imaging of the musculoskeletal system and has become the most widely used technique for a wide variety of pathologic conditions[6]. It is the gold standard imaging technique for evaluation of various pathologies & injuries to intra-articular structures of the knee as well as extra articular ligaments. MRI is a completely non-invasive diagnostic modality. Past two decades have shown that MRI is a highly sensitive and specific test for diagnosing a variety of knee pathologies, including meniscal tears and ligament injuries. However, while MRI was gaining its ascendancy, ultrasonography was also being used for musculoskeletal imaging, which is an important complementary tool, and there is now a large body of literature documenting the effectiveness of musculoskeletal sonography [6].

Material and methods

Study type : Prospective study.

Study Duration : 1st Jan14 – 30th Mar15.

Study size : 90 cases.

Inclusion criteria : Pts. Of both sex with age range of 10-70 years, who were clinically diagnosed or suspected cases of knee injury or other pathologies.

Exclusion criteria :

- Patients with metallic implants and claustrophobia.
- Patients with known past history of knee surgeries and inflammatory joint pathologies.
- Patients aged below ten years and above seventy years.

Findings of specific local examination of injured knee were recorded in detail and a clinical diagnosis was established in all the cases. On clinical examination various tests were done after taking thorough history. In case of meniscal tears McMurray test and Apley grinding test were done and in case of ACL & PCL disruption Lachman test and Drawer test were done. For any swelling, mass or other pathology full examination of knee joint was done. HRUS and MR films were assessed by a senior radiologist and findings were registered.

HRUS Technique :

Knee joint and surrounding soft tissue are examination carried out on Volsuon 730pro machine by high resolution probe. For scanning menisci medial, lateral and posterior approaches are used.

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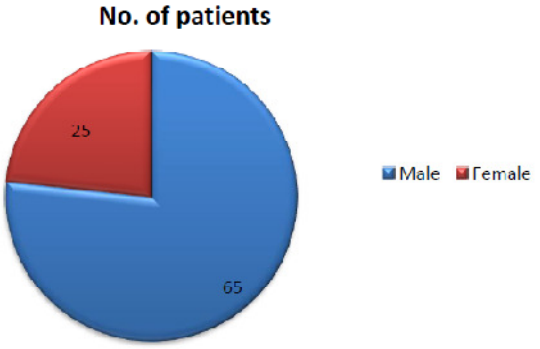
Patient in supine position with the knee comfortably flexed and externally rotated, for evaluating the anterior horns. Posterior horns were evaluated in prone position on an extended knee. For distal ACL visualization an anterior approach requires hyperflexion of the knee in order to access a possible small window through the patellar tendon and the Hoffa's fat pad. For PCL visualization, patients were in the prone position, with knees extended. The probe was positioned over the posterior knee for longitudinal scanning. One end of the probe was placed on the intercondylar tibial area and the other end was internally rotated around 15–30 degrees to the lateral margin of the medial femoral condyle. The clearest possible image of the PCL was obtained by adjusting the transducer. One helpful landmark is the characteristic bone contours of the tibial plateau at the posterior cruciate ligament attachment. Surrounding soft tissue structures were scanned from medial to lateral or lateral to medial.



Various injured structures identified on HRUS & MRI:

MRI Technique :

MR scan in all the patients included in this study was carried out on Siemens Magnetom C 0.3 Tesla MR Machine. MRI: performed machine using specific knee coil. Following sequences were obtained : T1 : axial & sagittal, T2: Axial & sagittal and PDFS (Proton density fat saturation): Axial, coronal & sagittal.

The slice thicknesses of 4 mm with 1mm gap and matrix size of 256 x256 were the scan parameters.

Observation & results

In our study, MRI in addition to high resolution ultrasound was performed to know the accuracy of each of them in the detection of meniscal and cruciate ligament injuries and other pathologies around the knee.

In this study, there were 90 patients, of which 69 were males and 21 were females.

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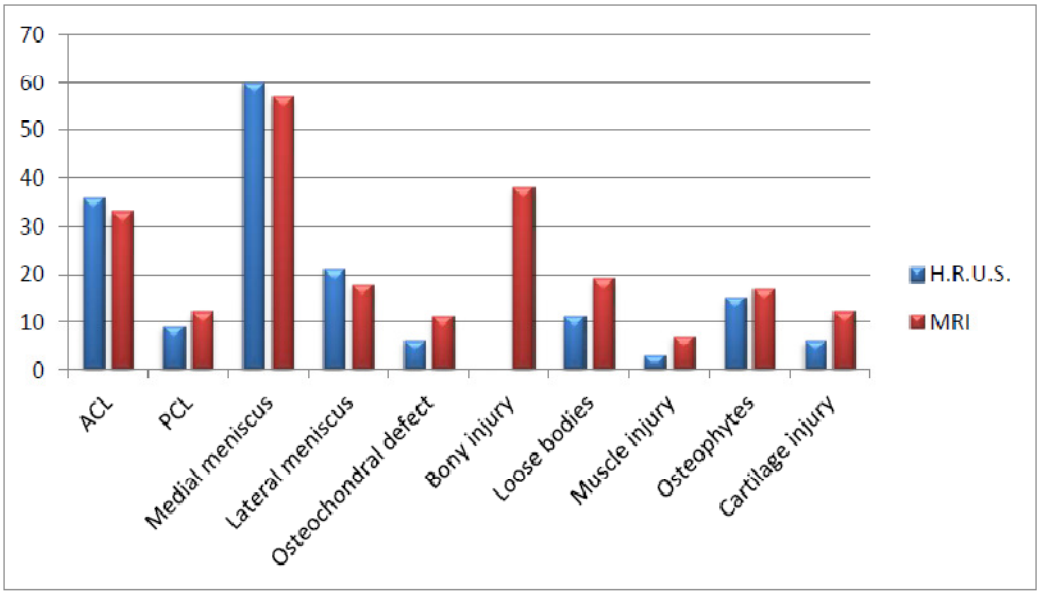
Structures injured	H.R.U.S.	MRI
ACL	36	33
PCL	9	12
Medial meniscus	60	57
Lateral meniscus	21	18
Osteochondral defect	6	11
Bony injury	0	38
Loose bodies	11	19
Muscle injury	3	7
Osteophytes	15	17
Cartilage injury	6	12



Other pathologies identified on HRUS & MRI:

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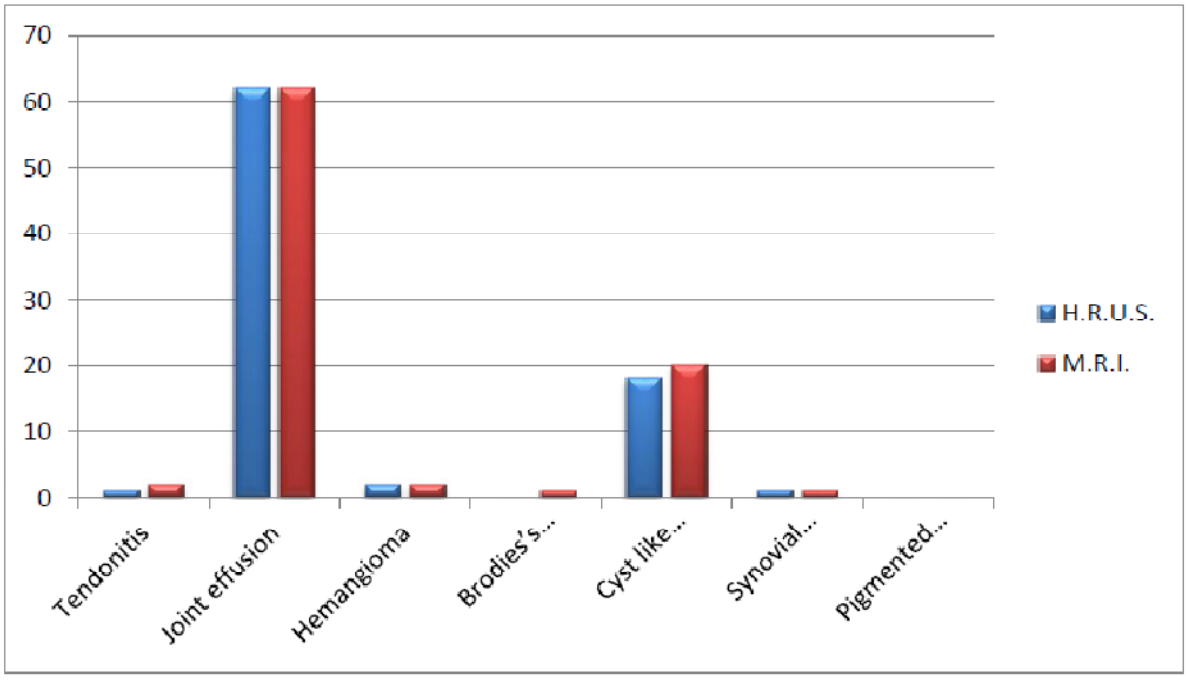
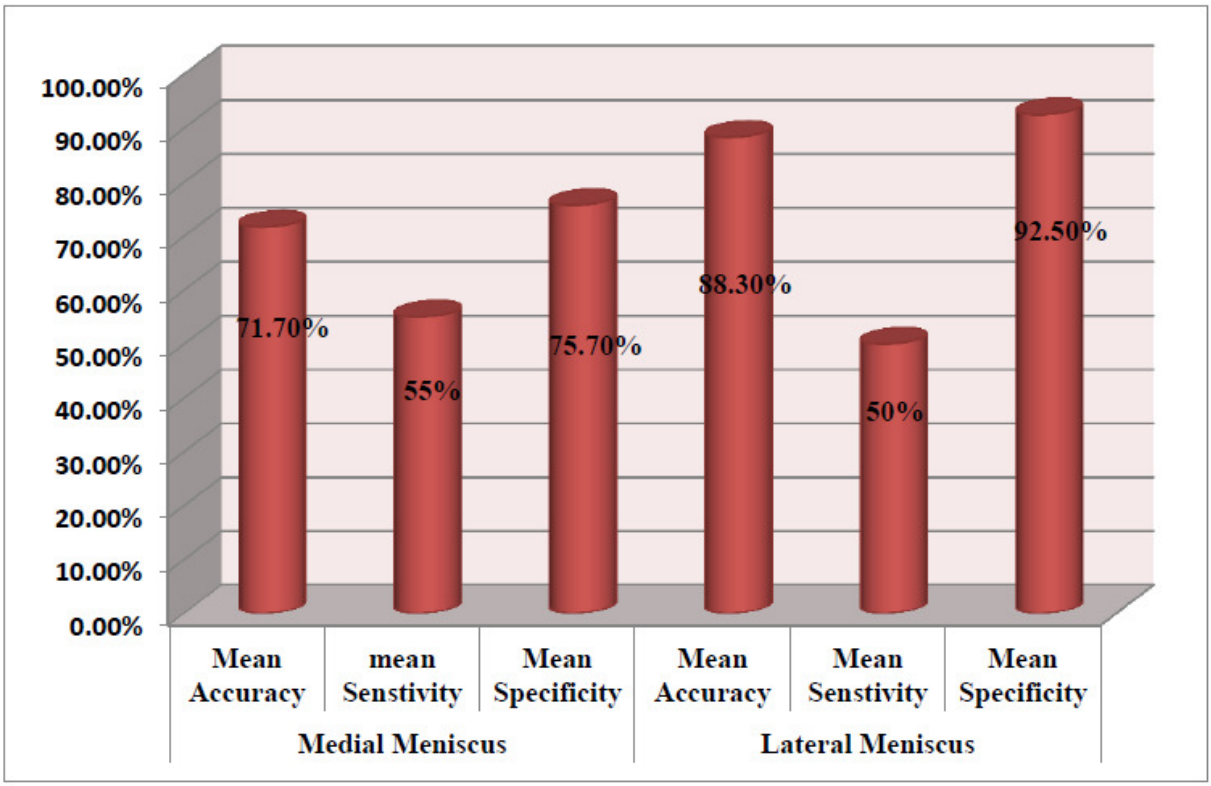
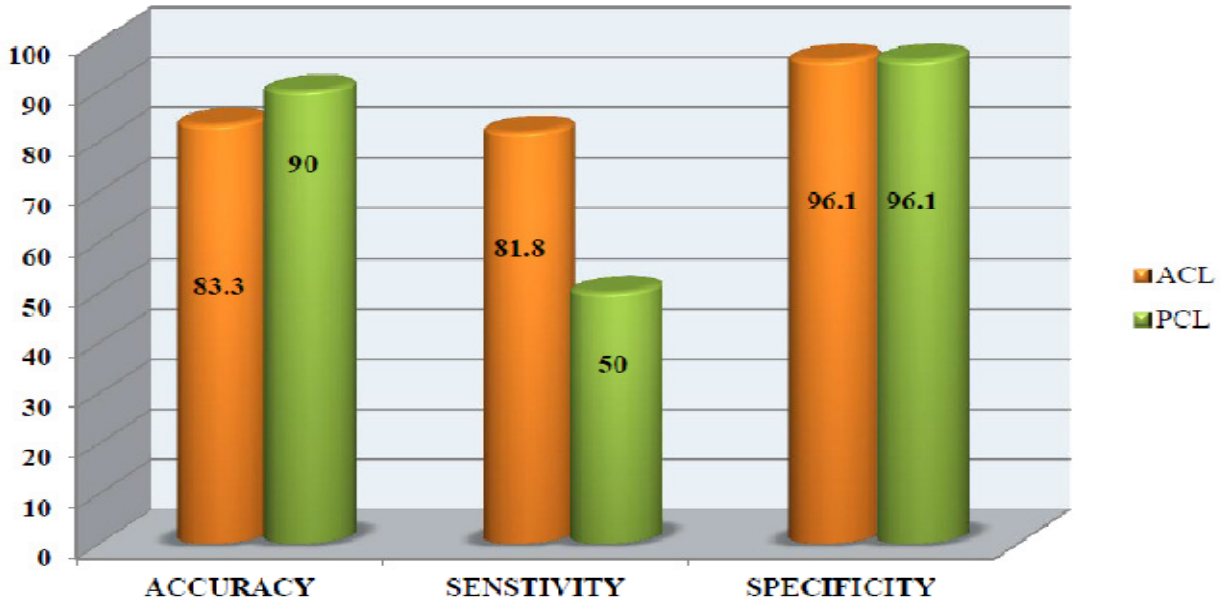
Pathologies	H.R.U.S.	M.R.I.
Tendonitis	1	2
Joint effusion	62	62
Hemangioma	2	2
Brodies's Abscess	0	1
Cyst like lesions	18	20
Synovial Osteochondromatosis	1	1
Pigmented Villonodular Synovitis	0	0



Mean Accuracy, Sensitivity & Specificity In Meniscal Pathology:



Mean Accuracy, Sensitivity & Specificity In Cruciate Pathology :



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Discussion:

In our study all the cases of baker's cyst, hemangioma, joint effusion, loose bodies and intra ganglionic cyst were diagnosed on HRUS.

In our study HRUS and MRI equally detected the effusion, sensitivity for detecting the osteochondral defect & cartilage injury was very low for ultrasound. Almost 50% cases were missed on HRUS which were later identified on MRI.

HRUS missed one case of synovial cyst and one case of parameniscal cyst. MRI is the most sensitive, specific, accurate and non-invasive method for depicting and characterizing the cystic masses[7]. We had one case of brodie's abscess missed on HRUS & 2 cases of tendonitis out of which one case was missed. We had one case of primary synovial osteochondromatosis which appear as heterogeneous, avascular mass surrounded by fluid with few gravity dependent osteochondral nodules seen as hyperechoic foci with acoustic shadowing on HRUS. MRI confirmed our diagnosis.The study revealed that the mean accuracy (80% – 90%) and specificity (84.15% - 96%) of high resolution ultrasound in the diagnosis of both meniscal and cruciate injury is nearly equal to that of MRI. However, sensitivity (52% - 81.2%) of HRUS is lower as compared to MRI[8]. For cystic lesions, hemangiomas and other pathologies both HRUS and MRI had similar diagnostic accuracy, though few cases were missed on HRUS in our study[7]. Therefore, it is preferable to use high resolution ultrasound as a preliminary investigation for diagnosis of various knee injuries & pathologies.

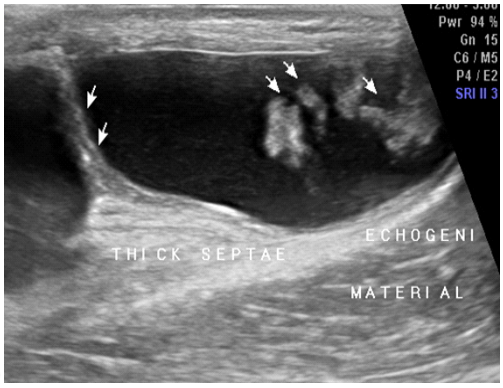
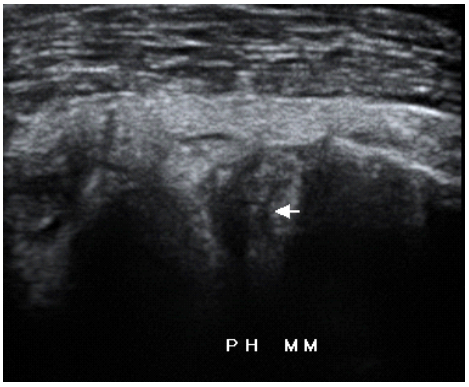
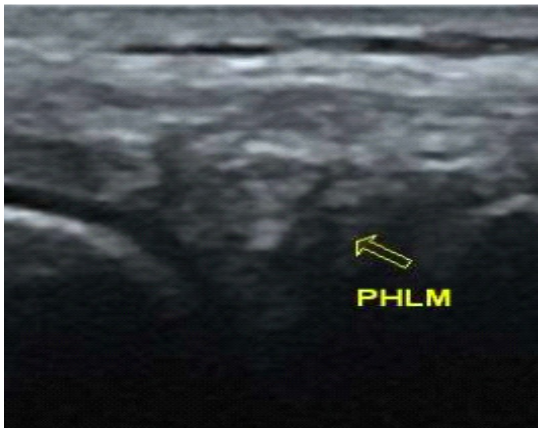


Fig 1 (a)



(b)



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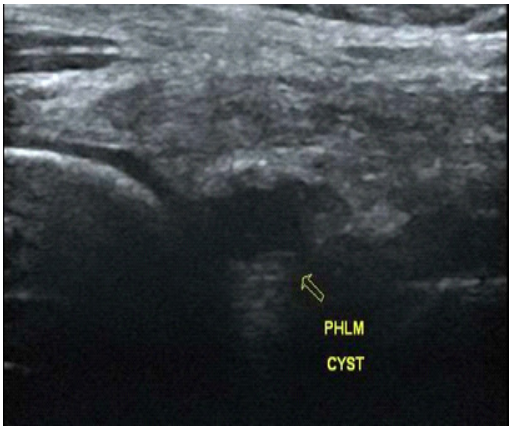

(d)

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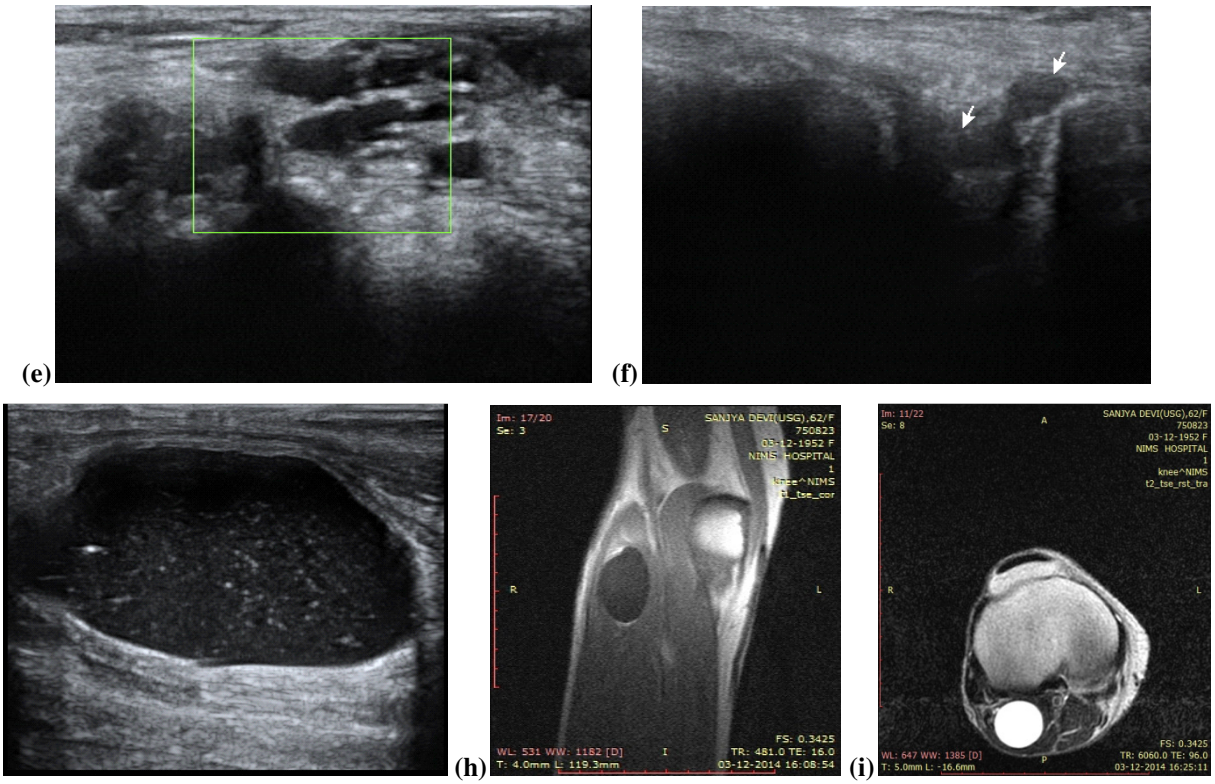

Fig 1(a &b) HRUS image shows ill-defined hypoechoic area in the posterio-medial compartment of knee joint, with echogenic material within and thick septae s/o baker's cyst. There is tear of posterior horn of medial meniscus also noted. **(c & d)** HRUS image showing tear in posterior horn of lateral meniscus & hypoechoic meniscal cyst is noted connected to tear of PHLM. **(e & f)** HRUS image showing multiple cystic areas in lateral compartment of knee joint with intra-articular extension of the lesion with increased vascularity on power doppler image s/o hemangioma**. (g, h & i)** HRUS image shows of lateral compartment of leg shows a well defined hypoechoic mass lesion is seen in lateral compartment of leg, with echogenic area within with no inter-condylar extension & vasularity on power Doppler s/o ganglionic cyst which is later confirmed by MRI.

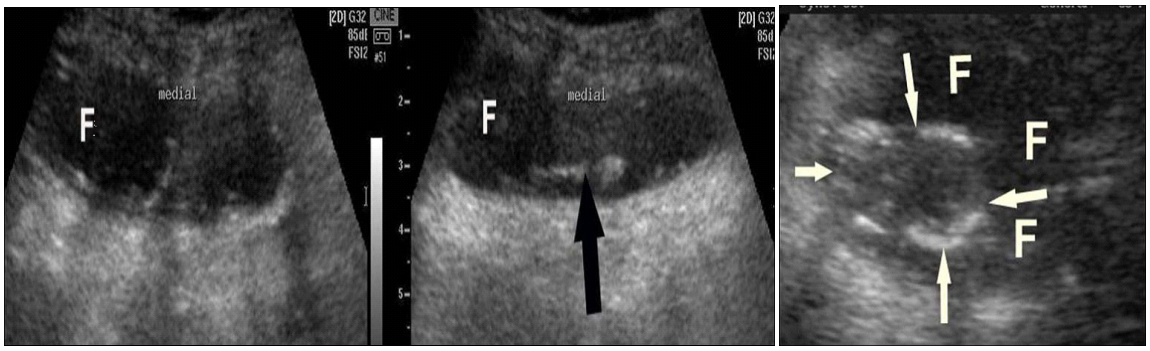

Fig. 2 (i)

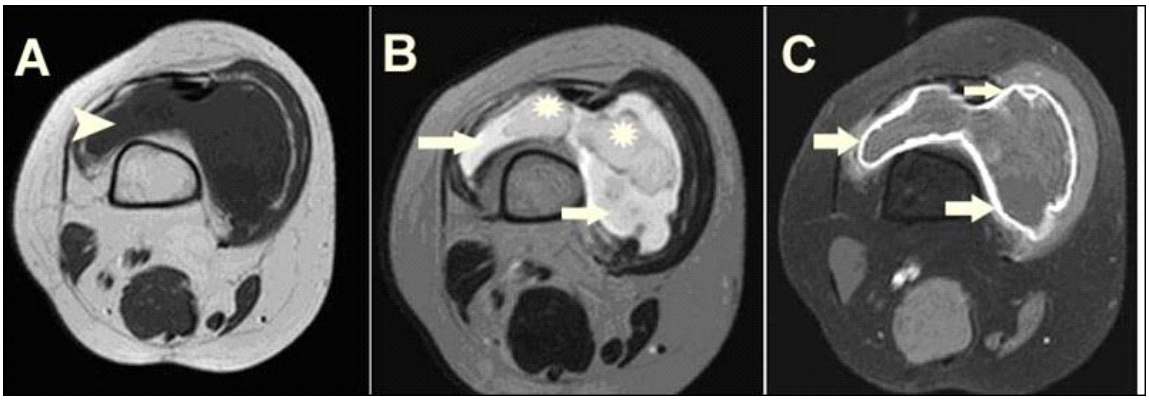

Fig. 2 (ii)

Fig 2 (i) HRUS images above showing PSC of the suprapatellar pouch of the knee showing fluid filled suprapatellar pouch with some calcified loose bodies, F= Fluid, black and white arrow = calcified loose bodies. Fig 2 on right side. Our findings are later confirmed on MRI **Figure 2(ii)**MRI knee joint showing (A) T1 W MRI scan shows distended suprapatellar pouch. Arrow= fluid (B) T2 W MRI SCAN shows distended fluid filled suprapatellar pouch. Loose bodies are also seen as hyperintense lesions with hypointense rims (asterisk). Arrows= fluid (C) Gadolinium enhanced T1W MRI Transverse scan showing enhancing inflamed synovial lining (white arrows) s/o PSC.

Conclusion

From above mentioned result, we can conclude that high resolution ultrasound gives high accuracy & specificity which nearly approaches that of MRI. However, sensitivity of HRUS is lower compared to MRI. Therefore, it is preferable to use high resolution ultrasound as a preliminary investigation for diagnosis of various knee injuries & pathologies and MRI can be reserved for those cases where HRUS is equivocal, patients condition is not improving and preoperatively for detailed assessment.

For cystic lesions, hemangiomas and other pathologies both HRUS and MRI had similar diagnostic accuracy, though few cases were missed on HRUS in our study. It's also advantageous for its availability, low cost, dynamic study and comparison with the other side.

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