DISCUSSION

Shoulder pain is one the most common complaints encountered in day to day practice and often leads to considerable disability. When shoulder sonography was first being investigated in the early 1980s, the only alternative technique was arthrography. Thus, there was an incentive to develop a non-invasive means to detect rotator cuff tears. Nearly all published ultrasound studies on shoulder has used echogenicity as a criterion for predicting involvement of rotator cuff muscles.

Our study revealed a predominantly male preponderance for shoulder pain. Male incidence is about four times more than that of females in shoulder pain. The predominant age group involved was between 21 – 40 years of age; about two thirds of the total patients belong to this group. In a report in Health information of India, 1993, published by the Government of India, similar findings of age and sex incidence were noted. The WHO Regional Health Report for the South Asia region in 1996 also revealed the similar statistics.

In our study, sports personnel and home makers were the major sufferers from shoulder pain accounting for about 73% of the cases. None of the study
in the past analysed occupation as one of the etiological factors for shoulder pain.

In most patients, shoulder pain results from periarticular lesions involving the rotator cuff, the biceps tendon and the subacromial- subdeltoid bursa. The differential diagnosis includes several entities of similar clinical picture. Calcific tendinitis and tears of rotator cuff, biceps tendinitis and subacromial-subdeltoid bursitis are the most common lesions found.

It has been established that tendon degeneration occurs as a part of the aging process\textsuperscript{3,4,11,19,34}. Progressive tendon failure then leads to rotator cuff rupture. Consequently tendinitis and tears of rotator cuff is thought to be tendon degeneration, repetitive trauma or both. Biceps tendon involvement has been reported to be present in about 85% of patients with a painful rotator cuff tear. Moreover, increased fluid in subacromial-subdeltoid bursa usually accompanies rotator cuff tears. The explanation for these findings is that the biceps tendon and the subacromial-subdeltoid bursa are exposed to the mechanical forces that contribute to cuff impingement because of its anterior location. Furthermore, the synovial sheath of the biceps tendon is an extension of the glenohumeral synovial membrane, and the subacromial-subdeltoid bursa communicates with the glenohumeral joint after rotator cuff full thickness tears.
The clinical diagnosis of periarticular shoulder conditions depends on a number of physical manoeuvres designed to increase the encroachment of the acromial arch onto the rotator cuff or to determine the location of tendon lesions by testing the motion against resistance. Clinically it may be difficult to differentiate the pain patterns of the rotator cuff lesions, biceps tendon pathology, and subacromial-subdeltoid bursitis. Obviously, any position in which rotator cuff is compressed by the acromial arch causing pain during examination is highly diagnostic of rotator cuff lesion. However, this finding could be indicative of any rotator cuff condition, such as tendinitis, partial thickness tear or full thickness tear. Moreover, many of these positions also compress or stretch the biceps tendon and the subacromial-subdeltoid bursa. Therefore the induced pain is not diagnostic of one rather than another disorder.

Our results show that the clinical diagnosis of periarticular conditions in the painful shoulder is not very accurate compared with ultrasound diagnosis. Other authors have also reported the low accuracy of clinical assessment compared with intraoperative anatomic lesions in the diagnosis of periarticular shoulder conditions. In contrast with our results Leroux et al reported satisfactory sensitivity but poor specificity for clinical tests, particularly for determining the location and type of rotator cuff lesions; the
probable explanation is the difference in populations. Norwood et al (1989) tried to define the clinical signs and symptoms that indicate the presence of a rotator cuff tear and predict its severity. They found that the characteristics of the pain and the site of tenderness were not helpful, nor was weakness to resisted abduction.

The histogram values were found to be accurate in predicting lesion in and around painful shoulder joint\footnote{25,46}. The word \textit{histogram} is derived from the Greek: \textit{histos} meaning 'anything set upright' (the bar of a loom, or the vertical bars of a histogram); \textit{gramma} 'drawing, record, and writing’. The histogram is one of the seven basic tools of quality control, which also include the Pareto chart, check sheet, control chart, cause-and-effect diagram, flowchart, and scatter diagram. A generalization of the histogram is kernel smoothing techniques. This will construct a very smooth Probability density function from the supplied data.

The histogram evolved to meet the need for evaluating data that occurred at a certain frequency. This is possible because the histogram allows for a concise portrayal of information in a bar graph format. The histogram is a powerful engineering tool when routinely and intelligently used.

A histogram is a graph which is used to determine the distribution of a set of data. The data is grouped into classes of fixed width. The histogram is a
simple graph that displays where all of the brightness levels contained in the scene are found, from the darkest to the brightest. We are at analyzing the images projected onto our retinas, using one third of our brains for vision. However, computers are being used more and more to automate and extend the potential of image analysis. Computers are better at extracting quantitative information from images than human observers they can be more accurate and more consistent from day to day. Furthermore, computers may spare us from much tedious image interpretation.

The histograms represent the echo-distribution intensity of the ROI area. The horizontal axis represents 0 to 63 shades of gray, and the vertical axis the distribution ratio of each shade. Here the numbers of picture elements (pixels) of the most common shades in the ROI areas were assumed to be 100%. (T, total number of pixels in ROI; L, gray scale level of shade component that is most common in the ROI; M, number of pixels of the shade component that is most common in the specified area). All data were expressed as mean ± SD. Differences between the variables in multiple groups were assessed. A histogram is used to graphically summarize and display the distribution of a process data set.

To our knowledge no studies that meticulously match the histogram findings in and around shoulder joint has not been reported previously. The shoulder
is recognized as a primary and common source of functional disability. Because of its wide range of motion, the shoulder is susceptible to chronic stress. Regardless of the type of abnormality or instability pattern, a combination of different osseous and soft-tissue restraints such as the ligaments, tendons, labrum, and capsule have increasingly received recognition either as stabilizers or as structures that sustain secondary damage in these situations.

Although primary sonographic evaluation of the painful shoulder concentrates on the tendons of the rotator cuff, we suggest that examination of the muscles should become a standard component of the comprehensive shoulder Sonographic examination, particularly given the potential clinical implications. More accurate diagnosis for a broad spectrum of periarticular shoulder disorders was not possible by physical examination alone.

The main shoulder structures that can be evaluated with ultrasound in patients with shoulder problems are the long head of the biceps, rotator cuff diseases, and bursal inflammation in and around the shoulder. High-resolution ultrasound is quick, non-invasive, and inexpensive and has specific advantages. These advantages, which include the capacity for higher resolution and for examining tissues in both static and dynamic states with the patient in different positions, warrant the wider use of ultrasound in
the evaluation of shoulder pain disorders. The usage of histogram values in accurate diagnosis of shoulder lesions was highlighted with the above results.

Despite the high sensitivities of high resolution ultrasound for diagnosing periarticular shoulder lesions except glenoid labral pathology, brightness mode gray scale ultrasound with histogram values able to accurately diagnose partial tear of rotator cuff muscle or tendon and characterize the fluid in bursal cavity. The above finding is essential for preoperative evaluation of the rotator cuff disease. The diagnosis was established within minutes of performing the shoulder examination and can be compared with opposite shoulder in the same setting. The single most useful and unique aspect of high resolution ultrasound relates to real time nature. The dynamic ultrasound enables the examiner to perform a series of provocative manoeuvres to elicit better suspected pathology with histogram values. The value of better definition of tendon tears that were occult on initial scans can impact subsequent therapy. Ultrasonography has been established as an effective imaging method in the evaluation of the rotator cuff disease.

Most of the papers in the literature are on rotator cuff and non rotator cuff lesions. The shoulder joint can be examined by static and dynamic high resolution ultrasound. Non rotator cuff examination of the shoulder must be
a routine part of the ultrasound examination of the shoulder. Ultrasound images are the most useful when the structures of interest are clearly defined. Unfortunately, ultrasound systems are inherently very noisy, rendering it difficult to interpret the images and to successfully auto-detect features in the images. Our study has led us to conclude that histogram values are great predictor of echogenicity and intensity of the shoulder joint lesions.

An important observation made in high resolution ultrasound is that the internal texture of lesion may correlate better with histogram values and inhomogeneity and reflectivity are important discriminators of the lesion detected by ultrasound. Van Holsbeeck et al (1995), noted that the specificity of high resolution ultrasound could be improved if the echogenicity was considered in addition to intensity. The present study has shown the value of applying these observations to high resolution ultrasound of muscle status, and the demonstration of intrasubstance heterogeneity is shown to be a highly specific. It is a common misconception that all structures of highly reflective contain fat. High resolution ultrasound allows the internal morphology of pathologic lesion to be evaluated. Histogram values clearly help to discriminate the lesion in and around shoulder joint. Roberts et al (1998) suggested that a low level echogenicity and
discontinuity might be predictor of partial tear of rotator cuff muscles, but the present study revealed that this feature alone did not correlate with partial tear of rotator cuff muscles unless intensity and histogram values were demonstrated within the lesion.

An interesting result of the present study was the very high specificity of (98%) and moderate sensitivity of (75%) of the echogenicity and intensity on high resolution ultrasound images. Curiously, this feature does not appear to have been evaluated previously, despite the fact that it is well recognized that partial or complete tear results in distortion of muscle and bursal distension due to bursitis. The defect may be occupied by fluid, debris, synovium and torn muscle fibers. The high resolution ultrasound technique of shoulder joint in assessing this feature, combined with the intrasubstance heterogenicity of the lesion, histogram values of this particular area, produces a powerful predictor of muscle status that shows good reproducibility between observers and is independent of, and greatly superior to, simple observation of high resolution ultrasound. The importance of accurately determining status of muscle and bursa with imaging techniques prior to surgery will increase. Preoperative high resolution ultrasound with histogram values in cases of complete tear of rotator cuff muscles will increase the diagnostic accuracy.
The following interesting observations also made in the study. Histogram values predicted by the rotator cuff tendon tear area mean value is 3500-3700, adjacent retracted tendon mean value 1100-1250. Subdeltoid bursal fluid mean value is 20-30 (Bursitis) adjacent muscle mean value are 600-900. Histogram values obtained from bicipital groove fluid mean value is 10-20. Histogram values of calcific tendinitis mean value is 61 – 140 and Deltoid muscle mean value is 650. Histogram values of subdeltoid haematoma mean value is 900 – 1100. Glenohumeral joint mean value is 300-350. Histogram graph is also significant. Calcific tendinitis area histogram graph is biphasic. All other areas graphs are monophasic.

The choice of an advanced imaging method can be based on the patient’s characteristics, such as age, sex, unresponsiveness to non-surgical treatment and cost. Ultrasonography does have several potential advantages over MRI, including low cost, dynamic features and uncomfortable positions need not be maintained for prolonged periods because the patient can change position during ultrasound examination at any time without compromising the examination in the evaluation of shoulder pain.

The factors influencing the patient satisfaction in shoulder joint evaluation is the length of imaging examination. Under normal...
circumstances, shoulder sonography can be completed in less time than shoulder MRI. Another factor influencing patient’s satisfaction with a diagnostic test is the degree of pain and discomfort caused by the test. Thirty-three percent of patients had an increase in the baseline level of shoulder pain during their sonography examinations. This increase was expected for sonography because the patient is required to move his or her arm into position that may be uncomfortable. Discomfort with positioning can be a particular problem in patients with rotator cuff tears. Fortunately, uncomfortable positions need not be maintained for prolonged periods because the patient can change position at any time without compromising the examination. Compression of the shoulder with the transducer, an important part of a sonography examination can also produce pain. Similar results obtained in our study.

High resolution ultrasound afforded by the current generation of high frequency linear transducers allow us to effectively assess superficial tendon and muscle lesions and bursitis\textsuperscript{1,5,31,57,69,78} The usage of variable high-frequency linear array transducers instead of a 5MHz curved array transducer can increase the accuracy of ultrasonography to detect lesions in and around shoulder joint\textsuperscript{86,84,95,98,99}. The difference in results may be due to difference in the selection of patients, ultrasonic techniques or level of
experience of investigators. This ultrasound technique has also been shown to be accurate for detecting fluid and abnormalities of rotator cuff.

Ultrasound can be used as guide in performing periarticular and intraarticular fluid aspirations, infiltrations and biopsies, making these procedures more accurate than when carried out blind. Ultrasound has considerable advantages over other imaging techniques; it can routinely be used for dynamic examination of the musculoskeletal system; it is quick and easy to perform; it has no secondary effects; the cost are low; it has proved to be accurate and reliable in diagnosing a wide range of shoulder disorders compared with arthrography, MRI, Arthroscopy and surgical findings. Several studies have shown accuracy for ultrasound detection of rotator cuff lesions compared with surgical findings of greater than 0.85 and an interobserver reliability of 0.63.

Ultrasound is considered to be most operator dependent imaging technique. However the results of any imaging technique depend on the skill of the examiner. Like arthrography, high resolution ultrasound examination of shoulder is an interactive examination. Not only can the patient and the examiner converse, but the patient can observe the real-time examination and ask questions as it occurs. In many situations, the results of
sonography are immediately available. It helps the clinician to plan for further management of shoulder lesions.