A CROSS-SECTIONAL STUDY ON EVALUATION OF DIAGNOSTIC APPLICATIONS OF LINEAR SONOGRAPHIC TRANSDUCER IN VARIOUS DISEASES

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ABSTRACT

Introduction: *An ultrasonography scan is a medical test that uses high-frequency sound waves to produce live images of the body. Linear transducer is used to create the images of superficial organs. Superficial sonography used for diagnose various pathologies like Large vessel vasculitis, carpel tunnel syndrome, thyroiditis, carotid artery disease etc. The aim of this study is to evaluate the diagnostic application of linear sonographic transducer in various diseases of superficial organs. In the simple sense of word, Transducers are the devices that converts a form of energy into another. These devices have been throughout the history, taking an example of Pythagoras in 550 BC, who sited that pitch and frequency is co-related and this lead to creation of Sonometer, instrument used in music[1]. A major physics breakthrough occurred in 1880 when the brothers Jacque and Pierre Curie demonstrated the piezoelectric effect, which results in formation of Ultrasound transducer. Over 60 years later, Dr Karl Dussik of Austria in 1940s, becomes the first physician to use the ultrasound in medical diagnosis[2].*

Research Methodology: *In this prospective cross-sectional study 40 patients, prescribed for superficial organs ultrasonography (USG) (thyroid {neck}, musculoskeletal, and doppler) were included and stat for result was mean and percentage stats used. This was a quantitative prospective cross sectional study in which high frequency ultrasonography of a maximum of 40 patients with proper indication under taken. Ultrasonography is performed after taking proper history and relevant physical examination performed by the linear transducer (6 – 12 MHz). In this study convenience sampling was used as the sample was taken from a section of the population that was easily accessible or readily available to the researcher.*

Findings: *Total 40 (100%) patient's data used in this study who undergone the superficial organ examination (Musculoskeletal, Doppler, thyroid {neck}) during the period of study. Out of which 50% (20) patients undergo Thyroid ultrasonography, 25% (10) patients undergo musculoskeletal ultrasonography and 25% (10) patients undergo Doppler imaging ultrasonography. Result of scan collected and master chart is prepared. Author found that in thyroid ultrasonography scan 15% patients have swollen neck and pain was due to cervical varicocele, 12.5% patients have lymph nodes, 2.5% patients have goitre, 2.5% patients have thyroiditis, 2.5% patients have cyst, 2.5 % patients have thyroid mass, and 12.5% patients have normal study. In Doppler ultrasonography scans 5% patients have edema, 2.5% patients have varicocele, 5% patients have varicosities, 2.5% patients have periphery arterial disease and 5% patients have thrombus/plaque and 5% have normal scan with no findings. In musculoskeletal ultrasonography scans 22.5% patients have normal study with no significant findings and 2.5% patients have focal encepahalocele.*

Conclusion: *It is concluded that ultrasound is the best modality to rule out the problems at any stage so that treatment can be started on behalf of reports of Ultrasonography scan in patients of superficial organs with various diseases, as it is fast and safe to patients, it does not include any ionizing radiation so female patients of reproductive age go through scan without any risk. And most common reason of swelling and pain in neck is cervical lymphadenopathy, lymph nodes, mass or goitre, and pain in joints and swelling is varicosities or thrombus in lower extremities and in musculoskeletal cranium study mostly has normal study with no significance but few have focal encepahalocele as per in this study.*

1.1. INTRODUCTION

Background

In the simple sense of word, Transducers are the devices that converts a form of energy into another. These devices have been throughout the history, taking an example of Pythagoras in 550 BC, who sited that pitch and frequency is co-related and this lead to creation of Sonometer, instrument used in music[1]. A major physics breakthrough occurred in 1880 when the brothers Jacque and Pierre Curie demonstrated the piezoelectric effect, which results in formation of Ultrasound transducer. Over 60 years later, Dr Karl Dussik of Austria in 1940s, becomes the first physician to use the ultrasound in medical diagnosis[2].

Transducers

Transducers using active parts, either natural or factory-made, to form the piezoelectric effect for sonographic imaging. Quartz is the active medium in early transducers that utilized in the piezoelectric effect. It is naturally found in environment because it is relatively plentiful and its crystalline property makes it nice alternative. These crystals found in United States as well as in large quantities in Switzerland. The another material is Tourmaline that has been utilized in transducers and additionally it's naturally found in environment such as in Southern California and Brazil, among other places in the world. Factory-made piezoelectric materials have included barium titanate, lead zirconate titanate (commonly abbreviated PZT, the fore-most widespread alternative and significantly used for Doppler transducers), barium lead zirconate, lead metaniobate, and polyvinylidene fluoride. The fascinating attributes of high frequency of natural resonance, and echo characteristics for balanced designs[1, 2].

As primarily illustrate, piezoelectricity is the response of certain materials that, when mangled by pressure, a voltage is produced. It was later known that a reverse piezoelectric effect was also possible; that is when a voltage is given to the material, it awry in a reproducible fashion. To manufacture a piezoelectric material, the raw material is placed in the strong magnetic field at a high temperature, attribute to as the Curie point, where the material basic structure is adjusting in such a way as to produce the piezoelectric effect. As an alert note, if the temperature eclipses the Curie point, the piezoelectric effect is absent: do not attempt to sterilize transducers in an autoclave or any other source of raised temperatures. More modern-day composite transducer elements are the build by cutting the piezoelectric material in a pre-determined pattern, with the resulting choke among the small individual elements produced filled with some type of epoxy resin. The size and shape of the cuts are done with the signal application in the mind, as they dogged the elements acoustic impedance as well as its resonant frequency and focusing characteristics.

The centre, or resonant frequency of an element is determined by the propagation speed of the material used and its thickness[3]:

Frequency = propagation speed/ 2 x thickness.

For PZT used in diagnostic medical ultrasound systems operating anywhere from 2 to 15 MHz, the element thickness is typically a portion of a millimetre. Once the elements are formed and shaped, matching layers are constructed into the transducer to allow effective coupling of the pressure waves created by the piezoelectric effect to the tissue. These matching layers (including acoustic gel) deliberately match the impedance of the active element to the tissue to oversight maximum reflection at the tissue interface and fails in transmission/reception. A backing or damping material is fixed to the back of the element to protect regular "ringing" of the active element when excited to produce a short pulse, mandatory for good axial resolution when imaging. A typical backing material has been a type of epoxy resin with tungsten filaments[4]. The next layers of transducer are made up of acoustic and electric insulators. Acoustic insulators protect external vibrations from causing a voltage in the active elements to the sonographer. Finally, all of these layers are kept in a moulded plastic case, allowing the user to grip the transducer securely during an examination.

Linear Transducer

A Linear transducer is distinguished by a rectangular field of view and instantly acknowledge as such any clinical image. Because the field of view is rectangular, superficial objects will be relatively easy to detect compared with different transducer types (i.e., convex, phased, annular) [1, 4].

A linear sequenced array is constructed as a linear array of elements that are operated sequentially. A complete image frame is achieved by ignite groups of elements from one end to another end of the linear array. Linear array which typically have 128 elements which set up a rectangular looking field of view. Linear array gives superficial imaging without litter or image exaggeration. The advantage is at the cost of the field of view, which is precise in comparison with other transducer geometrics. Linear transducer are thus best for scanning relatively superficial anatomy such as the breast or extremities[5].fig1.3.1

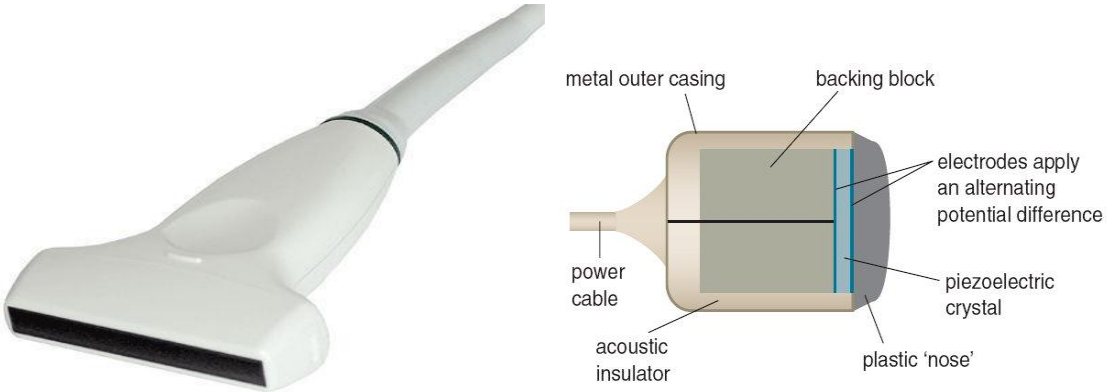


Fig: 1.3.1 Linear Transducer with construction.

Linear array are flat and provide rectangular or trapezoidal image format (as per in fig 1.3.2) with a field of view that is roughly equal to probe length, they engage over many frequency ranges, the choice of which depend on tissue depth of interest (higher the frequency, better the resolution, poor the depth tissue penetration). Typical frequency ranges for available probe are medium (3-11 MHz) for vascular and small parts[6] high (4-18 MHz) for vascular and musculoskeletal, and very high (8-24 MHz) for superficial anatomy (e.g. dermatology, rheumatology, superficial musculoskeletal) high ultra-frequency (30-70 MHz). Linear array are also exist for dermatology and pre-clinical research[7].

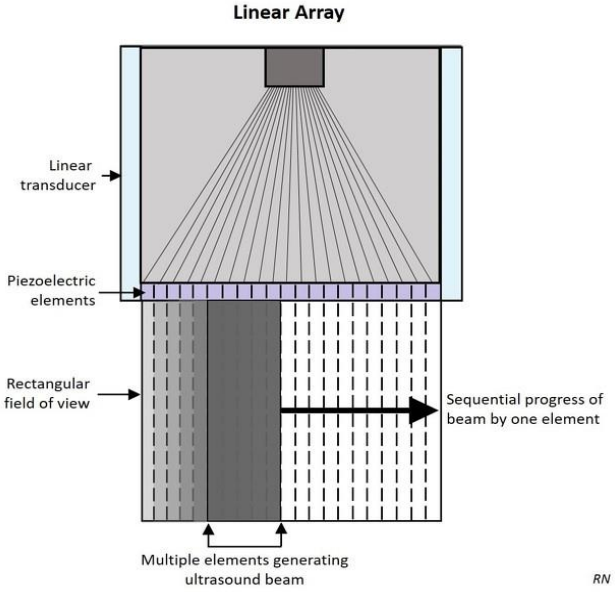


Fig: 1.3.2 Linear Array of Linear Transducer

Imaging format of Linear Transducer

Initial transducer were mechanically scanned in 2D plane for ultrasound imaging, in 1980's transducer array were commonly used for scanning. An ultrasound array consist of ensemble of arrangement in an individual single transducers, or elements that can be controlled in group or bundle to create pulse echo lines[8]. For a linear, group of in-line elements are incrementally switched on and off, adequately sliding an active group of elements parallel by Δx at a time to create the individual pulse echo lines that comprise the image plane. Pulse echo lines are interpolated to form the resulting rectangular image format and corresponding transducer of shape[9] (figure 1.4.1).

Fig 1.4.1Linear image format 2D rectangular

Figure.1.4.2 shows a Cartesian reference system useful for explaining linear scanning in the xz plane. For 2 dimensional (2D) scanning, the image plane is the xz plane. A simple scanning method is to move the acoustic beam incrementally, a little bit (defined as Δx) at a time, along the x – axis. At each position, a pulse echo line is created and set of lines is interpolated to produce a rectangular shaped image in which lateral translation is depicted from "a" to line "b".[10]

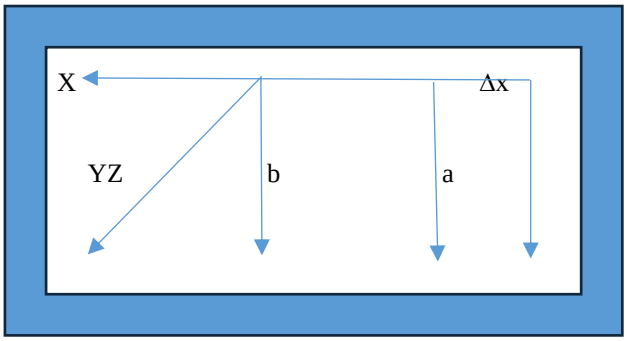


Fig.1.4.2 Cartesian reference system of linear scanning in the xz plane from acoustic line a to line b by increment Δx.

Specificity of Linear Transducer

The criteria covers the aspect of superficial organs, musculoskeletal and arterial and venous Doppler. The category "superficial" refers to the imaging of carotids, leg veins, breast, thyroid, testicles etc. and includes the categories of small parts, musculoskeletal, and peripheral vascular imaging. It is the last fortress of the application of linear arrays, which formed the starting design type for the applications. In this clinical category, access is usually not an issue, and the sizes of the probes themselves can be small (because of the use of high 7-15 MHz), while imaging of the peripheral vasculature has remained at lower (about 3-11 MHz) values due to the need to include deeper leg veins and successful Doppler performance.

Justification

To help in future of medical research, the advancement in technology and introduction of linear sonographic transducer has revolutionized the evaluation of superficial organs and small parts and musculoskeletal system. This study aims to evaluate the role of this sonographic transducer including its benefits and as well as limitations. Hence, contributing to the Medical literature in general and the practitioners in particular.

1.2. Aim

Evaluation of diagnostic applications of linear sonographic transducer in various diseases.

1.3. Objectives

- To assess the application of linear sonographic transducer in superficial organs with pre-determined diagnosis with the final impression after examination.
- To highlight the role of linear sonographic transducer in musculoskeletal studies and in vascular studies.

1.4. Literature Review

A retrospective study was done by **Kiwook Kim, Mi Kyung Song,2 et.al. Clinical application of linear transducer to breast masses on ultrasonography: a study evaluating the diagnostic performance and agreement with a dedicated breast radiologist. Published online 2016 Apr 14.**From June to August 2015, 192 breast masses in 175 women were included. US features of the breast masses were retrospectively analysed by a radiologist who specializes in breast imaging and another application, according to the fourth edition of the American College of Radiology Breast Imaging Reporting and Data System lexicon and final assessment categories. Of the 192 breast masses, 72 (37.5%) were malignant, and 120 (62.5%) were benign. Benign masses among category 4a had higher rates of possibly benign assessment on S-Detect for the radiologist, 63.5% to 36.5%, respectively (P=0.797). When the cut-off was set at category 4a, the specificity, PPV, and accuracy was significantly higher in S-Detect compared to the radiologist (all P<0.05), with a higher area under the receiver operator characteristics curve of 0.725 compared to 0.653 (P=0.038). Moderate agreement (k=0.58) was seen in the final assessment between the radiologist. Another technique may be used as an additional diagnostic tool to improve the specificity of breast US in clinical practice, and guide in decision making for breast masses detected via linear transducer.

A retrospective study was done by **Shui Lam, Kam On Kou et.al.The Use of a High Frequency Linear electrical device within the Assessment of vertebrate Anatomy at the Routine eleven to thirteen + 6-Week Scan among Chinese Population** printed on-line Sept 2015 in SciRes.The study says that within the era of non-invasive prenatal testing (NIPT), all pregnant girls ought to still be offered AN ultrasound examination within the trimester [11] with the advantages of early detection and exclusion of the many major anomalies[12,13], a number of that area unit either deadly or related to severe handicap that will warrant the discussion of AN earlier and safer termination of physiological condition with the pregnant girls. High radiofrequency is outlined as three to thirty mega-cycle[14], and linear electrical device is one that transmits ultrasound beam in parallel orientation. In literature search, the primary paper on the utilization of HFLT was printed in 1981, coverage the utilization of HFLT in examining baby intracranial pathology[15]. HFLT are used for the examination of smaller structures in radiology[16], medical specialty[17] and recently used additional in midwifery[18, 19] .A high-frequency (at seven.5 MHz) linear electrical device alone while not colour flow mapping didn't improve visualisation of viscous anatomy [19], in all probability due to its restricted penetration, only if the visibility of viscous anatomy was

reciprocally correlate with the transducer-heart distance. All ultrasound examinations were performed by 2 knowledgeable about operators (KY and KO) in our maternal-foetal medication team. The ultrasound machine used was Voluson E8 (GE health care, USA); the CCT used was the four - eight millimetre C4-8-D H48681AS (Wide band two-dimensional abdominal umbellate electrical device, FOV 75˚/ wide 95˚ for E8 skilled, 2 - 8 MHz, GE health care, USA); and also the HFLT used was 9L-D H40442LM (Wide band abdominal linear electrical device, FOV 43.0 mm, 3 - 8 MHz, mid-range of five.5 MHz, GE health care, USA).

A retrospective study was performed by **Rohit Rathi et.al. Role of high resolution ultrasound and Colour Doppler in pouch pathology Indian Journal of Basic and Applied Medical Research; June 2016** .The purpose of their study was to judge the role of high resolution ultrasound and colour Doppler in designation of pouch pathology and to review the patterns of duplex ultrasonography of pouch pathologies.100 cases with history any clinical manifestation of any pouch pathologies, United Nations agency were said Radiology Department for pouch ultrasound and Doppler study by Department of medical specialty, Department of Surgery and NIMS middle, Jaipur. Cases of any age bracket were enclosed during this study. Once the history, physical examination and duplex scanning a designation was created. Colour {doppler|Doppler|Christian Johann Doppler physicist} and Power Doppler was applied so as to review the property of the lesion. during this study, grey scale real time ultrasound and Colour Doppler of pouch was performed by victimisation GE VOLUSON 730 professional machine with high frequency probe of frequency 7-10 megacycle per second linear electrical device and abdominal ultrasound was done victimisation three.5- five megacycle per second umbellate curvilinear array electrical device. In their study, completely different pathologies of pouch were enclosed out of that inflammatory lesion (40%) accounts for max variety of cases followed by male reproductive gland tumour (14%), dilatation (9%), bollock (4%), trauma (5%), primary upset (7%), male reproductive gland torsion (10%) and miscellaneous (11%). Most of the patients were aged between 20-40 years with chief complaints of pouch swelling alone (34%) followed by pouch swelling and pain (27%). Acute rubber (25%) alone was the foremost common inflammatory lesion.

A retrospective study was conferred by **Yin-Ting Chen MD et.al. Review of prenatal diagnosis within the identification of Carpal Tunnel Syndrome and a planned Scanning Protocol[20]. Published: fourteen September 2016**.Carpal tunnel syndrome is that the commonest peripheral compressive pathology[21], accounting for ninetieth of all compressive neuropathies. it's characterised by a mixture of motor, sensory, and involuntary medicine impairments and might clinically manifest as intrinsic hand weakness, reduced grip strength, pain, tingling, and alteration in temperature management of the articulation radiocarpea and hand. The prevalence of carpal tunnel syndrome is calculable at three.8% of the overall population, (22) resulting in substantial morbidity, absence from work, and a $2 billion p.a. monetary burden to society. Ultrasonography has long been thought-about an acceptable candidate for analysis of carpal tunnel syndrome. Buchberger et.al.[23, 24] initial incontestable that US had comparable accuracy as resonance imaging criteria for carpal tunnel syndrome identification, as well as the cross-sectional space for mensuration the swelling of the median nerve within the proximal a part of the carpal tunnel, flattening of the median nerve within the distal a part of the carpal tunnel, and inflated area bowing of the flexor muscle retinaculum. Their work was later valid by Altinok et.al.7 mistreatment nerve physical phenomenon studies because the reference commonplace. Is protocol will give a fast and dynamic assessment for carpal tunnel syndrome.

A retrospective study was concluded by **Fatih Tok, Erkan Demirkaya** et.al. on **Musculoskeletal ultrasound in paediatric rheumatology [25]** in which he found out that Juvenile idiopathic arthritis (JIA) is the most common chronic inflammatory arthropathy in childhood, accounting for approximately 6-19 cases per 106 children per year [26] and intra-articular fluids Effusions, as small as 1 mL can be detected with ultrasound and interobserver agreement for ultrasound detection of effusion in hand and foot joints is reported to be 79% [27] and in patients with inflamed MCP and proximal interphalangeal (PIP) joints, MSUS improved accurate needle placement from 59% by palpation guidance to 96% by MSUS guidance [28], with overall findings at the specific area in cartilage alterations, bone erosion, other paediatric rheumatic diseases such as juvenile spondyloarthropathies and Systemic Lupus Erythematosus, So the conclusion of the research is MSUS is suitable for examination of children of all ages and it has certain advantages over different imaging modalities [29, 30]; it is cheaper, moveable, fast accessible bedside, easy to join with clinical determination (interactivity) and non-invasive. It does not require sedation, which simplify repetitive examinations. Assessment of multiple locations is possible during the same session. Disturbance is rarely a problem and small children can be seated in their parents' lap or they can even play while being examined. In this regard, when compared with the (already established) role of MSUS in the daily practice of adult musculoskeletal medicine, it is time for paediatric rheumatologists to start to use MSUS as well. **Michael Czihal** et.al. executed **a study of Ultrasound imaging in the diagnosis of large vessel vasculitis [31]** The study says that , According to the 2012 revised Chapel Hill Consensus Conference (CHCC) nomenclature, giant cell artheritis (GCA) and Takayasu arthritis (TA) are the two major variants of large vessel vasculitis (LVV) [32]. Modern noninvasive diagnostic imaging is essential in the diagnostic work-up of these disorders and other vasculitides involving large and/ or medium-sized arteries., e. g. chronic periaortitis (CP, categorized as single organ vasculitis in the CHCC), vasculitis associated to Behçet's disease (BD, variable vessel vasculitis in the CHCC), and inflammatory arteriopathies of large and medium-sized arteries not addressed in the CHCC. While use of sufficient visualization of such small superficial arteries, a high frequency linear probe with a frequency of at least 10 MHz, optimally > 15 MHz should be applied [33]. For sonographic imaging of the cervical arteries and extremity arteries linear transducers with a minimum frequency of 5 MHz, optimally > 8 MHz are required. Broadband linear transducers offer the opportunity to assess both small and medium-sized arteries. For the assessment of the abdominal aorta and its visceral branches as well as the iliac arteries,

normally a curved array transducer with a lower frequency (usually 3.5–5 MHz) is required, offering a higher penetration depth at the cost of a lower spatial resolution.

1.5. Methods and Materials

1. **Research Design:** This was a quantitative prospective cross sectional study in which high frequency ultrasonography of a maximum of 40 patients with proper indication under taken. Ultrasonography is performed after taking proper history and relevant physical examination performed by the linear transducer (6 – 12 MHz).

2. **Sampling:** In this study convenience sampling was used as the sample was taken from a section of the population that was easily accessible or readily available to the researcher.

3. **Data Collection:** Data collected from ultrasound rooms in radiology department in SGT hospital research Institute Gurugram Haryana where Philips and GE ultrasonic equipment's were placed. Data has been collected over the 6 months ultrasound room of radiology department. Data was collected from **1st October 2019 to 30th March to 2020.** Under the supervision of experts and existing radiologist along in the radiology department in SGT hospital and research institute. Patients are in the examination room, and patient will have to change clothes or wear gown or lower for certain cases. There is no need of any kind of preparation for the concerned exam.

4. **Prospective Study Phase:** Total 40 Prospective cases taken of USG Abdomen imaging were conduct for 6 Months. During this time the data of superficial organs (musculoskeletal, Doppler, thyroid {neck}) cases collected on daily basis along with the clinical history of patients and their information like name, age, sex etc. But analysis was only done at the end of the prospective study period. This study was carried out from 1 October 2019 to 1 April 2020.

5. **Methods of Collection:** The selection is on the basis of history and pre-diagnosis impression in the form of Small part organs (thyroid, breast, testis, salivary glands etc.) and Vascular, Musculoskeletal and some other area. The parameter are suggestively taken up by the mandatory check list for master chart.

- **Check list: -**
  a) History
  b) Purpose of Examination
  c) Application Used (linear sonographic transducer only)
  d) Benefit of Equipment
  e) Final diagnose match.
- **Inclusion criteria: -**
  a) Superficial glands/or gains studies
  b) Musculoskeletal sonography
  c) Vascular Doppler studies
- **Exclusion criteria: -**
  a) Whole abdomen, KUB, Upper Abdomen, Lower Abdomen etc. sonographic procedures
  b) Post Traumatic Patients
  c) Post-Operative Patients
  d) Obstetrics Patients

6. **Setting and resources:** The resources were taken from the Department of radio-diagnosis, SGT Hospital and research Institute, Gurugram, Haryana.

7. **Ultrasound equipment's**
   1. Ge healthcare logic f8 expert (2)
   2. Philips clear vue-350, Philips afiniti-50 and this equipment's are used during the whole research program.

8. **Statically analysis:** Analysis included collection, organization and interpretation of data. Categories formed resulting into content analysis with different methods. Data is presented in the form of frequency tables and various variables will be presented in the form of ratio of different aspects. The study was analysed using different methods such as mean, median and standard deviation. In my prospective study according to result of the research appropriate test was applied.

9. **Data Analysis :**The purpose of data analysis is to categorize, organize, manipulate and summarize the data that have been collected. The current study used a quantitative design. In this context, quantitative data refer to numbers that are collected and then interpreted using statistics. Numerical data are described in a meaningful manner thereby enabling any researcher to understand interrelationships that exist. Data analysis aims to describe statistical analysis results but does not comment on them. In this study analysis was done on the basis of **Mode frequency** of findings.

10. Case Study: The purpose of this study analysis by case study is to assessment of the application of linear sonographic transducer in superficial organs according to their history with the final impression after examination. All the patients taken here have complete privacy and no any personal declaration has been made anywhere in this research.

1.6. RESULTS

A study was conducted in department of radiology at SGT hospital to assess the application of linear sonographic transducer on superficial organs in Ultrasonography. Total 40(100%) patient's data used in this study who undergone the superficial organ examination (Musculoskeletal, Doppler, thyroid) during the period of study. Out of which 50% (20) patients undergo Thyroid ultrasonography, 25% (10) patients undergo musculoskeletal ultrasonography and 25% (10) patients undergo Doppler imaging ultrasonography. Result of scan collected and master chart is prepared. Author found that in thyroid ultrasonography scan 15% patients have swollen neck and pain was due to cervical varicocele, 12.5% patients have lymph nodes, 2.5% patients have goitre, 2.5% patients have thyroiditis, 2.5% patients have cyst, 2.5 % patients have thyroid mass, and 12.5% patients have normal study. In Doppler ultrasonography scans 5% patients have edema, 2.5% patients have varicocele, 5% patients have varicosities, 2.5% patients have periphery arterial disease and 5% patients have thrombus/plaque and 5% have normal scan with no findings. In musculoskeletal ultrasonography scans 22.5% patients have normal study with no significant findings and 2.5% patients have focal encepahalocele.

Chart 5.1 represents the criteria of selection, history and final diagnosis.

NECK ULTRASONOGRAPHY

History	Final diagnosis
Routine examination (4)	Normal study (3) Lymph nodes (1)
Koch's multiple nodes(1)	Cervical lymphadenopathy (1)
Swollen neck with pain (7)	Lymphadenopathy (3) Thyroid enlargement (1) Lymph nodes (2) Thyroiditis (1)
Follow up carcinoma tongue (1)	Mass lesion (1)
Mild swelling (2)	Nodular lesion (1) Thyroid mass (1)
Pain in frontal neck (3)	Normal study (1) Cyst (1) Cervical lymphadenopathy (1)
Thyroid history (2)	Goiter (1) Cervical lymphadenopathy (1)

MUSCULOSKELETAL ULTRASONONGRAPHY

History	Final diagnosis
Routine examination (9)	Normal study (7) B/L choroid plexus cyst (1) Cyst mass focal encepahalocele(1)
H/O fall (1)	Normal study

DOPPLER ULTRASONOGRAPHY

History	Final diagnosis
Routine examination (2)	Normal Study (2)
Swelling & pain(6)(lower extremities)	Sub cutaneous edema (2) Varicosities (2) Thrombus /plaque (2)
Pain & swelling (1) Upper extremities	Periphery artery disease (1)
Mild pain & visible swelling (Scrotum)(1)	Varicocele (1)

CHART 5.2 represents the number of male and female patients in each Age group.

TOTAL NO. OF MALE & FEMALE

Gender	Thyroid	Musculoskeletal	Doppler	Total
Male	6	5	4	15
Female	14	5	6	25
Total				40

Graph 5.1 represents the graphical data of total population gender

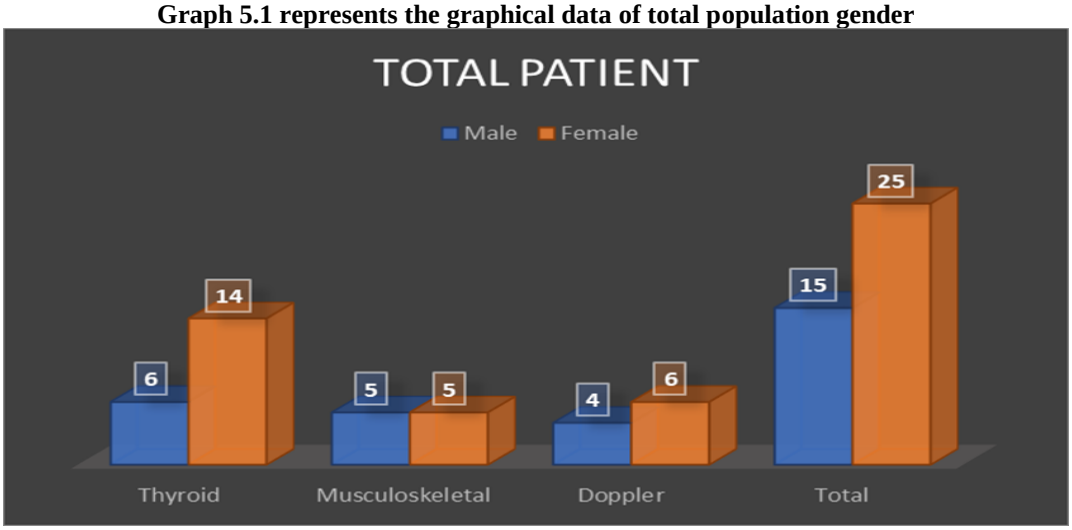


Chart no.5.3 represents the total cases of thyroid ultrasonography cases with final impression.

FINAL IMPRESSION THYROID	CASES
Normal	5
Cervical lymphadenopathy	6
Lymph nodes	5
Goiter	1
Thyroiditis	1
Cyst	1
Thyroid mass	1
Total	20

Graph 5.2 represents the final diagnosis in percentage of thyroid ultrasonography

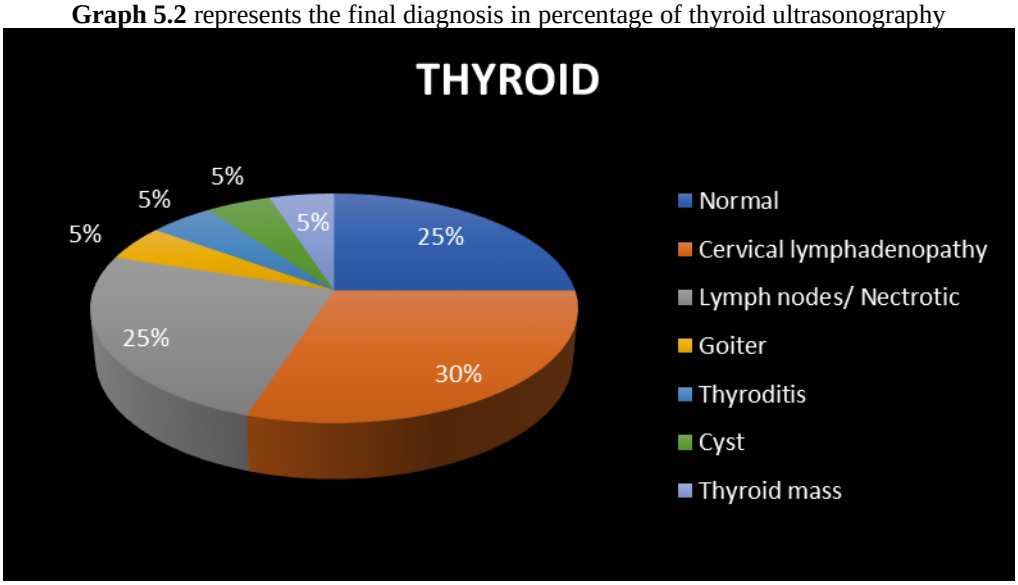


Chart 5.4 represents the total cases of Doppler ultrasonography cases with final impression.

FINAL IMPRESSION DOPPLER	CASES
Edema	2
Normal study	2
Varicocele (Testis)	1
Varicosities	2
Thrombus/ Plaque	2
Periphery arterial disease	1
Total	10

Graph 5.3 represents the final diagnosis in percentage of Doppler ultrasonography

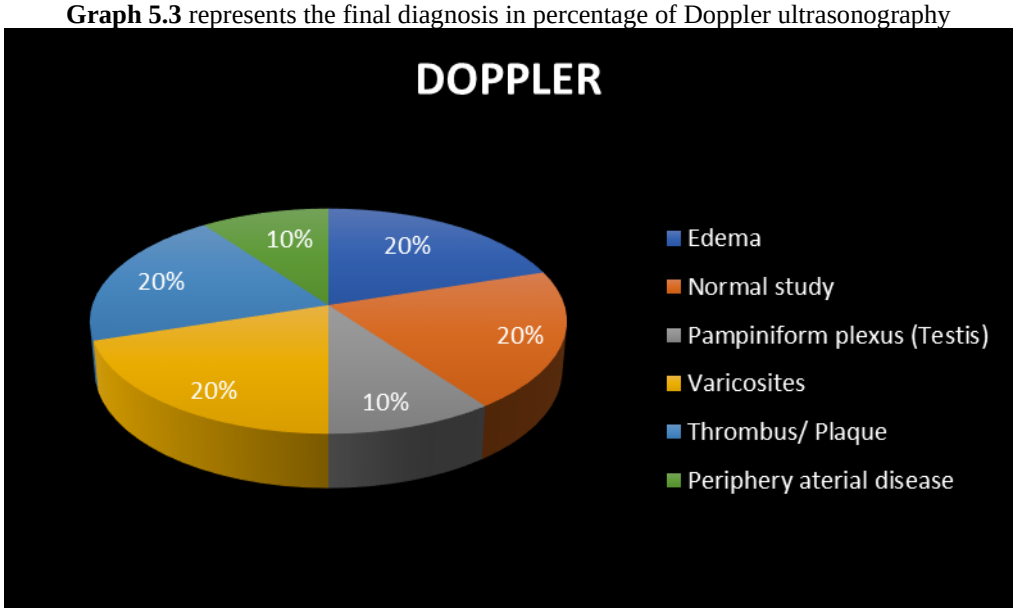
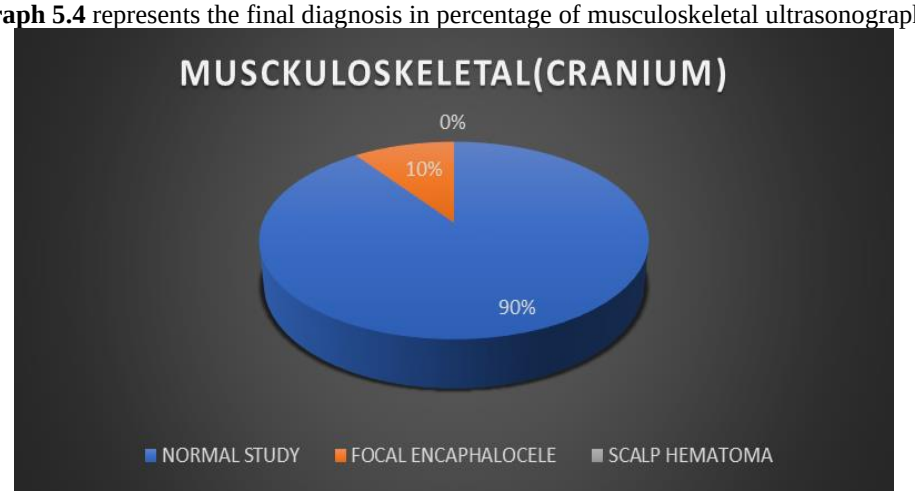


Chart 5.5 represents the total cases of musculoskeletal ultrasonography cases with final impression.

FINAL IMPRESSION MUSCULOSKELETAL	CASES
NORMAL STUDY	9
FOCAL ENCAPHALOCELE	1
SCALP HEMATOMA	0
Total	10

Graph 5.4 represents the final diagnosis in percentage of musculoskeletal ultrasonography



1.7. DISCUSSION

In this study, evaluation of diagnostic applications of linear sonographic transducer in various disease. This study is inspired by a research conducted by M. Aschwadan MD et al. who performed a study on wrist and hand with the help of linear transducer specification with relevant anatomy and scanning techniques. Observation of the study says many diagnostic evaluations with multiple of pathology and highlights the role of the transducer and relevant anatomical impressions.

An ultrasound test uses high-frequency linear ultrasound waves to create images of patient's superficial organs. Imaging tests can identify abnormalities and help doctors diagnose conditions. A superficial ultrasonography is a type of ultrasound used by doctors to examine thyroid, musculoskeletal, small part organs (testis), vascular imaging. In this study most common diagnosis is find out in the patients taken as sample of thyroid scan, Doppler imaging scans, musculoskeletal scan. And several findings have been seen in the research such as cervical lymphadenopathy, lymph nodes in thyroid ultrasonography, thrombus, periphery artery disease, varicosities in Doppler imaging and focal encepaholocele in

musculoskeletal ultrasonography was most common finding after calculation of result. This may need clinical as well as surgical treatment to be done. This study performed here because no any study done before on the topic evaluation of diagnostic applications of linear sonographic transducer in various diseases.

1.8. CONCLUSION

It is concluded that ultrasound is the best modality to rule out the problems at any stage so that treatment can be started on behalf of reports of Ultrasonography scan in patients of superficial organs with various diseases, as it is fast and safe to patients, it does not include any ionizing radiation so female patients of reproductive age go through scan without any risk. And most common reason of swelling and pain in neck is cervical lymphadenopathy, lymph nodes, mass or goitre, and pain in joints and swelling is varicosities or thrombus in lower extremities and in musculoskeletal cranium study mostly has normal study with no significance but few have focal encephalocele as per in this study

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