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Radiodiagnosis

ROLE OF 3D/4D ULTRASONOGRAPHY IN OBSTETRICAL PRACTICE

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ABSTRACT

INTRODUCTION: In the recent 30 years, obstetric ultrasound has revolutionized the clinician's approach to the fetus and more and more fetal malformations can be visualized by ultrasound in greater detail. Three-dimensional (3D) and four-dimensional(4D) sonography are regarded as further development of ultrasound imaging technology. The present study is to know whether 3D/4D ultrasonography helps in detection of anomalies more than those detected in 2D ultrasonography with the use of 3D/4D software.

OBJECTIVES: To evaluate the effectiveness of 3D/4D ultrasonography as an adjunctive tool to 2D ultrasonography in pregnancies that has shown fetal anomalies by 2D ultrasound.

MATERIALS AND METHODS: The study comprised of 58 pregnant women in whom there were fetal anomalies diagnosed in 2D ultrasound that were came to the Department of Radiology ,Kurnool Medical College, Kurnool. The study was conducted from October 2014 to October 2016. Pregnancies with anomalies diagnosed in 2D US were went 3D/4D US after taking consent and filling Form F. The ultrasound appearances were analyzed and compared with postnatal appearances.

RESULTS: Total 87 anomalies were seen pertaining to different systems either as isolated one or in association with syndromes. Among these 87 anomalies, 2D US identified 74 anomalies, missed 9 anomalies, suspected but not confirmed 4 anomalies. 3D/4D US - STIC detected 80 anomalies and missed 7 anomalies. 3D/4D US - STIC provided additional information in 8 anomalies in comparison with 2D US.

CONCLUSION: In this study 3D/4D US-STIC was an effective adjunctive tool in diagnosis fetal anomalies along with 2D ultrasound. It provided additional information in 9.09% of cases. It helped in diagnosing midline lesions of fetal brain. It was a valuable tool for diagnosing fetal lesions that require facial profile for diagnosis. STIC helped in diagnosing complex heart diseases with less time. Cleft palate was diagnosed confidently using 3D/4D US. Maximum Intensity Mode was very useful for diagnosing skeletal anomalies more easily. 3D/4D ultrasound did not provided extra information for diagnosing genitourinary, gastrointestinal, and pulmonary anomalies. However 3D/4D/STIC did not helped in cases with excessive fetal movements and less liquor.

KEYWORDS : US – ultrasonography, 2D – two dimensional, 3D – three dimensional, 4D –four dimensional, STIC – Spatio-temporal image correlation, DORV – double outlet right ventricle

INTRODUCTION

Three-dimensional (3D) and four-dimensional (4D) sonography are regarded as further development of ultrasound imaging technology. It was first introduced in the early 1980s. The first commercially available 3D scanner (Combison 330) was presented at the International Radiology Congress in Paris in 1989. The present study is to know whether 3D/4D ultrasonography helps in detection of anomalies more than those detected in 2D ultrasonography with the use of 3D/4D software. Let's have a brief introduction to 3D and 4D ultrasonography and its tools.

3D ULTRASONOGRAPHY:

The whole procedure of 3D includes volume acquisition, processing and display1. A special volumic transabdominal transducer is used for 3D scanning. The area of interest is defined by 2D ultrasound and a volume is automatically acquired by 3D probe. The digital information of each section plane is loaded into a computer along with the information regarding its position. The 3D data set is composed of a set of voxels, each with a certain grey value and brightness. These values are interpolated to the voxels in-between two section planes. The quality of 3D images depends on the positioning flexibility and the speed at which the data are acquired.

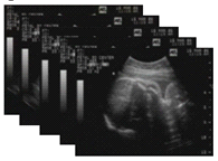

Fig 1 (a)

Fig 1 (b)

Figure 1: a) and b) showing 3D image is formed by sequential piling of 2D images.

4D ULTRASONOGRAPHY:

Four-dimensional (4D) ultrasonography is also called real-time three-dimensional ultrasonography. A 4D ultrasound can acquire the fetus in real time with very fast reconstructions of planes and volumes. Fetal movement and heart beat can be visualized by 4D technology lively. It is usually used in fetal cardiovascular system and fetal behavior assessment like yawning, swallowing etc. A 4D ultrasound uses the same technology as of 3D ultrasound but adds a video element to see the baby moving inside a mother's womb.

The present study is to know whether 3D/4D -STIC ultrasonography is really helpful in detection of fetal anomalies as adjunct to 2D ultrasonography. Very few studies were conducted on this topic. The study requires a volume probe with 3D and 4D software in addition to the routine 2D ultrasound apparatus.

AIMS AND OBJECTIVES

- Comparison of fetal anomalies detected by 2D and 3D/4D ultrasonography.
- To evaluate the effectiveness of 3D ultrasonography as an adjunctive tool to 2D ultrasonography in pregnancies that has shown fetal anomalies by 2D ultrasound.

PATIENTS AND METHODS

This is a prospective study comprised of 58 pregnant women in whom fetal anomalies were detected on 2D ultrasound and further evaluated by 3D/4D Ultrasound in the Department of Radiodiagnosis, Kurnool Medical College, Kurnool. The study was conducted from October 2014 to October 2016.

Inclusion Criteria:

- Pregnant women with fetal anomaly/anomalies detected on 2D US between the gestational ages 18 weeks to 24 weeks.

Exclusion criteria:

- Pregnant women of gestational age less than 18 weeks and greater

than 24 weeks.
- Pregnant women with oligohydramnios (AFI <5) were excluded from the study.

Data Collection:
- After proper filling of Form F/consent form, pregnant women underwent a thorough 2D & 3D/4D Ultrasonographic antenatal scan for fetal anomalies. The Ultrasound findings were assessed regarding the anomalies detected in 2D US and 3D/4D US.

Equipment:
- The present study was carried out using ESOATE MY LAB class 3 Ultrasound machine which has a volume probe BC431 with 3D and 4D software.

Examination technique:-
Once the pregnant women agreed to participate in the study, informed consent was taken prior to the ultrasound examination. The patient was made to lie supine on the examination table and fetal ultrasound was done. Firstly evaluation was done by 2D Ultrasound. Anomalies that were detected in 2D US were noted. Later 3D/4D ultrasonography was performed. The 3D fetal CNS volume was obtained from the axial plane with the middle of the acquisition sweep at the level of thalamus and the face volume was obtained at the sagittal view including the profile. All sweep volume angle were set at 65°. The acquired 3D volumes were stored immediately. Fetal intracalvarium parameters measurement and offline display were performed later on the same ultrasound machine after the women had left. Several volumes were routinely acquired in order to account for possible motion artefacts. Each volume was analyzed for head shape, lateral ventricles, corpus callosum, cavum septi pellucidi, thalami, cerebral parenchyma, cisterna magna, choroid plexus, cerebellar vermis and facial features (both eyes, nose, upper lip and profile) using multiplanar mode, rendering mode, and TUI.

4D STIC is used for cardiac evaluation. The 4D STIC acquisition angle was set at 20-25°. All volumes were obtained from an apical or a transverse four-chamber view. Volume acquisition time was between 7.5 to 10 seconds. The procedure was performed in absence of fetal movement or breathing. Patients were asked to momentarily suspend breathing during volume acquisition. In each case, two to three heart volumes were captured and the best volume illustrating the heart structures was selected for the study. Analysis of the volume was performed offline using multiplanar mode. The spine was always at 6 o'clock and the apex of the heart was between 10 and 11 o'clock in the A plane. In the B plane, the spine should be horizontal. The dot, which indicates the intersection of the 3 planes, should be positioned over the crux of the heart, between the insertions of the AV valves. To select the best inter slice distance for showing the heart structures adequately, the Tomographic Ultrasound Imaging (TUI) display mode was activated, using as a reference the four-chamber view. The number of slices was set at nine. The volume was then scrolled until the most significant echocardiographic views were displayed on the nine-screen windows. If too many windows showed intermediate non-diagnostic views (e.g. Five-chamber view or incomplete view of one outflow), the slice distance was adjusted finely (increasing gradually from 1.0 mm), until all key three views appeared in the various windows.

Later volume of chest and abdomen were acquired. It is then analyzed using multiplanar display mode, TUI, and Rendering modes. Surface mode was applied for limbs to identify polydactyly, mesomalia etc. Maximum Intensity Projection was used to see bones of limbs and vertebrae.

The ultrasound appearances were analyzed and compared with postnatal appearances.

Analysis: All the data was filled in pretested proforma and master chart was prepared. Later all the results were statistically analyzed.

RESULTS

Total of 58 pregnant women in whom anomalies detected on 2D were included in the study. Age of pregnant women was in the range of 18 to 37 years (mean – 23.5 years). Gestational age of pregnancies was in between 18 to 24 weeks. 2D US and 3D/4D/STIC was done in all cases. Later they were evaluated postnatally for the presence of anomalies. Anomalies of all cases were classified into different systems.

Total 87 anomalies were seen pertaining to different systems either as isolated one or in association with syndromes. 23 anomalies are of CNS, 16 anomalies in musculoskeletal system, 14 anomalies belongs to cardiac, 12 anomalies in genitourinary tract, 8 anomalies in fetal face, 6 anomalies in gastrointestinal system, 5 anomalies in pulmonary system and 3 miscellaneous anomalies.

Table 1: 2D versus 3D/4D/STIC Ultrasonography in detecting fetal anomalies.

FETAL ANOMALIES (TOTAL)	NO. OF CASES DIAGNOSED ON 2D	NO. OF CASES DIAGNOSED ON 3D/4D/STIC
CENTRAL NERVOUS SYSTEM (23) Anencephaly(5) Occipital encephalocele and meningocele(3) Spina bifida with or without hydrocephalous(6) Partial agenesis of corpus callosum(1) Isolated hydrocephalus(2) Porencephalic cyst(1) Dandy walker malformation(2) Blakes pouch(1) Microcephaly(1) Craniosynostosis(1)	20 5 3 6 - 2 1 1 (1 suspected) -(suspected) 1 1	22 5 3 6 - 2 1 2 1 1 1
MUSKULOSKELETAL SYSTEM(16) Polydactyly (with syndromes)(3) Syndactyly (with syndromes)(1) Clinodactyly (with syndromes)(1) Club foot(2) Rocker bottom foot (with syndromes)(1) Hemivertebra (with syndromes)(2) Arthrogryposis(1) Short rib polydactyly syndrome(1) Chondrodysplasia punctata(1) Osteogenesis imperfect(1) Achondroplasia(1) Congenital short femur with associated short tibia and absent fibula(1)	12 2 1 - 2 1 - 1 1 1 1 1 1	13 2 - 1 2 1 1 1 1 1 1 1 1
FETAL HEART(14) Ventriculo-septal defect(4) Artrioventricular septal defects(2) Tetrology of fallot(2) Coarctation of aorta(1) Hypoplastic left heart syndrome(1) Aortic stenosis(1) Double outlet right ventricle(1) Transposition of great vessels(1) Corrected transposition of great vessels(1)	11 3 2 2 - 1 -(suspected) 1 1 1	12 4 2 2 - 1 1 1 1 -
GENITOURINARY SYSTEM(12) Hydronephrosis(4) Renal agenesis(4) Bilateral bulky echogenic kidneys- ARPKD(2) Renal cystic dysplasia(1) Posterior urethral valves(1)	12 4 4 2 1 1	12 4 4 2 1 1

FACIAL (8) Cleft lip(2) Cleft palate(2) Agnathia otocephaly complex(1) Binders syndrome(1) Aperts syndrome(1) Micrognathia(1)	5 2 1 1 -(suspected) 1 -	7 2 2 1 1 1 -
GASTROINTESTINAL SYSTEM (6) Duodenal atresia(1) Intestinal obstruction(1) Omphalocele(1) Tracheoesophageal fistula(2) Abdominal cyst(1)	6 1 1 1 2 1	6 1 1 1 2 1
PULMONARY (5) Congenital diaphragmatic hernia(4) Congenital cystic adenoid malformation(1)	5 4 1	5 4 1
OTHERS (3) Cystic hygroma(1) Non immune hydrops(1) Conjoint twins(1)	3 1 1 1	3 1 1 1
TOTAL	74 – diagnosed, 4 – suspected but not confirmed 9 – missed	– 80 diagnosed 7 - missed

Of total 87 anomalies, 2D US diagnosed 74 (85.05%) anomalies. 3D/4D/STIC diagnosed 80 (91.95%) anomalies. 2D missed 13 (14.94%) anomalies where as 3D/4D/STIC missed 7 (8.04%) anomalies. 3D/4D/STIC gave extra information in 8 cases.

DISCUSSION

Three-dimensional (3D)/four-dimensional (4D) sonography is regarded as a further development of ultrasound imaging technology. This study was to determine the usefulness of 3D/4D – STIC US as an adjuvant tool to 2D US in obstetrical practice.

3D/4D-STIC US helped in diagnosis of Dandy Walker Malformation, Blakes Pouch, Sub-Aortic VSD in DORV, Aortic Stenosis, Clinodactyly, Hemivertebra in VACTERL Syndrome, Cleft palate and Binder's Syndrome. 3D/4D provided no extra information in case of genitourinary, gastrointestinal and pulmonary anomalies.

Table 3: Anomalies that were missed in 2D US, cause of failure to identify in 2D and usefulness of 3D/4D/STIC

S.NO	ANOMALIES THAT WERE MISSED IN 2D US	CAUSE OF FAILURE TO IDENTIFY IN 2D	USEFULNESS OF 3D/4D/STIC
1	Sub-aortic VSD in association of Double Outlet Right Ventricle	Failure to obtain specific plane in 2D US	Plane of Left ventricle outflow tract was obtained showing sub-aortic VSD
2	Clinodactyly in Down's syndrome	Difficulty in identifying in 2D US	Maximum Intensity Mode showed clinodactyly
3	Hemivertebra in VACTERL syndrome	Difficulty in identifying in 2D US	Maximum Intensity Mode showed hemivertebra at D10 level
4	Cleft palate in association with cleft lip	Due to unfavourable position	Volume was acquired. On rotation with the use of reference point end on view of palate was obtained showing cleft palate

Table 4: Anomalies suspected but failed to confirm the diagnosis in 2D and usefulness of 3D/4D/STIC in these conditions

S.NO	Anomalies that were suspected in 2D US but failed to confirm the diagnosis	Cause of failure to diagnose in 2D	Usefulness of 3D/4D/STIC
1	Blakes pouch	Posterior fossa cyst was identified but mid-sagittal plane was not obtained in 2D US	Volume was acquired. On rotation mid-sagittal plane was obtained
2	Dandy walker malformation	Posterior fossa cyst was identified but mid-sagittal plane was not obtained in 2D US	Volume was acquired. On rotation mid-sagittal plane was obtained
3	Aortic stenosis	Hypertrophied left ventricle with mitral regurgitation. Plane of left outflow was tract not obtained in 2D US	Plane of left ventricle outflow tract was obtained showing thickened aortic cups.
4	Isolated Binder's system	Hypoplasia of mid-face noted. But naso-frontal angle could not be calculated due to failure to obtain fetal profile	Volume was acquired. On rotation with the use of reference point fetal facial profile was obtained. Naso-frontal angle was calculated.

FETAL CENTRAL NERVOUS SYSTEM ANOMALIES:

Central nervous system anomalies are Anencephaly(5), Occipital Encephalocele(2), Occipital Meningocele(1), Spina Bifida with or without Hydrocephalous(6), Partial agenesis of Corpus Callosum(1), Isolated Hydrocephalous(2), Porencephalic cyst(1), Dandy Walker malformation(2), Blakes pouch(1), Microcephaly(1), Craniosynostosis(1). Among these anomalies 3D/4D US helped in 2 anomalies – Blakes pouch and Dandy walker malformation.

In this study, 3D/4D ultrasonography is very much useful for evaluation of midline structures. When fetus is not in favourable position it is very difficult to acquire mid-sagittal section. In such conditions 3D ultrasound is very much useful. The volume is acquired and on post-processing we can get mid-sagittal position. This scenario is seen in two cases.

A posterior fossa cyst was identified in axial section in 2D ultrasound but it failed to acquire mid-sagittal plane. Mid-sagittal plane is important to reveal the presence or absence of vermis and to identify the communication of 4th ventricle with posterior fossa cyst. Later 3D volumes were acquired and mid-sagittal plane is obtained. In this plane, the vermis is normal and there was communication of cyst to fourth ventricle. All these findings favoured the diagnosis of Blakes Pouch.

Another case of posterior fossa cyst was identified in 2D axial but mid-sagittal plane was not obtained. Later volume was acquired with 3D technique and mid- sagittal plane is obtained. It showed that cystic fourth ventricle extended superiorly, displacing the hypoplastic cerebellar vermis and elevating the tentorium cerebelli above its normal position. All these favoured the diagnosis of Dandy walker malformation.

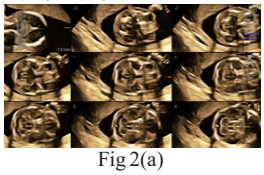

Fig 2(a)

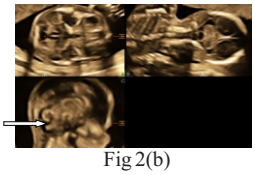

Fig 2(b)

Figure 2: a) – 3D TUI axial cuts showing posterior fossa cyst. b) – 3D Multiplanar mode showing normal vermis and the posterior fossa cyst is communicating with fourth ventricle in mid-sagittal plane (white arrow) – Blakes pouch.

FETAL MUSKULOSKELETAL ANOMALIES:

Total musculoskeletal anomalies were of 16. They were Polydactyly(3), Syndactyly(1), Clinodactyly(1) Club foot(2), Rocker bottom foot(1), Hemivertebra (2), Arthrogryposis(1), Short Rib Polydactyly Syndrome(1), Chondrodysplasia Punctata(1), Achondroplasia(1), Osteogenesis Imperfecta(1), Congenital short femur with shortened tibia and absent fibula(1)

3D/4D helped in diagnosing two anomalies - clinodactyly(1) in a case of Down's syndrome and hemivertebra(1) in VACTERAL syndrome. These were diagnosed in 3D ultrasonography using Maximum Intensity Mode.

Figure 3: 3D Maximum Intensity Mode showing radial deviation of left little figure – Clinodactyly.

FETAL CARDIAC ANOMALIES:

Among Cardiac anomalies, there are 4 Ventriculo-septal defects, 2 Atrio-ventricular septal defects, 2 Tetrology of Fallot, 1 Hypoplastic Left Heart Syndrome, 1 Valvular Aortic stenosis, Double Outlet Right Ventricle, 1 Transposition of Great Vessels 1 coarctation of aorta, and 1 corrected transposition of great vessels.

STIC helped in two fetal cardiac anomalies that were missed / suspected (not confirmed) in 2D ultrasonography. One was sub-aortic Ventriculo-septal defect in association with Double Outlet Right Ventricle and other was Aortic stenosis. Aortic stenosis is suspected in 2D ultrasonography. In 2D ultrasonography there was hypertrophied left ventricle, with dilated left atrium. There was mitral regurgitation with colour flow. There was altered three vessel view. Left ventricular outflow tract was not made out. Later STIC was performed. Multiplanar mode was acquired. Keeping yellow dot over the ventricular septum rotation was made to get end on valve view. There is thickening of aortic cusps with luminal narrowing. The blood supply to descending aorta was by pulmonary artery through ductus arteriousus. There was reversal flow in ascending aorta. All these findings favored the diagnosis of severe Aortic stenosis.

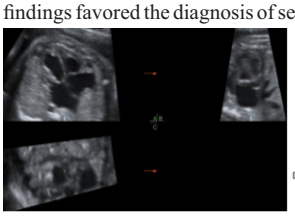

Fig 4(a)

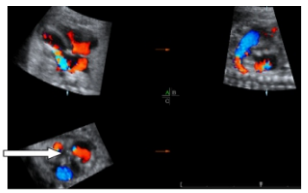

Fig 4(b)

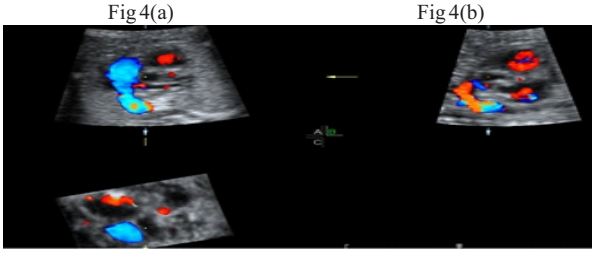

Fig 4(c)

Figure 4: a) STIC grey scale multiplanar images showing fibroelastosis and not opening of mitral value in A plane of multiplanar mode. b) STIC colour flow multiplanar images showing mitral regurgitation in A plane. B plane is an end on view showing thickened aortic cups with no obvious flow through the valve (arrow). c) STIC colour flow multiplanar images showing blood flow to the descending aorta is by pulmonary artery through ductus arteriousus in plane A. Plane B is showing reversal of blood flow in ascending aorta. All these features are suggestive of Aortic Stenosis.

FETAL FACIAL ANOMALIES:

Facial anomalies were cleft lip (2) and cleft palate (2), Binders syndrome (1), Apert's syndrome (1), Micrognathia (1) and Agnathia Otocephaly complex (1). 2D ultrasonography failed to identify cleft palate in one case. 2D US suspected binder's syndrome due to hypoplasia of nose and upper jaw but failed to calculate nasofrontal angle due to failure to attain mid-sagittal plane. Volume was acquired with 3D ultrasonography and on post-processing mid-sagittal plane is obtained. Nasofrontal angle was calculated and found to be deviated from normal. There was no punctate calcification of ends of long bones. All features favored the diagnosis of Isolated Binder's syndrome.

In this study 3D/4D ultrasound was useful for face abnormalities. Angles are to be measured in mid-sagittal plane only. It is sometimes difficult in 2D ultrasonography due to abnormal fetal position. 3D ultrasound is also very much useful for cleft palate. 3D/4D ultrasonography better displayed the fetal facial expressions such as yawning, swallowing etc.

Fig 5(a)

Fig 5(b)

Figure 5: a) 2D image at the level of palate showing defect in upper lip and hard palate on left side. b) 3D Surface Rendering mode showing cleft lip on left side.

Table 5: Studies on Prenatal diagnosis of congenital anomalies with 2D ultrasonography and 3D/4D ultrasonography

AUTHOR	YEAR	GA (WEEKS)	POPULATION	OUTCOME
Merz et al.2	1995	16-38	204 patients with a fetal malformation detected by conventional 2D us	3D/4D advantageous to demonstrate fetal structures in 62.3% (127), similar information in 35.8% (73), and less information in 2% (4) of cases
Merz et al.3	1995	16-38	242 normal cases and 212 with congenital anomalies diagnosed by 2D US	Diagnostic gain over 2D US was seen in 64.2% (139) cases

Platt et al.4	1998	6-35	Obstetric and gynecology patients attending a clinic. Anomalies in 32 cases	3D/4D US changed diagnosis or provided additional information in 9% (3) of cases
Baba et al.5	1999	13-35	36 abnormalities detected in 19 pregnancies complicated by congenital malformations. All exams with 4DUS	Additional information provided by 4D US in 25% (9) of anomalies
Dyson et al.6	2000	12-38	63 cases with 103 anomalies. Anomalies were examined by 2D US and 3D US	3D provided additional information in 51.5%, similar information in 44.7% and disadvantage in 3.9% of anomalies
Scharf et al.7	2001	7-41	433 cases. Mixed high and low risk population. 40 fetuses with congenital anomalies	Visualization of congenital in 3D US and 2D US was 68.3% and 97.5% cases. P value - <0.05
Xu et al.8	2002	7-41	216 high risk pregnancies with 41 cases of congenital anomalies	Definitive diagnosis of congenital anomaly in 3D US and 2D US seen in 92.7% and 78.0% 0f cases. P value - <0.05
Merz et al.9	2005	11-35	3472 high risk pregnancies. 1012 congenital anomalies detected in 906 pregnancies	3D US advantageous to demonstrate anomalies in 60.8% of cases
Present study	2016	18-24	58 cases with anomalies detected in 2D US. Total anomalies were 87	3D/4D US - STIC helped to diagnose 9.19% (8) of anomalies.

The 3D/4D ultrasonography on a whole provided unique images in both planar and rendered format that were not visualized with standard 2D ultrasound scans. Planar images derived from 3D US volumes were more useful than rendered images for physician interpretation in the majority of anomalies. 4D ultrasonography was helped to identify fetal behavior such as yawning, swallowing etc.

The 3D US offered advantage over 2D US imaging in terms of data storage, post-processing capabilities and the ability to send volumetric data to other locations electronically will also allow data to be reviewed by distant specialists.

The 3D US was potentially influenced obstetrical management in the cases where the findings were missed in 2D US such as Binder's syndrome. Visualization of an anomaly with rotated rendered image assisted the parents in choosing the management plan. There was higher confidence levels of diagnosis with 3D US in comparison with 2D US in anomalies that were often equivocal or difficult to discern such as cleft palate.

The 3D US scanning added a significant amount of time to the standard ultrasound examination. Multiple volumes of each anomaly were obtained, with an average of two to five acquisitions.

There were few disadvantages of 3D/4D US. Poor quality images were obtained when fetus was moving while acquiring the volume. For Surface rendering mode, minimum of 0.5 to 1 cm liquor should be present for good rendering. With less liquor rendering has not given any additional information.

Limitation of study:

The population of patients in this study was subjected to selection bias. As patients in whom anomalies were detected in 2D were asked for participation in study. Anomalies that were not detected in 2D were not included in study. This would biased subjects away from subtle anomalies missed on routine obstetric sonography.

CONCLUSION

3D/4DSTIC ultrasonography is the latest development of 2D ultrasonography. In this study 3D/4D/STIC was an effective adjunctive tools in diagnosing fetal anomalies along with 2D ultrasound. They provided additional information in 9.09% of cases. It helped in diagnosing midline lesions of fetal brain like posterior fossa cysts etc It was a valuable tool for diagnosing fetal lesions that require facial profile for diagnosis. STIC helped in diagnosing complex heart diseases with less time. Cleft palate was diagnosed confidently using 3D/4D US. Maximum Intensity Mode was very useful for diagnosing skeletal anomalies more easily. 3D/4D ultrasound did not provided extra information for diagnosing genitourinary, gastrointestinal, and pulmonary anomalies. However 3D/4D/STIC did not helped in cases with excessive fetal movements and less liquor.

REFERENCES

1. Aaron Fenster1, D´onal B Downey and H Neale Cardinal; Three-dimensional ultrasound imaging. Phys. Med. Biol. 46 (2001) R67-R99.
2. Merz E, Bahlmann F, Weber G; Volume scanning in the evaluation of fetal malformations: a new dimension in prenatal diagnosis. Ultrasound Obstet Gynecol. 1995;5:222–227.
3. Merz E, Bahlmann F, Weber G, Macchiella D; Three-dimensional ultrasonography in prenatal diagnosis. J Perinat Med 23: 1995b: 213-222.
4. Platt LD, Santulli T, Jr, Carlson DE, Greene N, Walla CA; Three-dimensional ultrasonography in obstetrics and gynecology: preliminary experience. Am J Obstet Gynecol. 1998;178:1199–1206.
5. Baba K, Okai T, Kozuma S, Taketani Y; Fetal abnormalities; Evaluation with real-time-processable three-dimensional US-preliminary report. Radiology 1999: 211:441-44.
6. Dyson RL, Pretorius DH, Budorick NE, et al.; Three-dimensional ultrasound in the evaluation of fetal anomalies. Ultrasound Obstet Gynecol. 2000;16:321–328.
7. Scharf A, Ghazwiny MF, Steinborn A, Baier P, Sohn C; Evaluation of two-dimensional versus three-dimensional ultrasound in obstetric diagnostics: a prospective study. Fetal Diagn Ther. 2001;16:333–341.
8. Xu HX, Zhang QP, Lu MD, Xiao XT; Comparison of two-dimensional and three-dimensional sonography in evaluating fetal malformations. J Clin Ultrasound. 2002;30:515–525.
9. Merz E, Welter C; 2D and 3D ultrasound in the evaluation of normal and abnormal fetal anatomy in the second and third trimesters in a level III center. Ultraschall Med 2005: 26:9-16.