

Image Acquisition Adequacy for Second Trimester Targeted Fetal Scans - A Clinical Audit

Krishna Prasad Bellam Premnath¹, Binu Joy², Ajith Toms³, Teena Sreeba³

¹Consultant Interventional Radiologist, Rajagiri Hospital, Chunangamvely, Aluva, Kochi, Kerala, India, ²Head, Department of Radiology and Health Informatics, Rajagiri Hospital, Chunangamvely, Aluva, Kochi, Kerala, India, ³Consultant Radiologist, Rajagiri Hospital, Chunangamvely, Aluva, Kochi, Kerala, India

Abstract

Introduction: Clinical audits are essential for health care quality assurance and improvement. Ultrasound has an important role in pregnancy, especially in foetal anatomical screening which is done between 18 and 22 weeks of gestation.

Aim: To audit image acquisition adequacy for targeted second trimester scans and to determine improvement after a few simple interventions.

Methods: Retrospectively audit the images of targeted scans performed over a period of one year, discuss the findings in an audit meet, recommend interventions to improve imaging adequacy and perform a re-audit after six months to document improvement.

Results: Initial audit showed that only 44.9% of studies had adequate acquired images as per guidelines, with higher percentage of scans performed by senior consultants being adequate. Proportion of scans with adequate image acquisition rose to 91.4% on re-audit.

Conclusion: Information regarding importance of adequate image acquisition and presence of easily accessible imaging checklist are effective ways to improve adequate imaging adequacy in targeted scans.

Key words: Anomaly scan, Clinical audit, Imaging quality, Rule of three, Ultrasound

INTRODUCTION

Ultrasound is a non-invasive medical imaging modality and relies on sound wave transmission and reflection of sound waves in tissues. In pregnancy, it has a very important role in generating images of the developing fetus which is used to monitor fetal development and screen for any abnormalities.¹ In spite of its safety profile, the use of ultrasound in pregnancy should be used only for medical purposes, because of the potential for tissue heating.^{2,3} Ultrasound image in pregnancy is indicated for specific purposes in each trimester. In the first trimester, it is performed to evaluate the location,

size and number of gestational sacs, yolk sac and cardiac activity of embryo. Second trimester scan is done between 18 and 22 weeks for detailed anatomical evaluation. Third trimester ultrasound is indicated for evaluating fetal growth, presentation, cardiac activity, placental abnormalities, and amniotic fluid volume.^{4,5}

Among the indicated ultrasonographic ultrasound examinations in pregnancy, the second trimester targeted anomaly scan can be considered the most important, and a thorough anatomical examination of the fetus is warranted during this examination.⁶ The report was given for an ultrasound, and the images are a part of the patient medical record, and the number of images should be adequate enough to ensure that a necessary standard of examination has been carried out. A written or printed radiology report is a legal document, and the associated recorded images should be archived for purposes of documentation and medico-legal requirements.^{7,8}

Guidelines state that widely published requirements for image acquisition should be followed. Various such

Access this article online



www.ijss-sn.com

Month of Submission : 04-2017
Month of Peer Review : 05-2017
Month of Acceptance : 06-2017
Month of Publishing : 06-2017

Corresponding Author: Dr. Krishna Prasad Bellam Premnath, Rajagiri Hospital, Chunangamvely, Aluva, Kerala, India.
Phone: +91-9947824499. E-mail: krishnaprasadir@gmail.com

standards are available, among which, the most widely followed in our region is the “rule of three” by Suresh and Suresh.⁶ It was made to extract maximum information from fetal anatomical ultrasound in the most time-efficient manner, and ensures satisfactory examination. It involves visualizing three anatomical structures in each section or part of the fetus and its environment.

Aim

The aim of this audit was to determine the adequacy of image acquisition for targeted second trimester scans in the radiology department of a tertiary care hospital and to determine improvement after a few simple interventions.

Audit Standards

“Rule of three” guidelines were used as a standard for image acquisition adequacy.⁶ Ideally, all studies should have all images acquired as listed in the guidelines. Proportion of scans which had recorded images of every particular plane of imaging mentioned in the imaging guidelines was used to measure extent of adequacy. The audit standards aimed for imaging planes were Around 100% for three planes of head, three sagittal spine aspects, transverse axis of spine, four chamber and three vessel views of heart, three planes of abdomen, proximal and distal segments of limbs, placental position, and transorbital facial view.

Outflow tract views of heart and facial views can be considered more difficult compared to the rest of the image planes, and heavily dependent on fetal position, and hence standard set was 90%.

Studies were conducted on patients with very high BMI precluding satisfactory fetus evaluation were excluded.

METHODS

This was a retrospective audit and images available in the picture archiving and communication system (PACS) of targeted scans performed over a period of 1 year from September 2015 to August 2016 were analyzed for adequacy in terms of percentage of studies with recorded specific imaging planes.

The results were discussed in a clinical audit meet. A presentation on the importance of adequacy of image acquisition with appropriate labeling and the widely used “rule of three” guidelines was made to all radiologists involved in the performance of targeted scans. “Rule of three” guideline pamphlets were made available near all ultrasound machines which were used to perform obstetric scans. Specific training about acquisition of specific cardiac and facial planes was given to all radiologists by a consultant obstetric sonologist. 30 min slots were allotted for anomaly scans. A re-audit was performed 6 months later to document improvement in image acquisition adequacy.

RESULTS AND DISCUSSION

Initial Audit

About 263 targeted scans were listed performed in radiology information system over the period of a year

Table 1: Percentage of imaging studies bearing various imaging planes during targeted second trimester scan

Structure	Plane	Audit standard (%)	Initial audit (%)	Re-audit
Head	Trans thalamic plane	100	100	100
	Ventricular plane	100	76.1	100
	Trans cerebellar plane	100	59	100
Spine	Three aspects of sagittal plane	100	57.4	100
	Transverse plane	100	69.2	97.1
	Coronal plane	Not a requisite	58.5	86.2
Thorax	Mid-thoracic plane	100	57.4	97.7
	Four chamber view	100	80.6	100
	Three-vessel view	100	65.4	100
	Left ventricular outflow tract	90	47.5	93.1
Abdomen	Right ventricular outflow tract	90	47.2	91.4
	Upper abdomen trans-gastric	100	100	100
	Mid abdomen trans renal	100	65.7	97.7
	Lower abdomen with Doppler showing two umbilical arteries	100	58.5	100
Extremities	Proximal segment - both sides femur and humerus	100	44.9	98.3
	Midsegment	Not a requisite	45.6	96.5
	Distal segment - upper limbs	100	57	100
	Distal segment - feet (either axial or sagittal)	100	55.1	100
Face	Trans orbital	100	62	100
	Nose - mid sagittal	90	58.5	92
	Nose and lips	90	51.7	96.5
	Premaxillary triangle	90	45.6	94.8

Table 2: “Rule of three” guidelines

Structure studied	Three planes of structure studied	Three structures in each plane
Head	Trans thalamic plane	Falx cerebri, cavum septum pellucidum, and thalami
	Transventricular plane	Lateral ventricles, choroid plexus, and cavum septum pellucidum
	Transcerebellar plane	Cerebellar hemispheres, vermis, and cistern magna
Spine	Sagittal plane	Cervical widening, parallel thoracolumbar spine and sacral tapering
	Transverse plane	Three ossification centers forming a triangular shape
	Coronal plane	Not a requisite
Thorax		Two lungs and heart occupying equal space
Heart	Four vessel view	Crux, chamber symmetry and real-time movement of mitral and tricuspid valves
	Three-vessel view	Pulmonary artery, aorta, and superior vena cava
	Outflow tract views	Bifurcation of pulmonary artery, crossing of outflow tracts and continuity of anterior aortic root with ventricular septum
Abdomen	Upper abdomen	Stomach, portal vein and liver
	Mid abdomen	Right kidney, left kidney, and small intestine
	Lower abdomen	Bladder, two umbilical arteries, and genitalia
Extremities		Proximal, mid and distal segments

from September 2015 to August 2016. All scans were performed between gestational periods of 17 weeks 4 days and 22 weeks 0 days. 128 scans were performed by senior consultants with more than 8 years of experience, 135 scans performed by junior consultants. 24 (9.1%) studies had only three images depicting biometry. 118 (44.9%) studies had all images present in them as per guidelines. Findings with respect to each imaging plane are shown in Table 1. 94.4% scans performed by senior consultants were adequate as per guidelines, while only 14.6% scans performed by junior consultants were adequate with respect to image acquisition.

Re-audit

Re-audit was done 6 months after the presentation of the initial audit. A total of 174 studies were analyzed. There was a significant improvement. Overall, 159 (91.4%) studies had adequate images stored in PACS, image section wise details are provided in Table 1. 100% and 86.3% of studies performed by senior consultants and junior consultants, respectively, had adequate images acquired as per guidelines.

Radiologists in senior grade and better experience demonstrated better documentation responsibilities.

Three views - trans thalamic view, upper abdomen axial view, and femur view - are routinely taken for biometry (assessment of fetal maturation). Acquisition of additional views of fetal anatomy was found to be extremely variable in the initial audit. Trans ventricular view of head and four chamber view of heart were the most performed among them, and image representation of face, heart (except for four chamber view), spine and extremities were grossly inadequate. Image acquisition inadequacy does not always indicate inadequate scanning; however, availability of images can only be proof of optimal scanning.

It is common knowledge that ultrasound detects most of the fetal anomalies. Whenever there is birth of an

anomalous baby, an inevitable question would always be whether it could have been detected antenatally. Excess of free information is available in the internet as to how ultrasound can be used to detect particular anomalies. This would raise the question why an anomaly was missed in an antenatal scan. In a medico-legal issue of such effect, evaluation of negligence relies solely on examination of available images.⁸ It is hence extremely important to not only image the fetus adequately but also to save appropriate images, document the findings, abnormalities and also document the reason whenever a structure could not be adequately assessed - persistent suboptimal fetal position precluding facial evaluation, for example. Various guidelines and checklists are available to ensure satisfactory fetal assessment.

“Rule of three” is an excellent method of making sure to perform a satisfactory and thorough scan and documentation of anatomical details of an intrauterine fetus in the least time.⁶ It is done ideally between 18 and 22 weeks of gestation. The “rule of three” guidelines are detailed in Table 2.

Evaluation of every plane and every structure mentioned has a specific significance in diagnosing or ruling out specific anomalies, and it is important in view of documentation and medico-legal aspects that each imaging plane mentioned be studied and saved. A considerable increase in the proportion of scans with complete documentation from 44.9% to 91.4% has been demonstrated in this audit.

CONCLUSION

Training regarding the importance of adequate imaging and method of scanning as per guidelines is a simple method of effectively increasing adequate image documentation.

Easily accessible pamphlets depicting the imaging checklist would be an effective reference that a radiologist can use during performance of a targeted scan without having to spend considerable time.

RECOMMENDATIONS

- Emphasizing the significance of documentation and medico-legal aspects of the radiological report and the associated images to all radiologists to encourage them to acquire and save adequate images.
- Training radiologists about the techniques of appropriate image plane acquisition for fetal anatomical assessment.
- Training radiologists about widely accepted guidelines for adequate image acquisition and making such guidelines readily available for reference during the performance of a scan.

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How to cite this article: Premnath KPB, Joy B, Toms A, Sreeba T. Image Acquisition Adequacy for Second Trimester Targeted Fetal Scans - A Clinical Audit. *Int J Sci Stud* 2017;5(3):57-60.

Source of Support: Nil, **Conflict of Interest:** None declared.