Review article

TIME TO SCALE-UP POINT-OF-CARE ULTRASOUND (POCUS) IN OBSTETRICS AND GYNAECOLOGY IN NIGERIA.

Abstract

The availability, affordability and portability of high-resolution-ultrasound machine in recent years have made ultrasound examination an indispensable point-of-care diagnostic and procedural tool in current practice of Obstetrics and Gynaecology. POCUS is a goal-directed (focused/emergency) ultrasound examination performed by the healthcare provider in the consulting office or patient's bedside to make a specific diagnosis that will direct timely definitive treatment of the patient. It improves clinical outcomes, prevents hospital delay, promotes swift definitive treatment, reduces cost and enhances patient satisfaction without exposure to ionizing radiation. It is advocated to be a readily available care in Obstetrics and Gynaecology. Skills acquisition in POCUS should be incorporated in teaching programs for midwives, medical students, resident doctors and consultants. This review aims to summarize the literature on the advances in ultrasound technology, indications and practice guidelines for clinician's POCUS examinations in Obstetrics and Gynaecology. Recommendations to fill the gaps in the current training and skills acquisition in Nigeria are proposed.

Keywords: POCUS, Obstetrics and Gynaecology, Indications, Guidelines, Scale-up-practice.

Introduction

1. Point Of Care Ultrasound (POCUS)

POCUS can be defined as a goal-directed bedside or office clinician-performed ultrasound examination (Figure 1) for a specific diagnostic and/or interventional purpose [1, 2]. The main objective of POCUS during patient evaluation is to make a prompt diagnosis that will direct swift definitive treatment of the patient. It is a rapid but limited study performed by the same clinician who knows the patient's history and has performed the necessary physical examination.

It reduces delays in diagnosis and initiation of necessary treatment [3]. The immediate diagnoses and swift definitive interventions are particularly relevant in obstetric and gynaecological emergencies where obstetric delays are known to aggravate adverse feto-maternal outcomes [4]. It is not, however, a substitute for an in-depth diagnostic ultrasound scan by skilled radiologists, but a complementary diagnostic tool that can make the clinician more efficient in clinical decision-making. It can also be called emergency, focused or clinician-performed ultrasound.

Figure 1: Antenatal clinic office POCUS at 37 weeks gestational age in Semino Hospital and Maternity, Enugu to exclude placenta praevia in a known low-lying placenta at 18 week.

2. Advances in ultrasound technology and relevance in clinical practice

Karl Theodore Dussik (Figure 2), an Austrian psychiatrist and neurologist, was the first physician to use a primitive-gigantic-complex ultrasound device to interrogate and visualize cerebral ventricles and brain tumors in 1946 [5]. Advances in ultrasound technology evolved from the 'immersion-tank ultrasound systems' to A-mode in the late 1950s, B-mode in the 1970s [6], real-time and gray-scale images in the 1980s [7], Doppler and color Doppler in the 1990s [8, 9]; and three dimensional and four-dimensional ultrasound in the 2000s [10]. The use of artificial

intelligence in ultrasound, new visualization methods and improved ergonomics are where the advances in ultrasound technology are currently going to [11].

The development of portable ultrasound devices including miniature handheld ones (Figure 3) in recent years has made it an indispensable point-of-care diagnostic and procedural tool in current practice of Obstetrics and Gynaecology. Ian Donald pioneered the use of Obstetrics and Gynecology [6]. POCUS has revolutionized the practice of medicine from the primitive bedside tools like the reflex hammer and stethoscope to bedside ultrasound that can make clinicians actually visualize immediately what they have palpated or auscultated. It is an extension of the physical examination and the greatest advancement in bedside diagnosis since the advent of stethoscope. It is relevant in virtually every field of medicine and surgery. The integration of POCUS into routine clinical practice was, however, too slow in spite of its enormous positive impacts in clinical outcomes. It reduces failure and complication rates during procedures [12], rapidly narrows differential diagnoses [13], shortens times to definitive treatment [14], lowers cost of care [15], and reduces the exposure to ionizing radiation [16]. It involves patients in their case managements, enhances patient-doctor relationships and patient satisfactions [17]. POCUS should be a **'must-know'** basic skill before a resident doctor qualifies to participate in the Part 1 Fellowship Examination in Obstetrics and Gynaecology in Nigeria.

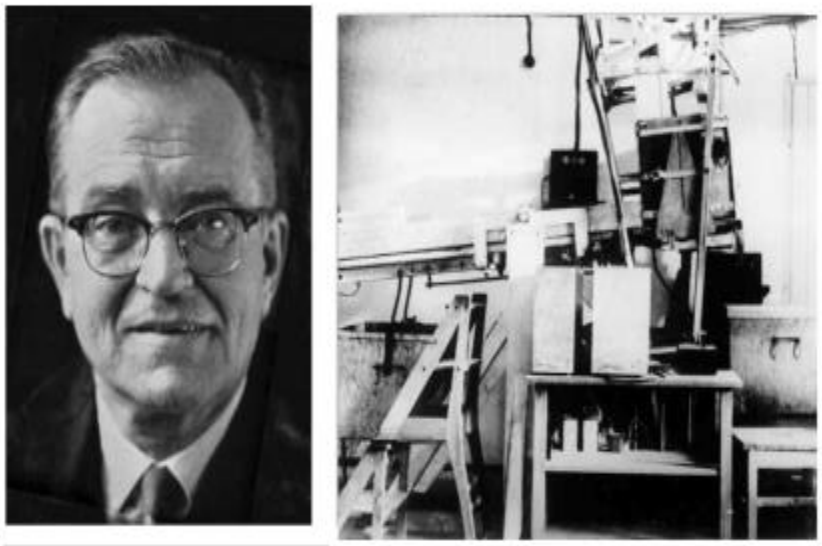

Figure 2: Karl Theodore Dussik and his first medical ultrasound device in 1946 [5].

Figure 3: Handheld "miniature" ultrasound system for POCUS [11]

3. Indications of POCUS in Obstetrics and Gynaecology [18-23]

The thermal index (TI) and mechanical index (MI) effects of ultrasound were observed in the 1920s to kill fish that were within the ultrasonic beam [18]. These bio-effects of ultrasound were initially used for therapeutic applications. Later ultrasound was used to visualize internal anatomy [19]. Today, there is a wide range of indications for POCUS (Table1) that one cannot imagine practicing modern Obstetrics and Gynaecology without basic ultrasound skills [20-22]. The impacts on clinical decision-makings are enormous [23]. These impacts are most beneficial when there are appropriate indications and the clinicians are competent to avoid unnecessary ultrasound examinations that can lead to irrelevant findings, further investigations, patient anxiety and even harmful treatments [23].

Table 1: Indications for POCUS

1. **Gynaecological and first trimester ultrasound examinations [23, 24]:**

- Vaginal bleeding.
- Abdominal and pelvic pain.
- Abdominal and pelvic masses.
- Amenorrhoea and infertility.
- Confirmation of an intrauterine pregnancy (IUP).
- Dating of pregnancy with crown–rump length of the embryo.

- Monitor embryo and fetal growth and/or demise.
- Confirmation of complete or incomplete abortion.
- Diagnosis of ectopic pregnancy especially with Trans-Vaginal Scan (TVS).
- Location of missing contraceptive devices.
- Measure endometrial thickness.
- Detection of uterine polyps and fluid in the cavity.
- Diagnosis of ovarian cysts and torsion.
- Diagnosis of multiple pregnancy and the determination of chorionicity and amnioicity.
- Serial measurements of cervical length for ultrasound directed cervical cerclage to avoidance unnecessary routine history indicated cerclage.
- Others include:
  - Suspicion of uterine malformation.
  - Follicular tracking and baby sex selection.

2. Procedural or interventional indications

- Ovum retrieval and embryo transfer.
- Retrieval of missing intrauterine contraceptive device.
- Medical treatment of ectopic pregnancy with potassium chloride and methotrexate.
- Aspiration of ovarian cysts.

3. Second and third trimesters, labour and puerperium POCUS indications

- Assessment of fetal well-being e.g. fetal growth, macrosomia, intrauterine growth restriction and demise.
- Assessement of fetal lie, presentation, position and weight.
- Placental localization.
- Amniotic fluid volume estimation.
- Accurate determination of presentation, position, and cervical dilation during labour and delivery management [24].
- Rupture of the pregnant uterus and free peritoneal fluid
- Puerperal uses to diagnosis haemoperitneum, pelvic abscess, retained fragment of the placenta and missing abdominal mops or surgical instrument.

4. **Training Curriculum, Practice Guidelines, and Skill Acquisition programs [25-30].** The availability of competent healthcare providers with basic ultrasound skills is critical for the integration of POCUS services into routine clinical practice [11, 21, 25-28]. The World Health Organization (WHO) [29], International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) [26] and American Institute of Ultrasound in Medicine (AIUM) [27] expert opinions have recognized the impact and importance of decentralization of POCUS service delivery through appropriate healthcare provider's training and task sharing. ISUOG and AIUM have developed consensus-based curriculum, standardized practice guidelines and competency assessment tools that can be ratified as in tables 2 and 3 as the minimum requirement for competency by a training institutions [26, 27]. Obtaining 3 ultrasound images with good image optimizations and at the appropriate planes within 1 minutes for a specified task can be used as the minimum standards for attaining competency. The use of ultrasound mannequins during training will enhance the competency-assessment process.

Table 2: Basic training curriculum [28] of practical batches of 5 students for 5 hours each day for 5 days

1. Basic principles of ultrasound physics.
2. Knobology: frequency, resolution, depth gain, time gain compensation etc
3. Ultrasound modes (B-mode, M-mode, Doppler, two-dimensional (2D) and three-dimensional (3D).
4. Ultrasound transducers: types and applications.
5. Image orientations : Trans Abdominal Ultrasound (TAS) and Trans Vaginal Ultrasound (TVS)
6. Bio-effects of ultrasound (As Low As Reasonably Achievable (ALARA) principle) [30].
7. Patient review: identification, counseling, indications, position and inputting information.
8. Ultrasound examination (**Hand-on-training in groups of not more** 5): coupling agents, ergonomic practices, correct transducer manipulation and image orientation, image

labeling and storage and documentation of findings. Careful transducer handling, cleaning and disinfection.

9. Recommended videos to watch during breaks
    a. The Principles Physics of Ultrasound Imaging: Medical Aid Films - Films for Life Made in partnership with ISUOG,
    Ultrasound Machine Basics- Knobology, Probes, and Modes www.pocus 101.
    b. Gynecology/Pelvic Ultrasound Made Easy:Step-By-Step Guide www.pocus101.com.
    c. The Basic Steps of an Obstetric Ultrasound Examination: Medical Aid Films - Films for Life. Made in partnership with ISUOG.
    d. ISUOG: Plan your movement and improve your image: Dr. Hisham Mirghani
    e. Obstetric/OB Ultrasound Made Easy: Step-By-Step Guide
    https://www.pocus101.com › obstetric-ob-ultrasound-m.

10. Basic first trimester ultrasound examination

Demonstration of steps for performance of first-trimester trans-abdominal and trans-vaginal ultrasound examinations. Obtaining 3 images of each of the following with good image optimizations within 1 minute can be accepted as minimum competency criteria during the training.

1. Ultrasound examination of non-pregnant uterus during various menstrual cycle phases, normal ovary, simple cyst and corpus lutein.
2. Demonstrations of intrauterine gestational sac, yolk sac, amnion and number of embryo/fetus.
3. Documentation of embryo/fetus cardiac activity or death.
4. Diagnosis of missed, incomplete abortions and molar pregnancy.
5. Pregnancy dating in first trimester especially with crown rump length.
6. Ultrasound evaluation of ectopic pregnancy, free peritoneal fluid and evaluation of pregnancy of unknown origin.

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Table 3: Senior Training of 5 days for 5 hours each day.

Ultrasound in the second and third trimesters

1. Components of basic second- and third-trimester ultrasound examinations.
2. Fetal biometry: BPD, HC, AC, FL, macrosomia and fetal growth restriction.

3. Placental localization, praevia, abruption and vasa preavia,
4. Ultrasound evaluation of twin gestations including chorionicity and amnionicity.
5. Amniotic fluid assessment: oligohydramnios, polyhydramnios and amniotic fluid index.
6. Fetal anomaly scan for common malformations.
7. TVS measurement of cervical length in second and third trimesters of pregnancy.
8. Anatomic locations of leiomyomas, adenomyosis. and adnexal masses in pregnancy and labour.
9. Sonographic characteristics of polycystic ovaries and adnexal cyst torsion.
10. Normal fetal anatomy and common malformations.
11. Umbilical artery Doppler studies in evaluation of fetal growth restriction, Twin-To-Twin Transfusion Syndrome (TTTS).
12. Doppler scan in evaluation of adnexal masses.
13. Writing the ultrasound report.

Conclusion and recommendation

POCUS is a 'must know-adjunct' skill to the routine history and physical examination in modern obstetric and gynaecological practice. The skill should be acquired through scaling-up of appropriate clinician's training curriculum, practice guidelines and task sharing as recommended above. The positive impacts of POCUS on improving clinical outcomes are enormous and delays in scaling-up trainings and integration in routine practice in current Obstetrics and Gynaecology can no longer be tolerated. Regulatory bodies should live up to their expectations.

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