Prenatal Sonographic Diagnosis of Musculoskeletal Anomalies in South Western Nigeria: A Hospital-based Study

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ABSTRACT

Introduction: Musculoskeletal anomalies are the second most common anomalies after anomalies of the central nervous system. The presence of these anomalies in children can cause emotional upset and social stigma to the affected parents. Early detection of these anomalies is important in the management of the condition and may help to reduce perinatal morbidity and mortality associated with them. The objective of this study is to describe the musculoskeletal anomalies diagnosed during prenatal ultrasound screening for anomalies in our center, the associated anomalies and outcomes.

Materials and methods: This is a retrospective evaluation of all cases of musculoskeletal anomalies detected during prenatal ultrasound screening for fetal anomalies at the University College Hospital, Ibadan, Nigeria between 2012 and 2018.

Results: Two thousand six hundred and thirty-four (2,634) fetuses were screened prenatally with ultrasound for anomalies over a 6-year period. A total of 14 (0.4%) of the fetuses had musculoskeletal anomalies. Four (28.6%) of the anomalies were isolated while the remaining had associated anomalies involving other systems. Seven (50.0%) of the pregnancies with these anomalies were terminated before term because of the severity and/or associated anomalies. Six (42.9%) of the fetuses were delivered at term of which three had early neonatal death.

Conclusion: Prenatal screening for anomalies affecting the musculoskeletal system is essential in the primary prevention of disability and reducing perinatal mortality and morbidity.

Keywords: Congenital anomalies, Fetus, Musculoskeletal, Prenatal diagnosis, Ultrasound.

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INTRODUCTION

The introduction of prenatal screening for fetal anomalies to midtrimester ultrasonography has significantly improved antenatal care by reducing the perinatal morbidity and mortality associated with major congenital anomalies (CAs). This screening involves a systematic and detailed thorough evaluation of fetal anatomy to rule out anomalies. This is in addition to the routine determination of the position of the placenta, assessment of the amniotic fluid, and measurement of fetal growth.¹⁻³

A CA is an abnormality of structure, functions, or body metabolism that is present at birth (even if not diagnosed until later in life) and results in physical or mental disability or death.² According to World Health Organization (WHO),² CAs result in an estimated 3.2 million birth defect-related disabilities every year. CAs, regardless of their cause, can affect any organ or system of the body but some systems are more commonly affected than the others.⁴

Musculoskeletal (MSK) anomalies are disorders affecting one or a combination of bone and muscle development in the skull, trunk, and limbs. They have been reported by the WHO as the second most common birth defect after central nervous system anomalies with a prevalence of 51.12/1,000 population.⁵ However, some other studies reported anomalies of MSK system as the most common anomalies.^{6,7} These anomalies have been linked to various teratogens applied during intrauterine life, producing permanent postnatal changes in morphology or function. Such teratogens can be drugs such as thalidomide, infections such as rubella, radiations, chromosomal disorders, and nutritional deficiencies.⁸⁻¹¹ MSK defects have also been associated with various maternal factors such as maternal age, parity, and antenatal illnesses.^{8,11,12}

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One of the major steps in reducing the incidence of MSK anomalies and proper management is early detection of the anomalies.^{3,13-15} Studies have shown that up to 96% of all fetal anomalies are detectable by ultrasonography before the 17th week of gestation while most skeletal defects will be detected during a detailed ultrasonographic scanning between 18 and 22 weeks of pregnancy.^{3,13,15} The ability to identify such conditions during the first or second trimester of pregnancy can facilitate alternative approaches for managing affected pregnancies, such as delivery and care of the infant at a tertiary center, undertaking therapeutic interventions during gestation (e.g., fetal surgery), or electively termination of the pregnancy.^{9,12,15,16} When defects are severe or life-threatening, selective termination of the pregnancy may frequently be chosen and this will partially reduce the incidence of congenital malformations among newborns.^{15,16} The objectives of this study are to describe the MSK anomalies diagnosed during

prenatal ultrasound screening for anomalies in our center, their associated anomalies, and their outcomes.

MATERIALS AND METHODS

This was a retrospective evaluation of all cases of MSK anomalies seen during prenatal ultrasound screening for fetal anomalies at the University College Hospital (UCH), Ibadan, Nigeria between 2012 and 2018. UCH is a federal tertiary teaching hospital located in South West Nigeria and it is also a referral center for state hospitals and community centers. The hospital runs many consultative clinics, which include an antenatal clinic. A dedicated ultrasound unit is sited at the antenatal clinic for easy access by patients attending the clinic.

All UCH antenatal clinic patients with gestational ages (GAs) between 18 and 24 weeks who presented at the ultrasound suite for detailed midtrimester screening for CAs during the study period were included in the study. Pregnant women who had fetuses with suspected anomalies from ultrasound scans done at referral centers referred to UCH for second opinions were also included in the study.

All the patients were scanned by radiologists with expertise in obstetric ultrasound using the Sonix touch and Voluson P6 General Electric (GE) ultrasound machines. The guideline for performing midtrimester ultrasound by the International Society for Ultrasound in Obstetrics and Gynecology (ISUOG)³ was used in the prenatal assessment of the fetuses for anomalies. Those fetuses who had anomalies involving any one or a combination of bone and muscle development in the skull, trunk, and limbs were included in the study. The presence of associated anomalies in other body systems was also documented.

Data analysis was done by simple proportion and percentages using the Statistical Package for Social Sciences (SPSS) version 20.0 software.

RESULTS

Over a 6-year period, 2,634 fetuses of mothers who presented for routine fetal anomaly ultrasound scans were screened. Fourteen of the fetuses had MSK anomalies giving a prevalence of 4/1,000 pregnancies. Seven (50%) of the anomalies were detected

during the midtrimester prenatal screening for anomalies between 18 and 22 weeks' GA, 3 (21.4%) between 22 and 28 weeks' GA, while 4 (28.6%) were detected after 28 weeks' GA.

Four (28.6%) of these anomalies involved only MSK system while the remaining had anomalies involving other systems. Those with solely MSK anomalies include a case each of osteogenesis imperfecta, achondroplasia, unilateral club foot, and bilateral absence of both forearms (Fig. 1). Those with associated anomalies involving other systems include a case each of bilateral clubfeet, unilateral absence of the entire upper limb, polydactyly of the fingers, two cases of thanatophoric dysplasia, and three cases of spina bifida (Table 1).

The most common of the associated anomaly was hydrocephalus (Figs 1 and 2) which accounted for 54.5%, followed by hypoplastic cerebellum (18.2%). Increased amniotic fluid was detected in seven (50%) of the cases (Table 1).

Seven (50.0%) of the pregnancies with these anomalies were terminated before term because of the severity and/or associated anomalies (Figs 2 and 3). Six (42.9%) were delivered at term out of which three had early neonatal death (Figs 1 and 4) while one (9.1%) was lost to follow-up (Table 1).

Twelve (85.7%) of the MSK anomalies were confirmed postdelivery or post-termination of pregnancy. Nine (64.3%) were confirmed by clinical evaluation, while three (21.9%) had both clinical and radiological evaluation (Table 1, Figs 1, 2, and 4).

DISCUSSION

The prevalence of musculoskeletal anomalies in this study is 4 in 1,000 pregnancies, which is similar to the incidence recorded by Agrawal et al.⁸ in India who recorded an incidence of 4 in 1,000 births. The incidence is however higher than what was reported by Prashar et al.¹⁷ and Shylaja et al.,¹² also in India, who both reported 3.2 in 1,000 as well as Nelson et al.¹⁸ who reported an incidence of 2 in 10,000. Greater incidences were reported in studies by Tayebi et al.,¹⁹ Gupta et al.,²⁰ and Oyinbo et al.²¹ who reported 14.2/1,000, 13/1,000, and 31/1,000, respectively. The variability in the incidence of MSK anomalies reported may be due to many reasons, which include—different genetic makeup and environmental factors, experience of the persons making the diagnosis; whether the

Figs 1A and B: A fetus at 20 weeks' gestational age (GA) with bilateral hypoplastic ulna and radius. (A) Ultrasound image of one of the upper limbs showing a normal sized humerus (short arrow) with shortened forearm (long arrow) and absent hand; (B) Ultrasound image of the forearm in longitudinal plane showing hypoplastic ulna and radius (long arrow). Pregnancy was terminated and anomaly confirmed by clinical evaluation

Table 1: The frequencies of the various anomalies, outcome, and presence of associated anomalies

Type of anomaly	Frequency (%)	GA at diagnosis(wks)	Outcome	Diagnosis confirmed	Associated anomalies	Amniotic fluid
Spina bifida	3 (21.42)	20	TOP	Yes (cli)	Yes	Increased
		30	Live delivery	Yes(cli/rad)	Yes	Normal
		35	Live delivery	Yes (cli/rad)	Yes	Increased
Abnormal skull shape	2 (14.29)	22	TOP	No	Yes	Normal
		26	Live delivery with ENND	Yes (cli)	Yes	Normal
Thanatophoric dysplasia	2 (14.29)	20	TOP	Yes (cli)	Yes	Increased
		34	Live delivery with ENND	Yes (cli)	Yes	Increased
Osteogenesis imperfecta	1 (7.14)	22	TOP	Yes (cli)	No	Normal
Achondroplasia	1 (7.14)	32	Live delivery	Yes (cli/rad)	No	Increased
Polydactyly	1 (7.14)	25	Live delivery with ENND	Yes (cli)	Yes	Increased
Bilateral hypoplastic ulna/radius (absent hands)	1 (7.14)	20	TOP	Yes (cli)	No	Normal
Unilaterally absent upper limb	1 (7.14)	21	TOP	Yes (cli)	Yes	Normal
Unilateral clubfoot	1 (7.14)	20	Lost to follow-up	No	No	Normal
Bilateral clubfeet	1 (7.14)	22	TOP	Yes (cli)	Yes	Increased
Total	14 (100.00)			100		

ENND, Early neonatal death; cli, clinical; rad, radiological; wks, weeks; TOP, termination of pregnancy

Figs 2A to D: A 35-week-old fetus with meningomyelocele and ventriculomegaly. (A) Prenatal ultrasound image of a fetus showing a cystic mass (short arrow) over the lower back (long arrow) at the level of the lumbosacral spine junction consistent with spinal bifida with meningomyelocele; (B) Ultrasound of the fetal skull in transverse plane showing associated severe dilatation of both lateral ventricles (stars); (C) Photograph of the baby after delivery with the cystic mass (arrow) seen over the lower back; (D) A trans-fontanel ultrasound of the baby confirming the dilated lateral ventricles (LV) and third ventricle (3V)

data includes only live born or stillborn babies and the spectrum of investigations carried out in confirmation of the diagnosis.^{9,12}

Congenital talipes equinovarus (CTEV) or clubfoot has been reported in many studies as the most common anomaly of the MSK system.^{8,9,12,17,22,23} This may be due to the fact most of these studies considered only anomalies of the limbs and most of them were done in newborns in which this anomaly is usually very obvious. Some other studies are however at variance with this, for example, Nelson et al.¹⁸ reported osteogenesis imperfecta as the most common MSK anomaly, while Simpkins et al.²⁴ and Bakare et al.²³ reported polydactyly as the most common anomalies. Spinal bifida with meningomyelocele was the most common anomaly in this study, while clubfoot was only reported in two of the fetuses, one bilateral and one unilateral.

The presence of concomitant abnormalities in other organ systems has been associated with increased morbidity and

mortality in MSK anomalies.¹⁶ Therefore, it is very important to routinely assess other parts of the fetus once the diagnosis is made to rule out other abnormalities. Concomitant anomalies of the cardiovascular and genitourinary systems were reported in a study by Vasluian et al.²⁵ Mammen et al.²⁶ in their study showed that associated anomalies were more common with fetuses with bilateral clubfeet and these include hydrocephalus, neural tube defects, cleft lip/palate and heart defects, and/or chromosomal abnormalities. Associated anomalies were reported in 10 (71.4%) of our cases with hydrocephalus being the most common, detected in six (54.5%) of the fetuses.

Abnormalities of amniotic fluid have also been indicated in some MSK anomalies even though it is usually reported more in neural tube defects and gastrointestinal anomalies.^{27,28} Taksande et al.²⁷ and Shawky et al.²⁸ in their studies found increased amniotic fluid in some of the fetuses with MSK anomalies. Prashar et al.¹⁷ on

Figs 3A to C: Bilateral clubbed feet associated with bilateral ventriculomegaly in a 22-week old fetus. (A) Prenatal ultrasound image of the fetus showing bilateral clubbed feet (arrows); (B) ultrasound of the fetal brain showing severe dilatation of both lateral ventricles (stars); (C) Photograph of the baby after pregnancy termination confirming the clubbed feet (arrow)

Figs 4A to E: A 24-week-old fetus with thanatophoric dysplasia associated with ventriculomegaly. (A) A longitudinal ultrasound scan of one of the fetal thigh showing a short, thick, slightly bowed femur (short arrow) with surrounding thickened soft tissue; (B) Ultrasound image of the fetal skull showing macrocephaly with dilatation of the posterior horns of both lateral ventricle (slim arrows); (C) Longitudinal ultrasound image of the fetus showing a narrow thoracic cavity (short arrow) with protuberant abdomen (long arrow); (D) Ultrasound image of the fetal forearm showing short bones (slim arrows); (E) Photograph of the baby after delivery showing a narrow thorax, protuberant abdomen, short limbs, and macrocephaly

the contrary reported oligohydramnios in 4 of the 49 fetuses with MSK anomalies, while polyhydramnios was reported in only one case. In this study, increased amniotic fluid was found in seven (50%) of the fetuses, which shows that there should be a high level of suspicion of MSK anomalies in mothers with polyhydramnios

for CAs especially when the commonly associated anomalies are absent.

The significance of diagnosis of congenital malformations of the MSK system lies not only in their contribution to mortality but also in causing disability and handicaps to the children when

born.^{16,17} Their presence can also cause emotional upset and social stigma to the affected parents especially in low-/middle-income countries where the social support system is very poor.²⁹

In most cases, primary prevention is not possible, therefore prenatal diagnosis by ultrasound scan affords the early diagnosis of the anomalies, some of which can be detected as early as 14 weeks' GA.¹⁵ The earliest GA at diagnosis in this study was 20 weeks and this may be due to the fact that prenatal screening for anomalies is done between 18 and 22 weeks' GA in our center.

In cases where a major structural defect is identified, the mother can be counseled on the possibility of either continuing with the pregnancy or terminate it.^{16,18} If the pregnancy is continued, the risk of stillbirth or early neonatal death should be explained to the parents. In our study, seven (50%) of the mothers opted for termination of pregnancy, and of those who continued with the pregnancies, half of them had early neonatal death. The reason for the high rate of termination in our study could be because of the cost of managing a malformed baby, the stigma attached to families with such babies in our environment and lack of social support. On the contrary, in a study by Nelson et al.¹⁸ in the USA, only 16% of the parents with fetuses with MSK anomalies opted to terminate the pregnancies while more than 70% were continued to term with 4% stillbirths. The low rate of termination of pregnancy in the USA may be attributed to the good social support and well-organized National Health Scheme in the country.

When a fetus is suspected to have a MSK anomaly, it is very important to have the diagnosis confirmed postdelivery or postmortem. This confirmation could be made by clinical and/or radiological evaluation. It is also essential to have the photographs taken and in case of abortion or early neonatal death, autopsies should be offered and encouraged for accurate diagnosis.¹⁶ In this study, 12 (85.7%) out of the 14 cases were confirmed, 10 (83.3%) of them by only clinical evaluation while 2 (16.7%) had in addition radiological assessments. Some of the photographs were also taken, but no postmortem assessment was done for any.

A major concern of families who have or have lost a child with CA is the possibility of recurrence of the anomaly in future pregnancies. Therefore, there is need for genetic counseling on the risk of recurrence of the anomaly, which provides guidance and support for those families.^{13,16} This is a major challenge in the developing world and also in this present study where molecular testing to confirm the diagnosis which aids in the counseling is not usually done because it is very expensive and not readily available.

CONCLUSION

Congenital anomalies are major contributors to perinatal morbidity and mortality. They also cause emotional upset and social stigma to parents with affected children. Prenatal screening for these anomalies, especially those affecting the MSK system, is very essential in the primary prevention of disability and reducing perinatal mortality and morbidity.

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