CASE REPORT

# Incidental Diagnosis of Dextrocardia with Situs Inversus During Echocardiographic Examination: A Case Report from Zambia

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## ABSTRACT

**Dextrocardia with situs inversus is a rare congenital condition** characterised by the mirror-image reversal of the heart and the abdominal organs. This congenital anomaly has a prevalence rate of approximately 1 in 10,000 people and is higher in males than in females. It is generally asymptomatic unless associated with congenital heart conditions. For this reason, most individuals are unaware of having dextrocardia with situs inversus until they seek medical attention for unrelated conditions, as in this case report. In this case report, we report a case of dextrocardia with situs inversus in a 27-year-old female patient diagnosed incidentally during echocardiographic examination in a private medical facility in Zambia. This case underscores the crucial role of imaging examinations such as echocardiography, plain film radiography, and ultrasound in diagnosing dextrocardia with situs inversus, especially in resource-limited settings where advanced imaging modalities are scarce. It further emphasises the need for thorough examination techniques and awareness of anatomical variations to avoid diagnostic errors and guide appropriate patient management. The challenges related to their availability in the Zambian healthcare system are also reviewed.

## INTRODUCTION

Dextrocardia is a congenital condition characterised by the mirror-image reversal of the heart. At the same time, Situs Inversus is a congenital condition characterised by the mirror-image reversal of the abdominal organs.[1] When the heart and abdominal organs present with a mirror-image reversal, the condition is called Situs Inversus Totalis (SIT).[2] This condition was first described in animals by Aristotle and in humans by Fabricius. In 1643, for the first time, Marco Severino discovered dextrocardia. SIT prevalence rate is approximated at 1 in 10,000 people and is more frequent in males than females (3:2).[1] It is a rare condition caused by an autosomal recessive genetic condition where both parents pass on a mutated gene to their offspring. The unaffected carrier mother and unaffected carrier father have a 1 in 4 chance of having a child born with situs

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inversus.[3] Although SIT is usually asymptomatic, it must be recognised to avoid diagnostic inaccuracies and provide guidance on suitable medical and surgical interventions.[4]

SIT is a rare condition often diagnosed lately when patients present to the hospital with unrelated health conditions.[5,6] In other words, this unusual congenital anomaly is found incidentally during imaging investigations. Dextrocardia is often diagnosed using a chest X-ray examination.[7] On the chest X-ray, the heart shadow, aortic knuckle and gastric bubble appear on the right side of the thorax.[7,8] However, when interpreting a chest X-ray in someone suspected with dextrocardia, it is important to exclude spurious dextrocardia. Spurious dextrocardia is an imaging technical error common in digital radiography because the radiographer inadvertently flips the radiographic image over in the mediolateral plate during post-processing.[9] However, a chest X-ray cannot diagnose situs inversus, and other imaging examinations are required.

Abdominal ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) are the most common imaging examinations to diagnose situs inversus.[8] Ultrasound adequately identifies the mirror-image arrangement of abdominal organs such as the liver and spleen.[8] In addition, ultrasound is more affordable and readily available in limited resource settings such as Zambia than more advanced cross-sectional imaging modalities such as CT and MRI.[10,11] However, its reliability might be limited by large body habitus, bowel gas and operator skills.[12] Therefore, CT and MRI are the modalities of choice for conformation and outlining the complete underlying anatomic variation when ultrasound is limited.[6] These three cross-sectional imaging examinations help diagnose situs inversus. This diagnostic information is crucial in planning the management of the patient, which may include interventions if any complications arise.

Medical imaging plays an important role in diagnosing SIT. Therefore, radiologists, sonographers, radiographers, and referring medical practitioners must be aware of this anomaly. A lack of knowledge may pose a considerable danger to the patient if not detected before surgical or radiology interventions.[6,7] In this case report, we report a case of SIT in a 27-year-old female patient diagnosed incidentally during echocardiographic examination in a private medical facility in Zambia. This case report aims to contribute to the existing knowledge base by presenting the role of medical imaging examinations in diagnosing SIT. The challenges related to the availability of advanced imaging modalities in the Zambian healthcare system are also discussed concerning the case report.

## CASE PRESENTATION

### Clinical case information

The 27-year-old female patient presented to our private medical facility with a complaint of easy fatigue. No breathing symptoms were noted. The patient was being managed for Paroxysmal Nocturnal Dyspnoea (PND) with suspected Congestive Cardiac Failure (CCF) in a background of Anaemia and Gestational hypertension (GHTN). The working clinical diagnosis was hypertensive heart disease (HHD) with ?congestive heart failure. The patients' vitals were obtained on the day of the imaging examinations. Table 1 shows the patients' clinical vitals.

**Table 1: Patients' clinical vitals**

| Pulse | Blood Pressure (BP) | Respiration | Temperature | Weight |
|---|---|---|---|---|
| 64 | 142/93 | 20 | 36.5 | 52kgs |

The attending medical practitioner decided to undertake imaging investigations, and an echocardiography examination was requested. The first imaging examination the patient undertook was ECG, followed by echocardiography and abdominal ultrasound, and finally a Chest X ray.

**Psychosocial and family history**

The patients psychosocial did not show any current or history of mental illness. She did not show symptoms of depression, anxiety or substance abuse. She reported to have a stable mood, sleep, eating, or activity levels. She also reported that she had not experienced any problem with concentration or memory lapses, social withdrawal and difficulty in relationships. She did not report any history of trauma. She reported a health relationship with family and friends. She reported no known congenital, chronic or mental illness in her immediate family members.

using a "mirrored image or reversed anatomy" technique. In this technique, a reversal of the procedure for the standard cardiac technique was done. Specifically, the ultrasound probe was placed on the right parasternal area with the reference point of the probe pointing to the right shoulder. The ultrasound equipment employed for this examination was the LOGIQ7 ultrasound machine, using a 2.5 to 5.0 MHz phased array echocardiographic probe. Figures 1 shows the electrocardiogram while Figures 2 and 3 show the echocardiographic images.

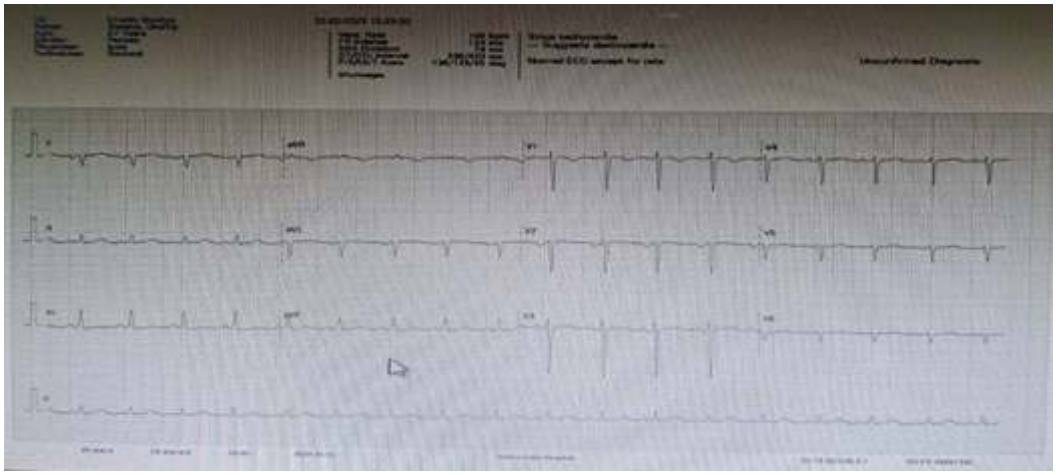

**Figure 1:** Patient's electrocardiogram

**Echocardiography examination**

The patient came with a radiology request form reading Echocardiographic examination with ?CCF after completing an electrocardiography examination from the hospitals outpatient department (OPD). The sonographer correctly identified the patient and prepared for a transthoracic echocardiographic examination at the ultrasound department. She was positioned in the left lateral decubitus position, with the left arm extended behind the head to bring the heart closer to the chest wall for optimal echocardiographic imaging. The examination commenced with the examiner performing a left parasternal long axis view. In this view, the heart was barely visible, prompting the sonographer to sweep the thoracic area extensively. The heart was found on the right side with a mirror image of cardiac structures. The sonographer noted this phenomenon and examined

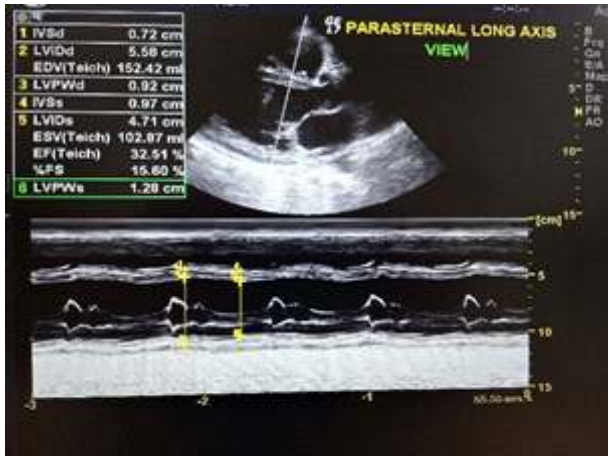


**Figure 2:** Right Parasternal Long Axis View showing CCF


**Figure 3:** Right Apical 4-chamber view with mitral regurgitation

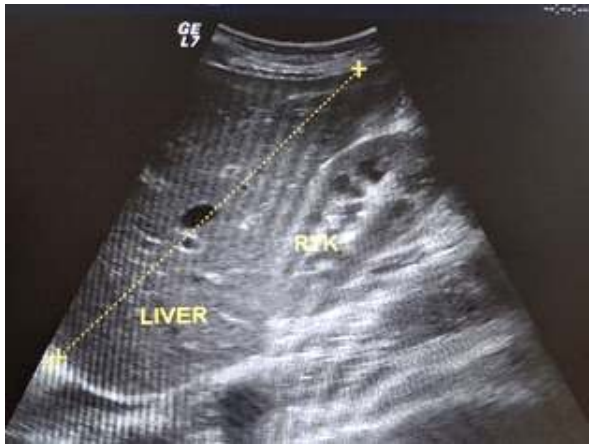


**Figure 5:** Left-sided liver and left sided right kidney

## Abdominal ultrasound examination

Upon establishing a diagnosis of dextrocardia during the echocardiography examination, the sonographer sought verbal consent from the patient. The sonographer then conducted an abdominal ultrasound scan to assess possible situs inversus using 2.0 to 5.0 MHz curvi-linear probe of the preceding ultrasound equipment. The findings confirmed the preceding diagnosis (SIT). The liver and right kidney were in the left upper abdominal quadrant (Figure 5), and the spleen and left kidney were in the right upper abdominal quadrant (Figure 4). The mirrored orientation for these abdominal organs was also noted (Figures 4 and 5).

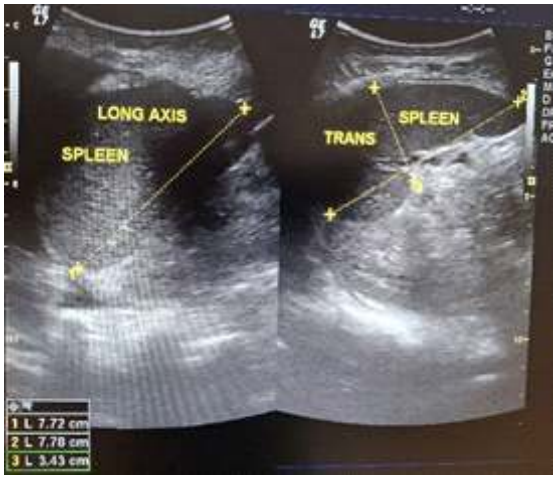


**Figure 4:** Right-sided spleen

## Chest X-ray examination

The sonographer discussed the findings with the referring clinician, who later requested a chest X-ray to confirm the diagnosis. The patient changed into the hospital gown in the X-ray room and was positioned in erect for the postero-anterior (PA) projection against the digital image receptor. The arms and shoulders were rolled forward to remove the scapula from the lung field. Per radiography best practice, the right anatomical marker was placed on the receptor (Figure 6). The patient was then asked to take a deep breath and hold it. An X-ray exposure was then taken while the patient was still breathing using the General Electric (GE) Medical Systems X-ray equipment, model; precision RXi; version-e. Finally, the patient was told to breathe normally and change into the hospital gown. The chest x-ray exposure factors used included 66 Kilo-electron volt (KeV) and 12 milli-amperes per second (mAs). The heart shadow and aortic knuckle were on the right side of the chest, confirming dextrocardia (Figure 6). The resident hospital physician and the sonographer collaborated in interpreting the chest x-ray to arrive at the diagnosis of dextrocardia. This is because the hospital does not have a resident radiologist.

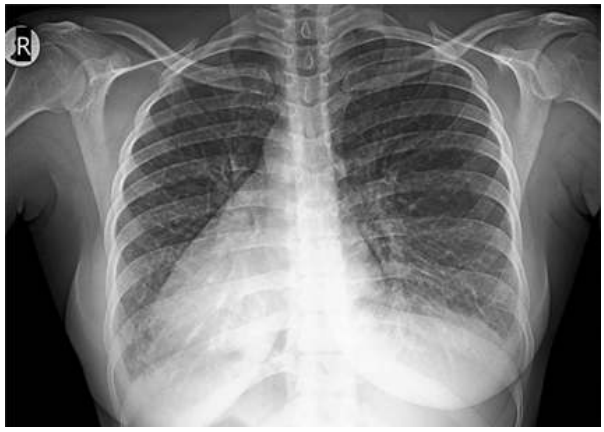

**Figure 6:** Chest radiographic image with heart shadow on the right side

### Final diagnosis and Patient management

The diagnosis of CCF was finally arrived at by the physician after the patient undertook an echocardiographic examination. This was in tandem with the patients' clinical picture. In addition, a coincidental finding of dextrocardia with situs inversus was also arrived at after the patient underwent additional abdominal ultrasound and chest x-ray examinations.

The patient was treated with drugs for the diagnosis of CCF in a background of Anaemia and Gestational hypertension (GHTN) to help reduce blood pressure as shown in table 2 below. Regarding the coincidental finding of Dextrocardia and Situs inversus, the referring physician assured the patient that the condition is compatible with life while counselling her.

**Table 2**. Patient treatment

| Name of Drug | Dosage | Frequency | Treatment Duration |
|---|---|---|---|
| Carvedilol tab 6.25mg | 12.50mg | Once daily (OD) | 10 days |
| Enalapril tab 5mg | 15mg | OD | 14 days |

### Follow-up and Outcomes

The patient was reviewed after 14 days of treatment. On review, she presented with significant improvements with no complaints of easy fatigue and breathing problems. The patient did not report experiencing any side effects to the medication administered. She reported having adhered to the treatment schedule. No further imaging tests were requested by the physician on review date.

## DISCUSSION

This case report discusses an incidental finding of dextrocardia with situs inversus in a female patient referred for an echocardiography **examination** with a clinical diagnosis of suspected CCF. The patient was unaware of her unusual congenital anomaly. This agrees with the literature, which reports that most individuals are unaware of having dextrocardia with situs inversus until they seek medical attention for unrelated conditions.[5, 8] This finding is vital as it provides detailed anatomical roadmaps for surgeons to visualise vascular anomalies and other complexities that may impact surgical procedures.[6] Due to this anomaly, the ECG leads and defibrillation pads were placed in reverse positions for this patient.[7]

The standard views for an echocardiographic examination include parasternal long axis view, parasternal short axis view, apical four chamber view, apical five chamber view, subcoastal four chamber view and the modified subcoastal view.[13] These views are typically obtained from the left coastal area since the bulk of the heart lies on the left. It is imperative to adhere to this protocol to avoid misdiagnosing cardiac abnormalities. In this case report, locating the heart on the initial echocardiography examination was difficult. This was due to its mirrored location on the right side of the thoracic cavity. However, the sonographer correctly recognised this phenomenon and adapted the technique by "mirroring" the standard procedure. This involved placing the probe on the right side of the chest and reversing the probe orientation. This shows the importance of

knowledge, experience and proper skill in echocardiography examination, as echoed by the American Society of Echocardiographers.[14, 15] These findings were consistent with the clinical diagnosis of CCF. Further, the echocardiography examination showed dextrocardia.

In this case report, a chest X-ray was requested and performed to enhance confidence in the echocardiography findings. It demonstrated the heart shadow and aortic knuckle on the right side of the chest, confirming dextrocardia (Figure 6). Dextrocardia is usually found incidentally during a chest X-ray examination.[7] Anatomical side markers (ASM) on chest radiographs should be correctly labelled to avoid wrong diagnosis of spurious (false) dextrocardia.[16] The best practice for radiographers is to place the ASM in the primary X-ray beam before X-ray exposure.[17] Adding post-processing ASM used in digital radiography in patients with dextrocardia can result in the wrong ASMs being placed on an image.[9] Radiologists, radiographers and referring medical practitioners should pay attention to ASMs and interpret them appropriately.[9] The chest X-ray should be repeated with the ASM placed before X-ray exposure if in doubt.

In this case report, the referring medical practitioner interpreted the chest X-ray due to the absence of a radiologist at our medical facility. The Ministry of Health[18] has acknowledged that the critical shortage of radiologists in Zambia hinders the delivery of quality imaging services. When writing this case report, there were 22 radiologists in Zambia[19] compared to 1,200 in South Africa and 688 in Nigeria.[20] The finding of dextrocardia prompted the sonographer to investigate for situs inversus. This was done by undertaking an abdominal ultrasound examination. The liver and right kidney were found in the left upper abdominal quadrant, while the spleen and left kidney were in the right upper abdominal quadrant (Figures 4 and 5). Therefore, an ultrasound examination confirmed the diagnosis of dextrocardia with situs inversus by demonstrating the mirror-image arrangement of abdominal organs. Ultrasound does not expose patients to ionising radiation. It is also readily available in medical facilities. However, it is highly operator dependent.[12, 21] In Zambia, there are limited sonographers to diagnose congenital anomalies such as dextrocardia with situs inversus. The number of sonographers is expected to increase with the establishment of academic programmes in sonography. This includes the master's degree in ultrasound (by research) by the University of Zambia (UNZA) in 2022 and the bachelor's degree in ultrasound by the Lusaka Apex Medical University (LAMU) in 2024. LAMU also plans to offer master's degrees in ultrasound and specialised ultrasound courses, such as echocardiography.

Advanced imaging modalities, such as CT and MRI, can also confirm the diagnosis of dextrocardia with situs inversus. These can also be employed to evaluate precise anatomical details and any abnormal findings on the ultrasound.[6] Prenatal MRI of the foetus can detect dextrocardia with situs inversus. It can also provide a complete description of the foetal abnormalities before birth.[22] However, CT and MRI are limited in Zambia and often restricted to urban areas. In addition, the high cost of CT and MRI services poses a significant barrier to access for many patients, particularly those from low-income backgrounds.[23,24] CT also delivers a high dose of radiation. Published reports show 40 CT and 8 MRI scanners in the country.[16, 25] The other challenge is Zambia's lack of specialised CT and MRI radiographers. To improve the quality of advanced imaging services, there is a need to establish postgraduate CT and MRI training programmes. In addition to the preceding challenges, this case study encountered some limitations. These included a lack of a resident radiologist at the hospital to report on the chest x ray and a short patient follow-up. This is because the nature of the case study which focused on dextrocardia and situs inversus.

## PATIENT PERSPECTIVE

The patient agreed with the proposed imaging tests by the physician. This was after the referring

physician explained the importance of undertaking the preceding investigations. She also consented to the treatment prescribed to her by the physician. Further, she expressed having understood the information regarding her medical and congenital conditions.

## CONCLUSION

Dextrocardia with situs inversus is a rare congenital anomaly often diagnosed when patients present to the hospital with unrelated health conditions. The patient reported in this case report was also unaware of her unusual congenital anomaly, which was incidentally diagnosed during echocardiography examination for CCF. This case study raises the importance of considering medical imaging examination of the heart with the possibility of dextrocardia with situs inversus in patients with respiratory symptoms. It also demonstrates the significance of knowledgeable and experienced sonographers who can identify anatomical variations and adopt the scanning techniques appropriately. Finally, this case report has demonstrated the crucial role that medical imaging plays in diagnosing dextrocardia with situs inversus. A lack of knowledge may pose a considerable danger to the patient if not detected before surgical or radiology interventions.

## CONSENT FOR PUBLICATION

The authors obtained the patient's written and signed informed consent to publish this case report. The medical director of our private medical facility also granted permission to use radiographic images and accompanying images for this case report.

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