



## Clinical case

### Situs inversus totalis and the contribution of standard electrocardiography to diagnosis: A case report and literature review

Situs inversus totalis et apport de l'électrocardiogramme standard au diagnostic :  
À propos d'un cas et revue de la littérature

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#### Résumé

Cas clinique : Il s'agissait d'une patiente de 67 ans, mère de sept enfants vivants en bonne santé apparente, hypertendue connue depuis près de dix ans mais insuffisamment suivie, sans autre antécédent pathologique connu. Elle a été adressée au service de cardiologie du Centre Hospitalier Universitaire Sourou Sanon pour une exploration cardiovasculaire dans le cadre d'un bilan de santé.

L'électrocardiogramme standard a mis en évidence des anomalies électriques évocatrices d'un situs inversus totalis ou d'une dextrocardie. L'échocardiographie-Doppler transthoracique, la radiographie thoracique et les autres examens d'imagerie réalisés dans le cadre du bilan ont confirmé un situs inversus totalis découvert fortuitement, sans autre malformation congénitale associée. La patiente menait une vie normale. Son traitement antihypertenseur a été réajusté et un suivi régulier lui a été recommandé.

Mots-clés: Situs inversus totalis; électrocardiogramme ; diagnostic.

#### Abstract

Clinical case: A 67-year-old woman, mother of seven living children who were reportedly in good health, had a nearly 10-year history of hypertension with irregular follow-up and no other known medical history. She was referred to the Cardiology Department of Sourou Sanon University Hospital for cardiovascular evaluation as part of a routine health assessment. A standard electrocardiogram showed electrical abnormalities suggestive of situs inversus totalis or dextrocardia. Transthoracic Doppler echocardiography, chest radiography, and additional imaging confirmed incidentally discovered situs inversus totalis without another associated congenital malformation. The patient was leading a normal life. Her antihypertensive treatment was adjusted, and

regular follow-up was recommended.

**Keywords:** Situs inversus totalis; electrocardiogram; diagnosis.

## Introduction

Situs inversus totalis is a rare congenital anomaly characterized by mirror-image transposition of the thoracic and abdominal organs [1–3]. Organs normally located on the left lie on the right, and vice versa.

Although recognized for centuries, situs inversus totalis remains rare, with an estimated incidence of 0.01% (1 in 10,000) [1,2]. The diagnosis may be unexpected because affected individuals are generally asymptomatic and have a normal life expectancy. The condition can therefore remain undetected for years and is often identified incidentally during imaging performed after a routine consultation for another condition [2,4,5]. A standard surface electrocardiogram, routinely used in cardiology, may also provide an important diagnostic clue [6–8]. Situs inversus totalis may coexist with cardiovascular or extracardiac malformations. A comprehensive evaluation, particularly of the cardiovascular system, is therefore warranted to identify associated abnormalities and guide appropriate management.

We report a case of situs inversus totalis incidentally discovered during routine cardiovascular evaluation in a 67-year-old woman. This report highlights the contribution of electrocardiography to the diagnosis and describes the subsequent diagnostic work-up.

## Clinical case

A 67-year-old homemaker, gravida 7 para 7, with seven living children who were reportedly in good health, was evaluated in March 2026. Her cardiovascular risk factors were age, a sedentary lifestyle, and hypertension known for nearly 10 years. She was receiving ramipril/hydrochlorothiazide 10/12.5 mg but had not been followed regularly. She had no other

known relevant medical history. She was referred to the Cardiology Department of Souro Sanon University Hospital (CHU-SS) for cardiovascular investigations as part of a routine health assessment.

A standard 12-lead electrocardiogram showed inverted P waves in lead I, an unusual rS morphology of the QRS complex, positive P waves and QRS complexes in aVR, right-axis deviation, and a progressive decrease in R-wave amplitude from V1 to V6, mimicking a lateral myocardial infarction scar. After probable electrode reversal had been excluded, situs inversus totalis or isolated dextrocardia was suspected from the electrical features of the tracing (Figure 1). A repeat electrocardiogram recorded with mirror-image electrode placement supported this diagnostic hypothesis. It showed a regular sinus rhythm at 83 beats/min, left atrial enlargement, left ventricular hypertrophy, and normal repolarization (Figure 2).

The chest radiograph obtained after the electrocardiograms showed dextrocardia, elevation of the left hemidiaphragm relative to the right, a dense homogeneous left subdiaphragmatic opacity consistent with a left-sided liver, and a right-sided gastric air bubble. The cardiac silhouette and lung parenchyma were otherwise normal (Figure 3).

Transthoracic Doppler echocardiography was performed to search for associated congenital malformations and hypertensive cardiac changes. It demonstrated rightward rotation of a morphologically normal heart, apart from moderate septal hypertrophy. Systolic and diastolic function were normal, and no associated congenital heart defect was found (Figure 4).

Additional imaging was obtained to assess clinically significant associated malformations.

Abdominopelvic ultrasonography delineated the position of the viscera, particularly the liver in the left hypochondrium and the spleen on the right, as well as the relationship between the inferior vena cava and the abdominal aorta (Figure 5).

Thoracoabdominal computed tomography angiography showed dextrocardia, a left-sided

ascending thoracic aorta, a right aortic arch, and a descending thoracic aorta to the right of the vertebral column. The inferior vena cava ascended on the left, parallel to the descending thoracic aorta (Figure 6). Three-dimensional reconstruction further demonstrated mirror-image transposition of the intrathoracic and abdominopelvic organs across the

sagittal plane (Figure 7).

The final diagnosis was situs inversus totalis without another associated congenital malformation in a patient with hypertension. She was informed of the diagnosis, reassured, and advised to maintain regular follow-up for her hypertension.

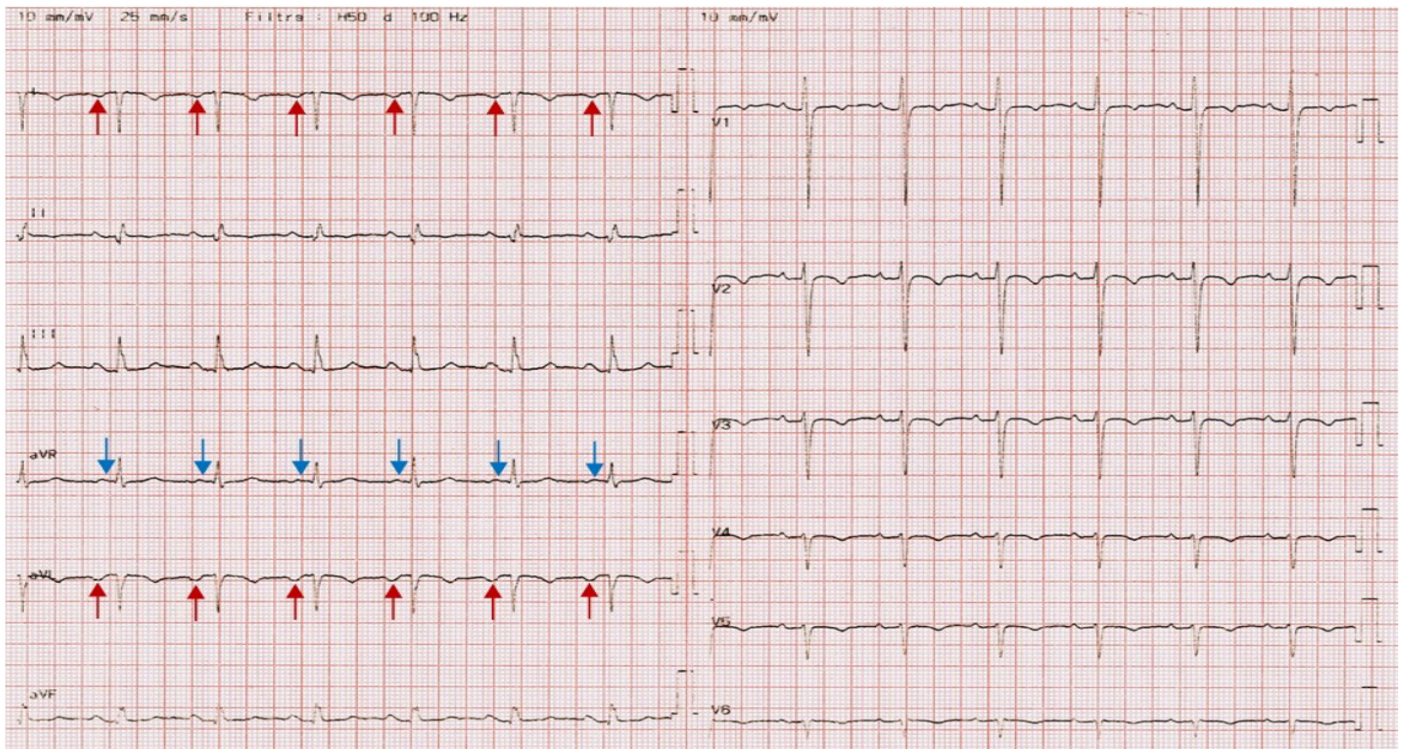


Figure 1: Standard electrocardiogram showing negative P waves and QRS complexes in leads I and aVL, with positive P waves and QRS complexes in aVR.

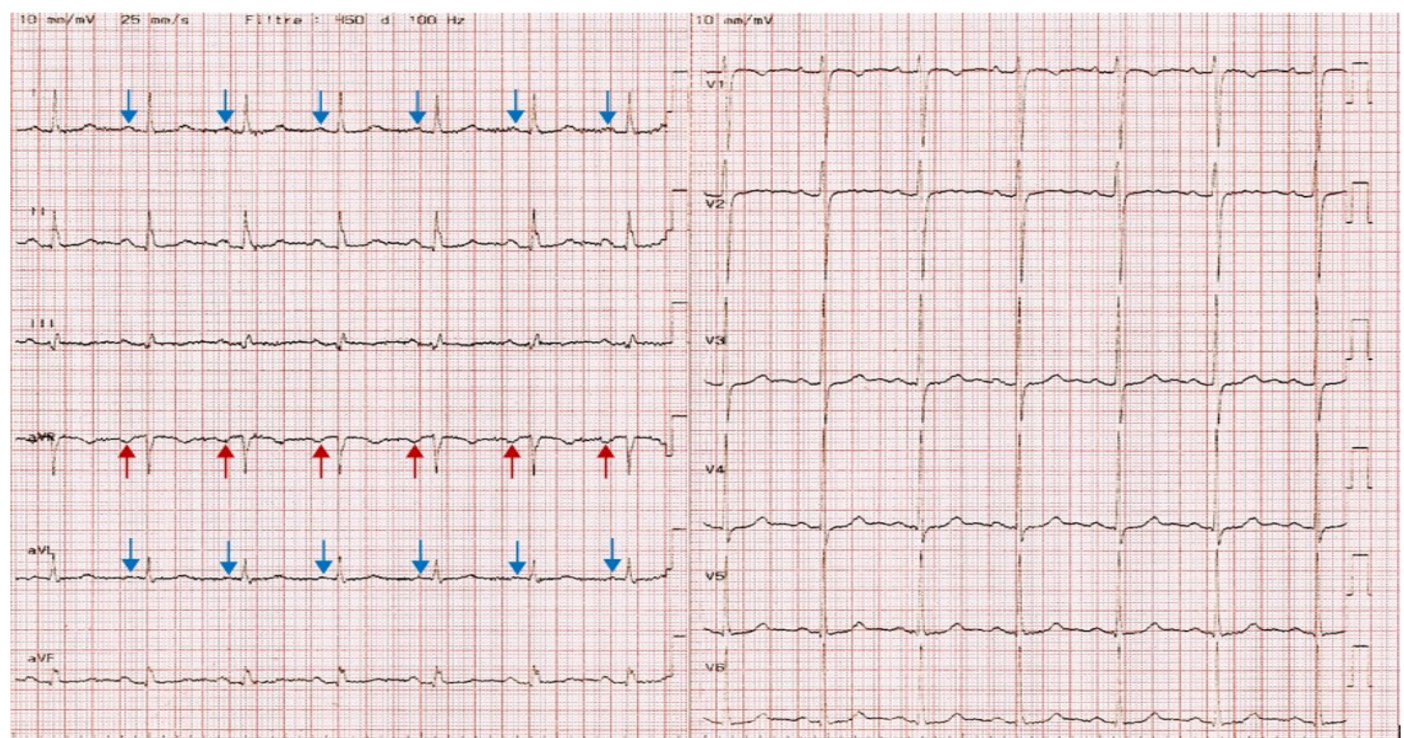


Figure 2: Electrocardiogram recorded after mirror-image electrode placement in the same patient.

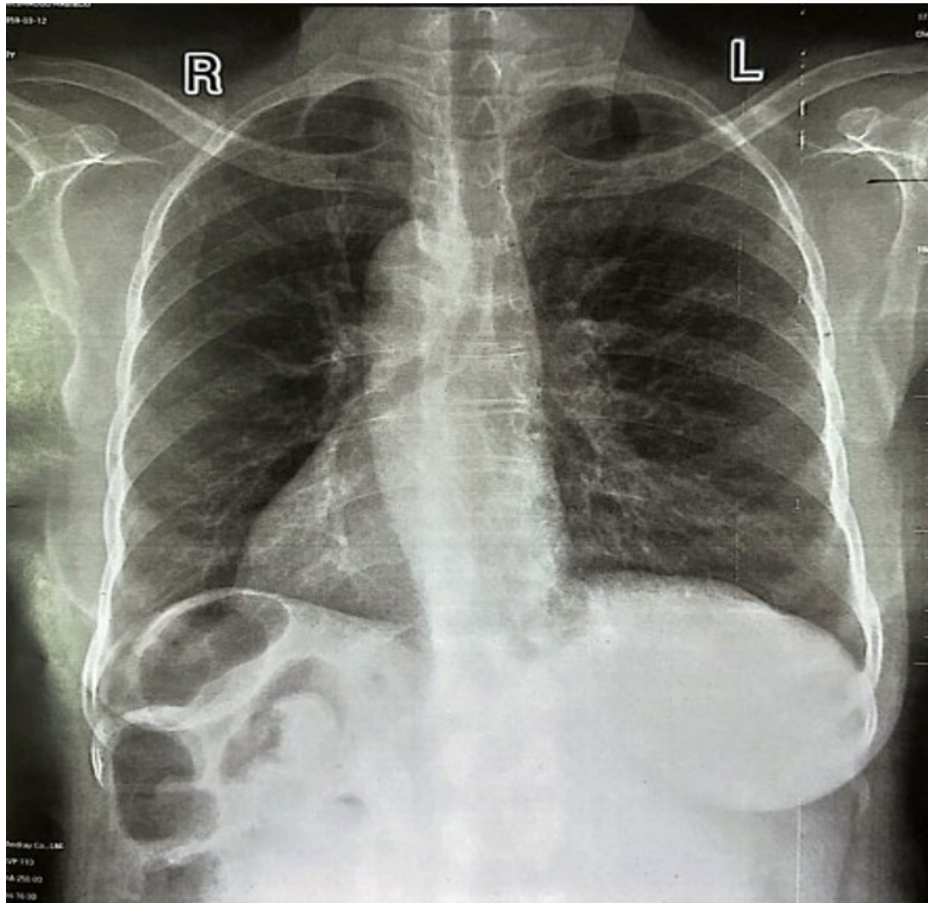


Figure 3: Frontal chest radiograph showing dextrocardia, a right-sided gastric air bubble, and a homogeneous opacity in the left hypochondrium.

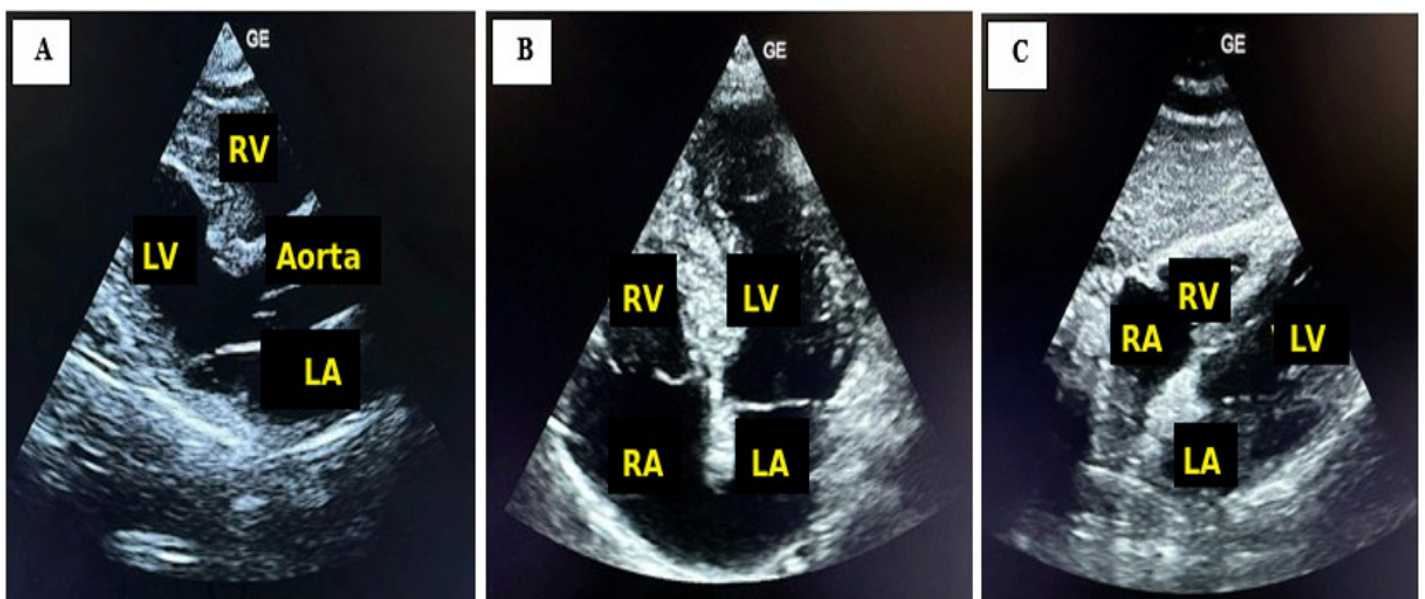


Figure 4: Transthoracic Doppler echocardiography with probe rotation. A. Parasternal long-axis view; B. Apical four-chamber view; C. Subcostal four-chamber view.

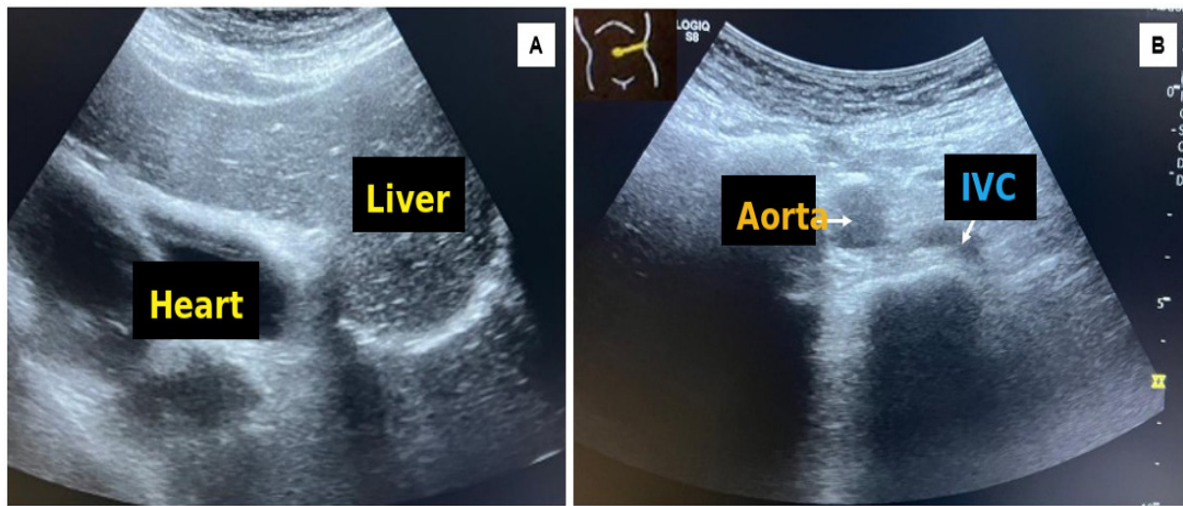


Figure 5: Abdominal ultrasound images in situs inversus. A. The heart is on the right and the liver on the left. B. The descending abdominal aorta is on the right and the inferior vena cava on the left.

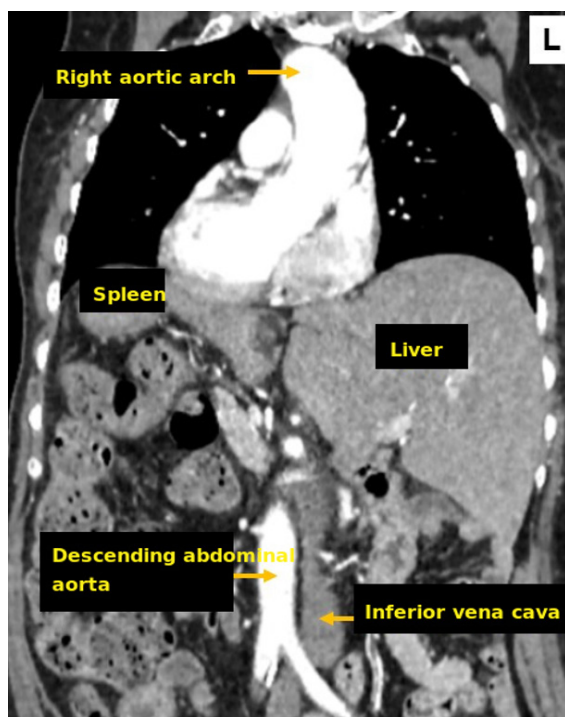


Figure 6: Coronal thoracoabdominal computed tomography angiography showing dextrocardia and the course of the great vessels.

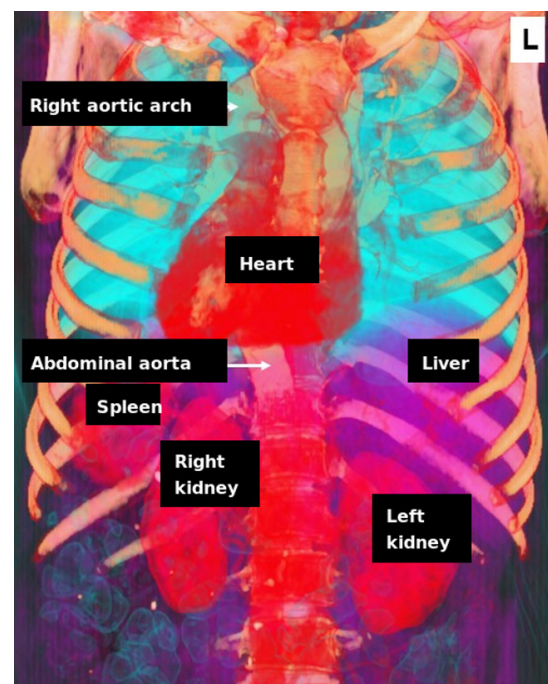


Figure 7: Coronal thoracoabdominal computed tomography angiography with three-dimensional reconstruction showing the mirror-image arrangement of the organs.

## Discussion

Situs inversus totalis is a rare anomaly recognized since antiquity. It was first described in animals, whereas the earliest descriptions in humans date from the 17th century [1]. The anomaly arises early in embryonic life, during the third or fourth week

of organogenesis, because of abnormal left-right lateralization of the thoracic and abdominal organs relative to the sagittal plane [2,4]. Situs abnormalities are commonly grouped into three main patterns: situs inversus totalis, with complete mirror-image transposition; situs inversus with levocardia; and heterotaxy, also termed situs ambiguus [2,4].

Situs inversus totalis is generally inherited as an autosomal recessive trait, and more than 100 associated genes have been identified [3,9]. It may occur with primary ciliary dyskinesia; the combination of situs inversus, bronchiectasis, and chronic sinusitis defines Kartagener syndrome, which is reported in approximately 25% of cases. Kartagener syndrome may also cause male infertility [4,10]. Congenital heart disease occurs in 5%–10% of patients with situs inversus totalis and may include transposition of the great arteries. The prevalence is substantially higher, approaching 95%, in situs inversus with levocardia [7,9,11].

Electrocardiography has a recognized role in the diagnosis of situs inversus [6–8]. It is non-invasive, reproducible, and widely available. A standard 12-lead electrocardiogram may raise suspicion of the diagnosis. Because the cardiac chambers are mirror-imaged, the left ventricle lies to the right of the right ventricle, the left atrium lies to the right of the right atrium, and the cardiac apex points toward the right hemithorax. With conventional lead placement, cardiac activation therefore appears reversed. Lead I typically shows negative P waves and negative QRS complexes with an unusual rS morphology; P waves and QRS complexes are negative in aVL but positive in aVR. In the precordial leads, normal QRS progression is reversed, particularly from V4 to V6, with a progressive decrease in R-wave amplitude from V1 to V6 [6,12,13]. These findings help distinguish dextrocardia from arm-electrode reversal: when arm electrodes are reversed, precordial R-wave progression remains normal, whereas dextrocardia produces poor or reversed R-wave progression.

A near-normal tracing can be obtained by reversing the arm electrodes and placing the precordial electrodes in mirror-image positions on the right side of the chest. This arrangement restores the expected R-wave progression and septal depolarization pattern [6,12,13]. Normalization of the tracing provides further support for dextrocardia or situs inversus.

The aVR lead, although often overlooked, can provide important diagnostic information in isolated dextrocardia and situs inversus totalis.

Chest radiography helps confirm the diagnosis by

showing dextrocardia, with the cardiac apex and aortic arch on the right and the gastric air bubble in the right hypochondrium [2,4]. Doppler echocardiography confirms the cardiac position and assesses associated structural abnormalities. Examination can be technically difficult because of cardiac dextrorotation and may require probe reorientation to obtain standard views. An experienced operator may therefore be needed [2,4].

Other imaging modalities, including abdominopelvic ultrasonography, computed tomography, and magnetic resonance imaging, can confirm situs inversus totalis by defining the position and anatomical relationships of the thoracic and abdominal organs [2,4].

Early recognition remains important for appropriate care, particularly when an acute surgical condition occurs. Mirror-image anatomy may delay the diagnosis of common disorders because pain and other symptoms can occur in an unexpected location. It may also complicate procedural planning and prolong surgery when the operative approach must be adapted to reversed anatomy [14,15].

### Study limitations

Situs inversus was diagnosed late, at 67 years of age. The patient did not undergo genetic evaluation for a familial form or for primary ciliary dyskinesia associated with Kartagener syndrome.

### Conclusion

Situs inversus totalis is a rare congenital anomaly that is often discovered incidentally. Electrocardiography can raise suspicion of the diagnosis and prompt confirmatory imaging. Familiarity with its electrocardiographic features helps prevent diagnostic error and supports timely evaluation for associated congenital heart disease. In the absence of associated malformations, situs inversus totalis generally represents a rare, benign anatomical variant rather than a disease.

**Consent**

The authors state that consent for publication of this report was obtained from the patient and her accompanying person. Written informed consent was obtained from the patient in accordance with the journal's patient consent policy. Local ethics committee approval was therefore not required for this case.

**Data availability**

The data supporting the conclusions of this report are available from the corresponding author upon reasonable request and in accordance with applicable regulations.

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**Conflict of interest :** None

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