

Situs Inversus Totalis (Dextroversion) - An Anatomical Study

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Abstract

A female, dead abortus was studied in detail for academic interest. Detailed study revealed Situs inversus totalis. By this study an anatomical, embryological exploration for reverse organogenesis is proposed.

Situs inversus totalis with dextrocardia was detected incidentally in an aborted foetus in routine dissection kept for research work in Kamineni Institute of Medical Sciences, Narketpally. The term *Situs inversus* is a short form of the Latin phrase "*Situs inversus viscerum*", meaning inverted position of the internal organs.

The Situs inversus totalis is a rare syndrome, with an estimated prevalence of 1/10,000 births, characterized by the inverted position of the thoracic and abdominal organs with respect to the sagittal plane.

Situs inversus totalis, a not so uncommon congenital positional anomaly can be a diagnostic problem at times. The condition affects all major structures within the thorax and abdomen. Surgeons and radiologists should be aware of this anomaly, during preoperative and surgical management. Routine premedical examination helps the patient to be aware of his condition, thereby preventing wrong diagnosis possibly death due to delay in surgical management.

Keywords: Situs Inversus Totalis (SIT); Dextrocardia (DC); Superiorvenacava (SVC)

Introduction

Situs inversus is a short form of the Latin phrase "*Situs inversus Viscerum*" meaning "inverted position of the internal organs, as first described by Marco Severino in 1643. All dead, aborted foetuses are dissected in the Department of anatomy of KIMS, Narketpally. The index case showed the Situs inversus totalis.

The incidence is about 1:10,000 live people. Normal human development results in an asymmetrical arrangement of the organs within the chest and abdomen. Typically, the heart lies on the left side of the body (*levocardia*), the liver and spleen lie on the right. Mirror image i.e. transposition of abdominal and thoracic viscera is termed Situs inversus totalis. It has shown the anomalies of rotation, fixation during the development, a perfect mirror image. Such relationship between the organs is does not lead to functional problems in most.

The apex of the heart is located on the right side of the thorax, the stomach and spleen on the right hypochondriac region in the abdomen and the large lobe of the liver and gallbladder on the left side. The left lung is tri-lobbed and the right lung bi-lobbed, and blood vessels, nerves, lymphatics and the intestines are also transposed (Figure 1).

Materials and Methods

An unknown dead, aborted fetus was dissected at Department of Anatomy, KIMS, Narketpally. Detailed protocol parameters of Morphometric and Internal Anatomy were studied.

Methods

Normal dissection method for foetal autopsy from standard text books.

Observation

The condition affects all major structures within the thorax and abdomen. Generally, the organs are simply transposed through the sagittal plane. The SITUS INVERSUS TOTALIS study was done and observations are tabulated (Figures 2 and 3; Tables 1-3).

Results

Situs inversus is rare with incidence of one in ten thousand.



Figure 1: Fetus with Situs Inversus totalis.

Surgeons and radiologists should be aware of this anomaly, during preoperative and surgical management. Encouragement of routine premedical examination helps the patient to be aware of his condition, thereby preventing wrong diagnosis possibly leading to death due to delay in surgical management. Dextrocardia with Situs inversus is asymptomatic. Situs inversus totalis in dead aborted foetuses is

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Figure 2: Contents of the Thorax and Abdomen.



Figure 3: Microscopic structure of the Kidney.

S.No	Features	Observation
1	CRL	18.1 cm
2	BPD	3 cm
3.	Weight	1.87 kg
4.	Gestational age	27-30 wks

Table 1: Morphometric study.

relatively rare.

Discussion

Situs inversus totalis is a condition in which the organs of the chest and abdomen are arranged in a perfect mirror image reversal of the normal positioning. Situs inversus totalis is a rare condition occurring in about one in ten thousand. This anomaly may not be diagnosed until late life in some cases and it is associated with primary ciliary dyskinesia and splenic malformations. It may be total or incomplete in 10% cases. Levocardia with Situs inversus associated with cardiac anomalies.

Aristotle first detected *Situs inversus* in animals and considered it a visitation from the gods. The condition was uncovered in cadavers in 1600 but the clinical significance of Situs inversus was not grasped until the advent of X-ray imaging which made diagnosis in humans easy and reliable. Situs inversus is rarely symptomatic except digestive difficulties, in appendicitis, heart sounds liver palpations etc.

Abdur-Rahman et al. reported extrogastria, reverse midgut rotation and intestinal atresia in a neonate [1].

Janchar et al. reported “Situs Inversus: Emergency Evaluations of Atypical Presentations” [2]. It is dangerous if not diagnosed prior to surgery. It may be diagnosed by routine medical examination when cardiac function is examined.

Ainsworth and Claire reported “Left Right and Wrong” [3]. Situs inversus also complicates organ transplantation operation as donor organs will almost certainly come from situs solitus (normal), as heart and liver have geometric problems while placing the organs into cavity shaped in mirror image. Orientation of these blood vessels also reversed necessitating steps to be taken so that blood vessels join properly.

Therefore in conclusion Situs inversus is rare with incidence of one in ten thousand. Surgeons and radiologists beware of this anomaly, during preoperative and surgical management. Routine premedical examination helps the patient to be aware of his condition, thereby

Region	Name of the organ	Observations
Thorax	Heart	Apex – on Right side Chambers–positioned reversely
	Superior venacava (SVC)	Formation is normal but seen on the left side.
	Inferior vena cava (IVC)	Formation is normal but directed on to the left side
Diaphragm	Ductus Arteriosus	Connects right branch of the pulmonary trunk to arch aorta.
	Lungs	On right side two lobes with normal hilar structures, lingula and cardiac notch On left side Three lobes with normal hilar structures,
Abdomen	Crus, Central tendon, domes	No herniation, structures passing through diaphragm are on normal basis
	Oesophagus	Oesophageal hiatus in diaphragm is towards right side
Pelvis	Stomach	Infantile, with normal gross features
	Spleen	Present at Right Hypochondria
	Liver	Large left lobe with gallbladder fossa on its inferior surface, microscopic structure has no cysts presents
	Small Intestine	Loops of Intestines placed at the centre without getting fixed Duodenum oriented on left side
	Vermiform Appendix	Positioned centrally without mesocolon
	Large Intestine	Caecum is not sacculated, no ascending colon, transverse colon and rectum placed at the centre of the cavity.
	Kidneys	Enormously grown occupying most of the abdomen
Supra Renals	According to the shapes they are present reversely	
Genital Organs	Normal, well developed external and internal genital organs	

Table 2: Internal Anatomy.

Organs	Observation
Kidney	Polycystic
Liver	Normal

Table 3: Microscopic anatomy.

preventing wrong diagnosis possibly death due to delay in surgical management.

Eroschenko reported that Situs inversus is generally an autosomal recessive genetic condition, although it can be X-linked. There is a 5-10% prevalence of congenital heart disease in individuals with Situs inversus totalis. The incidence of congenital heart disease is 95% in Situs inversus with levocardia [4].

Yokoyama et al. [5] described "Reversal of left-right asymmetry: a Situs inversus mutation"

Lowe et al. [6] reported Conserved left-right asymmetry of nodal expression and alterations in murine situs inversus.

Levin [7] described the "Left-right asymmetry in vertebrate embryogenesis."

Levin et al. [8] reported "Left/right patterning signals and the independent regulation of different aspects of situs in the chick embryo."

Logan et al. [9] described "The transcription factor Pitx2 mediates situs-specific morphogenesis in response to left-right asymmetric signals."

In our study, we observed an aborted fetus showing dextrocardia with transposition of great vessels, lungs and transposition of abdominal viscera. The mechanism responsible for malrotation of intestinal loops is yet to be understood. Evidence from the literature

shows that the direction of rotation under influence of forces exerted by adjacent organs on intestines and its mesentery. Dextrocardia with Situs inversus is asymptomatic.

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