Accessory right crus of the diaphragm – a case report

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Abstract:
The diaphragm is a dome-shaped sheet of muscle that separates the thoracic and abdominal cavities. Diaphragm is the principle muscle of inspiration and is present only in mammals. The muscle fibres, forming the periphery of the partition, arise from the circumference of the thoracic outlet and are inserted into a central tendon. During routine gross anatomy dissection of the abdomen, for the purpose of teaching medical students, in a middle-aged male cadaver, we observed an unusual morphology of the right crus of diaphragm. There were two crura on the right side of diaphragm and the left side was normal. Therefore, an attempt has been made to highlight its embryological basis and clinical implications.
Keywords: *accessory crura, crus, diaphragm anomaly*

Introduction

The diaphragm does not belong morphologically with the thoraco-abdominal musculature because it develops from cervical myotomes and is innervated by cervical spinal nerves through the phrenic nerve; it is included here because of its physiologic and anatomic relations. It arises on each side from the xiphoid process, the cartilages and the tips of the last six or seven ribs, and by a long crus from the front and sides of the first three or four lumbar vertebrae. It inserts into an aponeurotic central tendon (1).
The crura are tendinous at their attachments, and blend with the anterior longitudinal ligament of the vertebral column. The right crus is broader and longer than the left, and arise from the anterolateral surfaces of the bodies and intervertebral discs of the upper three lumbar vertebrae. The left crus arise from the corresponding parts of the upper two lumbar vertebrae. The medial tendinous margins of the crura meet in the midline to from an arch, the median arcuate ligament, crossing the front of the aorta at the level of the twelfth thoracic vertebra; it is often poorly defined (2).

It is well known that the crural and costal parts of diaphragm are not only distinct anatomically and functionally, but also have separate origins and nerve supply. During human development of costal diaphragm, myoblasts originating in the body wall probably derived from 3rd, 4th and 5th cervical segments, invade the pleuroperitoneal membranes. The diaphragm is formed from the 4th to 12th week of intrauterine life. By the 4th week, the coelom or body cavity appears as a horseshoe-shaped cavity in the cardiogenic and lateral mesoderm area, this cavity will later give origin to the thoracic and peritoneal cavities. By the 6th week, the pleuropericardial membranes extend medially and their free edges fuse with mesentery of esophagus and with the septum transversum, separating the pleural cavities from peritoneal cavity. Further growth of myoblasts will ensure pleuroperitoneal openings, forming the posterolateral elements of the diaphragm. The dorsal mesentery of the esophagus constitutes the median portion of the diaphragm. The diaphragmatic crura develop from myoblasts that grow into the dorsal mesentery of the esophagus (3).

In this report, we present a rare variation in which double right crura were observed in a middle aged male cadaver. The embryological and clinical highlights are emphasized.

Case report

During routine dissection of the posterior abdominal wall, with the purpose of teaching medical students, in a middle aged male cadaver we observed an unusual presentation in the vertebral origin of right crus of diaphragm. The additional right crus were found arising from the body of first lumbar and from the cranial part of the medial border of the right psoas major muscle. Proximally, the accessory right crus was found blending with the usual right crus of the diaphragm, but distally it is separated from the right crus by a considerable wide

gap, through which the right sympathetic trunk was found running downwards. However the left crus exhibited the normal morphology. The medical history of this middle aged male cadaver was not available. Following the dissection, the accessory right crus were photographed (Figure 1).

Discussion:

The knowledge about variations of diaphragmatic crura is necessary due to the fact that it is related to numerous structures around it. It might help in understanding the role played by it in various physiological processes and in treatment of gastroesophageal reflux disease, hiatal hernia and Dunbar's syndrome. Partial duplication of the diaphragm may involve the crura. It is thought to result from improper timing in the interaction of the lung buds and septum transversum.

Although cases of double right crus of diaphragm unilaterally have not been reported, there have been cases where a cleft within the crura mimics the presence of two separate crura. In one of the case reported the right renal artery was found to pass through a cleft in the right crus of diaphragm. Embryologically it has been established that right crus of the diaphragm develops from dorsal mesoesophagus and the ligaments of stomach develop from dorsal mesogastrium. However defective right crus of diaphragm are not reported thus far as a separate entity. The gastrointestinal physiologists are increasingly becoming aware of value of crural diaphragm in helping to stop gastric contents from refluxing into the esophagus (3).

Various detached or aberrant bundles of muscle fibres have also been described. They may compress the renal artery. From the right crus, a slip may extend in the suspensory ligament of Treitz to the back of the duodenum near the duodeno-jejunal junction, with an extension to the mesentery along blood vessels. From the medial borders of the crura, a band of connective tissue containing muscle fibres may be joined to the surface of the oesophagus. Frequently, detached bundles of muscle fibres are found in the tendinous center, located on the surface or between the layers of the aponeurosis. Partial duplication of the diaphragm has been reported (4).

Renal artery entrapment by the diaphragmatic crus is a very infrequent cause of reno-vascular hypertension. Renal arteriography confirms a 50% reduction in diameter (stenosis) of the renal artery entrapped by the diaphragmatic crus. Right crus of the diaphragm were passing anterior to renal artery causing compression of renal artery. On left side it was normal. It is important to detect the etiology of renal artery stenosis because correct diagnosis of renal artery entrapment is difficult but crucial. It has been reported that the cases of arterial hypertension in young individuals is because of renal artery stenosis due to compression of renal artery by diaphragmatic crus. Renal artery compression is not congenital but may be favoured by changes in relationships between the aorta and the musculoskeletal structures over the time (5).

The sternal portion may be absent, and the costal origins extend to the sixth or even to the fifth rib. The slip from the twelfth rib may be absent, and if this be associated with an absence of fibres from the lateral arched band, the trigonum lumbo-costalis becomes and extensive gap. This condition in exaggerated form occurs in congenital diaphragmatic hernia. In such cases it must be noted that the lumbar portion of the diaphragm extends antero-posteriorly on the medial side of the aperture. The extension of the muscle fibres on to the fascia of the psoas or quadratus lumborum occasionally occurs (6).

Conclusion

An understanding of the anatomical variants of diaphragmatic crura facilitates the diagnosis of disease processes within the retro-crural space. Knowledge of possible variations and the relations of the crura to the renal vessels are essential for radiologists and surgeons. Due to all these implications, we believe that this case is of worth reporting, since it will be enlightening to the clinicians, physiologists and researchers.

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Figure . 1

1. Inferior vena cava
2. Oesophageal opening
3. Abdominal aorta
4. Right crus of the diaphragm
5. Additional right crus
6. Sympathetic chain
7. Central tendon of diaphragm
8. Psoas major muscle

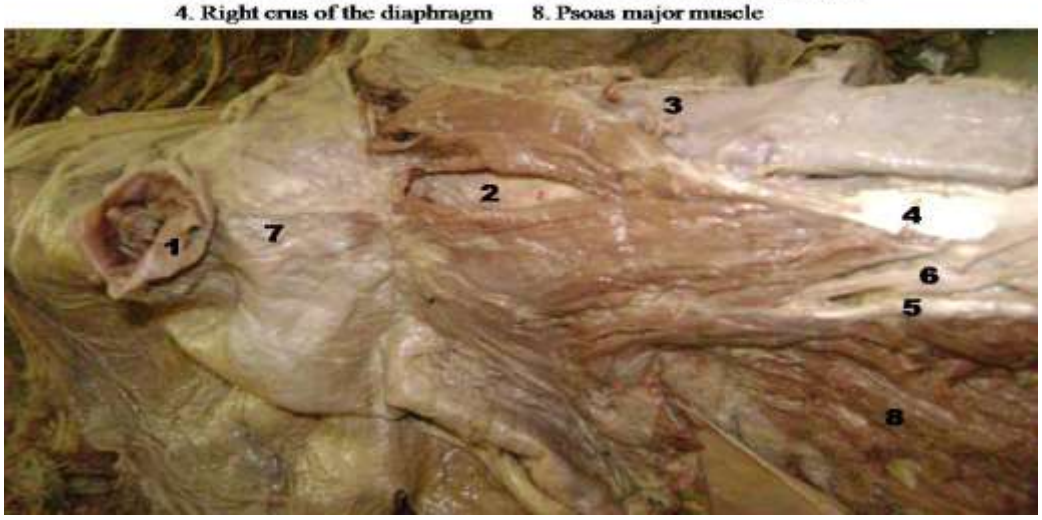

Figure . 1