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A Cadaveric Study of Rare Presence of Psoas Minor Muscle Pierced by Genitofemoral Nerve

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SUMMARY

Background. The psoas minor muscle is an inconstant muscle found only in 65% of the population. It is a slender muscle with long tendon lies on the anterior surface of the psoas major muscle. The aim of the present study was to determine the parameters like the occurrence of psoas minor muscle with its position related to psoas major muscle, present whether unilateral or bilateral and its relation to genitofemoral nerve.

Methods. The study was conducted in 10 cadavers in the Department of Anatomy at Panimalar Medical College Hospital and Research Institute. The presence of psoas minor muscle was observed during routine dissection of posterior abdominal wall by the undergraduate medical students. The parameters included are presence, position, unilateral or bilateral and relation to genitofemoral nerve of the muscle was evaluated on both sides (right and left) of 10 cadavers.

Results. The psoas minor muscle was found in 20% (2/10) cadavers. The muscle was found on the anterior surface of psoas major in 20% (2/10), bilateral in 10% (1/10) cases, unilateral in 10% (1/10) cases and in one cadaver (unilateral) the genitofemoral nerve pierced the psoas minor muscle which was a rare finding reported in the present study.

Conclusions. The psoas minor is not frequently found muscle in humans. But the knowledge about its presence in some cases may avoid confusion during surgical or radiological procedures. Therefore, it's the responsibility of anatomist to report its presence and variations which will be useful for the surgeons as a reference guide.

KEY WORDS

Psoas minor; psoas major; genitofemoral nerve; lumbar vertebra; pecten pubis.

INTRODUCTION

The psoas minor muscle is an inconstant muscle found in 65% of the population (1). It is a slender muscle with long tendon that lies on the anterior surface of psoas major muscle. The psoas minor muscle originates from vertebra T12-L1 and the intervertebral disc between them. It ends in a slender, long tendon that get attached to the pecten pubis, iliopubic ramus and laterally to the iliac fascia. It is innervated by L1 ventral rami. It assists in the hip joint stabilization, flexion of the lumbar spine and a tensor of the fascia iliaca. Contraction of unilateral psoas minor muscle causes sideway tilt of lumbar spine (2).

The structures related to the psoas minor muscle are similar to the psoas major muscle. As the psoas minor muscle lies on the psoas major muscle, its proximal anterior relations are those of the anterior or anteromedial surface of that muscle. Anteriorly, the right psoas is overlapped by the inferior vena cava and crossed by the terminal part of the ileum, the colon crosses the left psoas. Along its anteromedial margin, it is in contact with the sympathetic trunk, aortic lymph nodes and, along the pelvic brim, with the external iliac artery. This margin is covered by the inferior vena cava on the right side, and lies posterior and lateral to the abdominal aorta on the left side (3). These relations are important for clinical manifestations as infection or compression of these neurovascular structures are crucial. The clinical aspect of psoas minor muscle is called "psoas minor syndrome". Psoas minor syndrome presents as pain in the iliac fossa due to increased tension of the PMM. Pain is exacerbated by palpation of the taut tendon (4).

The psoas muscles are enclosed in the psoas sheath is formed by psoas fascia, it is a part of lumbar fascia. Pus from trabecular infection of the lumbar vertebrae may spread into psoas minor muscle is called psoas abscess (5).

The psoas minor is the vestigial muscle that is well developed in quadrupeds and brachiates that leap, run and jump. It has become vestigial in humans during the course of evolution (6). Although it is a vestigial muscle the knowledge about its presence is indispensable for radiologist and surgeons. This study may give an idea about the variation and probability of the presence of this muscle which may help the surgeon while operating this muscle.

MATERIALS AND METHODS

During routine dissection in the Department of Anatomy at Panimalar Medical College Hospital and Research Institute, the psoas minor muscle was observed in 2 cadavers out of 10 male cadavers. To study the attachment of the muscle the cadaver was further dissected as per the practical manual of Cunningham's dissector (1). All the 10 cadavers were observed for the presence of psoas minor muscle and its position were noted. Rarely the genitofemoral nerve was found piercing the psoas minor. The nerve was carefully dissected and photographed. The parameters included are presence, position, unilateral or bilateral and relation of genitofemoral nerve to the muscle was evaluated on both sides (right and left) of 10 cadavers. Therefore 10 cadavers with two sides were considered for the study.

RESULTS

Totally 10 male cadavers were dissected in the abdomen region to find the presence of psoas minor on right and left sides of the posterior abdominal wall. The psoas minor muscle was found in 20% (2/10) cadavers. The muscle was found on the anteromedial surface of psoas major in 20% (2/10), bilateral in 10% (1/10) cases, unilateral in 10% (1/10) cases and the genitofemoral nerve pierced the psoas minor muscle which was a rare finding reported in the present study (**table I**).

The genitofemoral nerve pierced the psoas major muscle in 80% (8/10) cases where psoas minor muscle was absent. In one cadaver where the psoas minor found bilaterally on the anteromedial surface of psoas major, the nerve was found adjacent (lateral) to the muscle belly of psoas minor and it pierced out psoas major muscle. The variation of this nerve was observed in the unilaterally present psoas minor muscle. The muscle was found unilaterally on the anteromedial surface of psoas major and its muscle belly was pierced by genitofemoral nerve (**figure 1**). The nerve runs on the anterior surface of psoas minor and divides into femoral and genital branches near the external iliac artery. The femoral branch passed into the arterial compartment of femoral sheath and supplied the skin of the upper part of the front of the thigh. The genital branch pierced the psoas sheath passed into deep inguinal ring, entered the inguinal canal and innervated the cremaster muscle.

The right psoas minor muscle was related to the right crus of the diaphragm, inferior vena cava and external iliac artery (**figure 2**).

DISCUSSION

The common variation observed regarding the psoas minor muscle was its agenesis. Agenesis can be unilateral or bilateral. In the present study, the psoas minor muscle was found in 20% (2/10) male cadavers. The muscle was found on the anteromedial surface of psoas major in 20% (2/10), bilateral in 10% (1/10) cases, unilateral in 10% (1/10) cases and the genitofemoral nerve pierced the psoas minor muscle which was a rare finding reported in the present study. These results were corroborated with the findings of the following authors, Singh and Agarwal (2): in 9 cadavers they showed the presence of this muscle in 55.55% (5/9) cadavers. The muscle was bilateral in 22.22% (2/9) cases and unilateral in 33.33% (3/9) cases.

Joshi *et al.* studied the presence of psoas minor on 30 embalmed cadavers (males: 24, females: 6). They found psoas minor to be present in 9 cases (30%). It was present bilaterally in 23.3% and unilaterally only on the left side in 6.6%. In all the cases the psoas minor was present on the anterior surface of psoas major and tended to lie medial to

Table I. Presence of psoas minor muscle, its position and relation of genitofemoral nerve.

S.No	Parameters	Cadavers (n = 10)	%
1	Presence of psoas minor muscle	2	20
2	Position related to psoas major	1	10
	Anterior	1	10
	Medial	1	10
	Lateral	-	-
3	Unilaterally present	1	10
4	Bilaterally present	1	10
5	Related to genitofemoral nerve		
	Pierced psoas minor	1	10
	Pierced psoas major	9	90

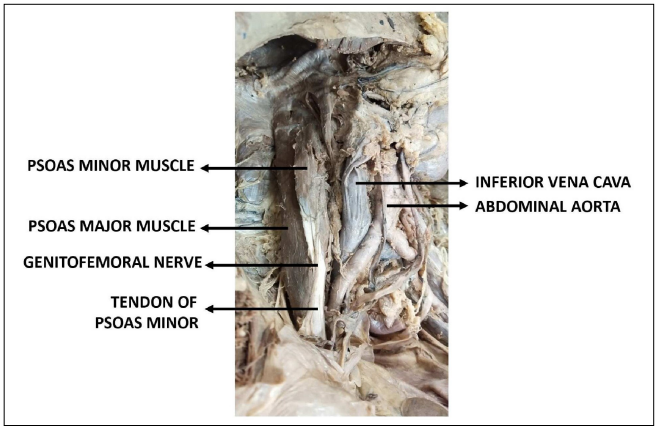


Figure 1. Psoas minor muscle pierced by genitofemoral nerve.

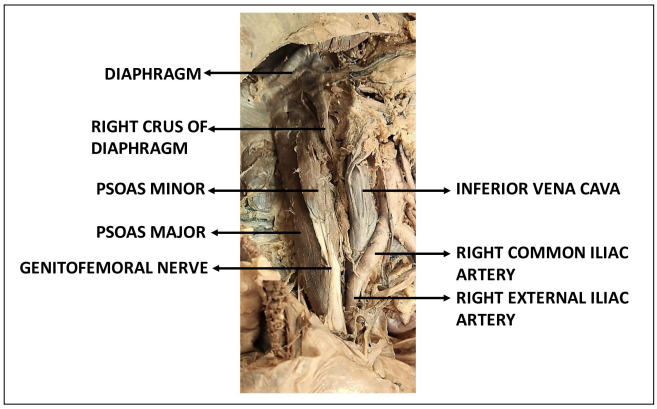


Figure 2. Relations of the right psoas minor muscle.

the psoas major towards its insertion (7, 8).

Markov *et al.* reported that, during a standard posterior abdominal wall dissection of an adult female cadaver, a unilateral right-sided psoas minor muscle was established, with a complete absence of the same muscle on the contralateral left side. The unilateral right-sided psoas minor muscle was located superficially and laterally to the psoas major muscle (9).

Jones *et al.*, Dragieva *et al.*, Garg *et al.* and Tufo *et al.* have reported the presence of psoas minor in the cadaver (10-13).

Pooja *et al.* reported the presence of psoas minor muscle which was pierced by genitofemoral nerve (12).

Bali *et al.* reported the bilateral presence of psoas minor. The genitofemoral nerve was oriented along the medial border of psoas minor muscle bilaterally (14).

Therefore, the presence or absence of psoas minor muscle was correlated to Lamarck's first law "Use and Disuse of organs", he proposed that organs which are frequently and continuously used will be transferred to the next generation. In contrast to this, those organs that are less used will slowly lose their functionality and will disappear from future generation (15). Based on this law, the present study findings states that the presence of psoas minor muscle in 20% cases may be the muscle be used and 80% absence of muscle it had become vestigial due to its disuse.

According to the work done by Guerra *et al.*, on fetuses, out of the 22, the psoas minor muscle was present in 13 (59.09%) (16). Among these, it was present bilaterally in ten and unilaterally in three. Similarly in the present study, the psoas minor muscle was found in 20% (2/10) male cadaver. Out of which 1 unilateral and 1 bilateral. Based on Lamarck's first law, the psoas minor may be found in the fetus stage but as years progresses based on its usage it may become vestigial (it appears like a thin tendon on the medial area of psoas major muscle) or prevail prominently.

Although the psoas minor is a vestigial muscle, a thorough understanding of the anatomical structures surrounding this muscle is necessary for clinical diagnosis. The psoas minor muscle lies on the anteromedial surface of the psoas major muscle, and it is related medially to the bodies of the thoracic and lumbar vertebra. Certain tuberculous of vertebral origin may form abscess which may pass down through psoas and may form a mass in the groin (17, 18). According to the present study, the right psoas is overlapped by the inferior vena cava, and its anteromedial margin is in contact with the sympathetic trunk, aortic lymph nodes and along the pelvic brim it is related with the external iliac artery. And also here, in the present study, the genitofemoral nerve runs on the psoas minor muscle. Thereby it is important for surgeons while operating the structures near by the variation reported in this study.

The psoas minor syndrome occurs if psoas minor muscle is present and it is over strained by the sports players like football (19, 20). This syndrome manifests as iliac fossa pain due to increased psoas minor muscle tone and this pain may be mistaken for appendicitis if present on right side (21). The symptoms in this syndrome appear due to compression of the neurovascular structures related to this muscle. Tenotomy is the treatment of choice in such cases (22).

Kenan *et al.* reported the sports people, especially the athletes, have this muscle. They concluded that in weightlifting and other branches of sports, which require lumbar stabilization, the absence of the psoas minor muscle may be considered as a disadvantage in the success of athletes (23).

A further study with a larger sample size can be done on athletes through imaging techniques will be useful to prove the psoas minor muscle evolution, which can be of significant value for anatomists, clinicians and physiotherapists.

CONCLUSIONS

A detailed knowledge about the presence of psoas minor muscle and its variations could help the surgeons and radiologists to avoid confusion during their clinical procedure.

Though psoas minor is not frequently found muscle in humans, the problems associated with the presence of psoas minor is crucial as in differential diagnosis for conditions like appendicitis and sports injuries.

Therefore, it's the responsibility of anatomists to report its presence and variations which will be useful for the surgeons as a reference guide.

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DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

PG contributed entirely to this work.

CONFLICT OF INTERESTS

The author declares no conflict of interests.

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