

Variation in Origin of the Obturator Artery and *Corona mortis* in Thai

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ABSTRACT

Objective: To determine the variation in origin of the obturator artery and incidences of arterial and venous *corona mortis* among Northeast Thais.

Methods: Dissection of 204 cadaveric Northeast Thai pelvic halves between 20 and 95 years-old at decease. Chi-square test was used for statistical analysis.

Results: The respective origin of the obturator artery was the internal iliac (77.5%) and inferior epigastric arteries (22.5%), while double origins (from both arteries) in one pelvic half and bilateral abnormal origins (from the inferior epigastric arteries) were 5.4 and 9.6 percent, respectively. Sex and side made no significant difference ($P>0.05$). The occurrence of the arterial *corona mortis*, venous *corona mortis* and both structures was 22.5, 70.6 and 17.2 percent, respectively. The arterial *corona mortis* while crossing over the *iliopubic ramus* was frequently found anterior to the venous *corona mortis*.

Conclusion: The incidence of an anomalous obturator artery forming the arterial *corona mortis* among Northeast Thais was 22.5% although a venous *corona mortis* (70.6%) was more frequent. Seventeen percent had both arterial and venous *corona mortis*. Nevertheless, both their courses, crossing over the *iliopubic rami*, would be at risk of damage during an ilioinguinal approach or operation of the anterior ring of the pelvis.

Keywords: Corona mortis; obturator artery; variation

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The obturator artery and vein are usually described as a branch and tributary of the internal iliac vessels; however, the obturator artery is highly variable in origin and no embryological explanation has been found. Gray's Anatomy describes the abnormal obturator artery as arising from the common trunk with the inferior epigastric artery occurring in 20-30% of the population.¹ An abnormal or anomalous obturator artery is not infrequently reported arising from the inferior epigastric or external iliac arteries.²⁻³

The vascular connection between the obturator vessels and inferior epigastric (or external iliac vessels) are described as *corona mortis* (crown of death), since their courses are at risk of injury during direct, indirect inguinal, femoral or obturator hernias or operations on the anterior ring of the pelvis.⁴⁻⁸ Less attention is paid to the venous *corona mortis* than the arterial *corona mortis* even though both course over the superior border of the *iliopubic rami* lateral to the obturator foramen and the latter is probably the greater source of bleeding.⁴

Albeit previous investigators have reported great variation in the *corona mortis*,^{5,9} there was only one report of the anatomical study about the origin of the obturator arteries in Thai population.¹⁰ However, the investigator did not mention the diameter of the anomalous obturator arteries which are known as arterial *corona mortis*. We, therefore, designed an investigation of the variation in origin of the obturator artery and incidence of the arterial and venous *corona mortis* among Northeast Thais.

MATERIALS AND METHODS

We accessed 204 cadaveric pelvic halves, 111 of which were taken from 56 males and 93 pelvic halves from 48 females (between 20 and 95 years of age at decease) from the Department of Anatomy, Faculty of Medicine, Khon Kaen University.

The pelvic halves were dissected to expose the obturator foramina. Pelvic regions with any evidence of surgery were excluded. The origins of the obturator arteries were examined and recorded. Vessels with a diameter bigger than 2 mm, which connected the obturator and inferior epigastric or external iliac vessels were described as the arterial/venous *corona mortis*.

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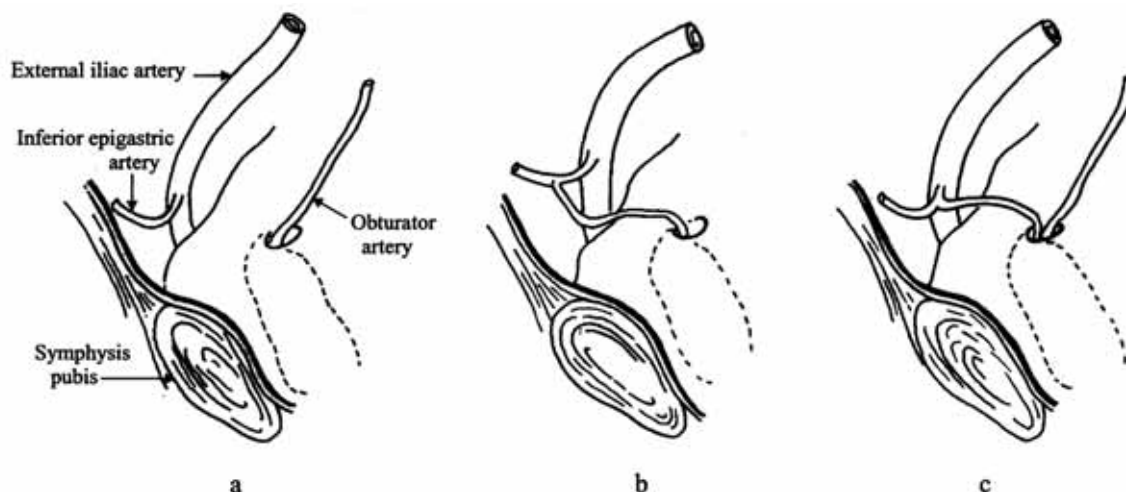


Fig 1. Types of origins of the obturator arteries; (1a) from the internal iliac artery, (1b) from the inferior epigastric artery, and (1c) from double origins of the internal iliac and inferior epigastric arteries.

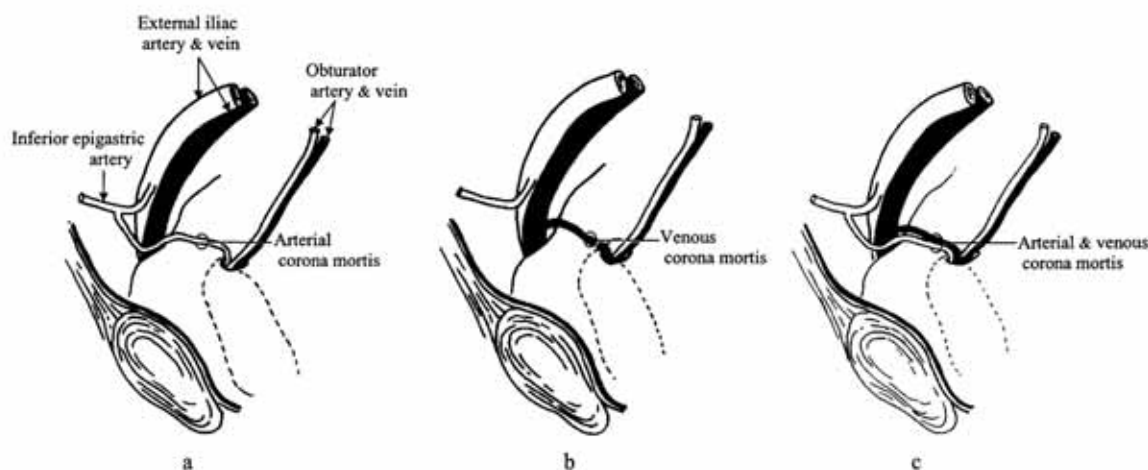


Fig 2. Types of corona mortis; (2a) arterial corona mortis, (2b) venous corona mortis, and (2c) both arterial and venous corona mortis.

The relation of the arterial and venous *corona mortis* while crossing over the *iliopubic rami* were observed. Pearson's χ^2 -test was used to assess statistic significance of the differences in the origins of the obturator arteries by sex and side. The criterion for statistic significance was $P < 0.05$.

RESULTS

I. The frequency of origin of the obturator artery

Most of the obturator arteries (77.5%) originated from

the internal iliac arteries (Fig 1a), while the less common origin of the obturator artery was from the inferior epigastric or the common trunk with the inferior epigastric artery (21.6% males vs. 23.7% females) (Table 1) (Fig 1b). Double origins of the obturator arteries (6.9% right vs. 3.8% left) (Fig 1c) occurring in females and males was 4.3 and 6.3 percent, respectively. Bilateral anomalous obturator arteries arising from the inferior epigastric arteries occurring in males and females was 5.4 and 14.6 percent, respectively, and according to side was 20.8% at the right and 24.3% at the left (Table 2). The differences

TABLE 1. Frequency of origin of the obturator artery by sex.

Origins	Male		Female		Total	
	n	%	n	%	n	%
Internal iliac artery	87/111	78.4	71/93	76.3	158/204	77.5
Inferior epigastric artery or common trunk (anomalous obturator artery)	24/111	21.5	22/93	23.7	46/204	22.5
Double origins (both internal and external iliac arteries)	7/111	6.3	4/93	4.3	11/204	5.4
Bilateral anomalous obturator artery (in each cadaver)	3/56	5.4	7/48	14.6	10/104	9.6

* P-value < 0.05

TABLE 2. Frequency of origin of the obturator artery by side.

Origins	Right		Left	
	n	%	n	%
Internal iliac artery	80/101	79.2	78/103	75.7
Inferior epigastric artery or common trunk (anomalous obturator artery)	21/101	20.8	25/103	24.3
Double origins (internal and external iliac arteries)	7/101	6.9	4/103	3.8

* P-value < 0.05

TABLE 3. Incidence of arterial and venous corona mortis.

Type of connection	Right		Left		Total	
	n	%	n	%	n	%
Arterial	21/101	20.8	25/103	24.3	46/204	22.5
Venous	71/101	70.3	73/103	70.9	144/204	70.6
Both arterial and venous	15/101	14.9	20/103	19.4	35/204	17.2

in frequency of abnormal origins of the obturator arteries between sexes or sides were not statistically significant ($P > 0.05$).

II. The incidence of arterial and venous corona mortis

The incidence of an arterial vs. a venous connection between the obturator and inferior epigastric vessels coursing over the *iliopubic rami* are presented in Table 3. The arterial *corona mortis* (Fig 2a) was identified in 21 (20.8%) pelvic halves on the right and 25 (24.3%) on the left. The venous *corona mortis* (Fig 2b) was found in 71 (70.3%) pelvic halves on the right and 73 (70.9%) on the left. Thirty-five pelvic halves (17.2%) had both an arterial and a venous *corona mortis* (Fig 2c). While passing over the superior *iliopubic rami*, 20 of 35 (61%) pelvic halves had the arteries running anterior to the veins. The arterial *corona mortis* was often found running anterior to the venous *corona mortis* on the *iliopubic rami*.

DISCUSSION

The obturator artery has been described in classical anatomy as a branch of the internal iliac artery. Variation in the origin of the obturator artery was thoroughly described and reviewed by Bergman et al. in 1988.² The most common variation of the obturator artery originated from the inferior epigastric artery.

Gray's Anatomy states the incidence of this anomalous obturator artery is 20-30%.¹ In the literature, the incidence of variation (anomalous) of the obturator artery is between 8-43%.^{4-7, 9} We found its incidence was 22.5% (males 21.6%; females 23.7%, no significant difference), concurring with Karakurt et al. (2002) who reported that the frequency of anomalous obturator artery in males (31%)

and females (26%) was not significantly different.¹¹ The previous investigator found 13.3% of anomalous obturator arteries in Thai including Chinese but he did not determine the diameter of those arteries.¹⁰ Our study included the anomalous obturator arteries with the diameter greater than 2 mm since they could be the potential source of bleeding.

We found the difference in incidence of an anomalous obturator artery on the right (20.8%) vs. the left (24.3%) was not significant ($P > 0.05$), to our knowledge a first report comparing right and the left occurrence.

Braithwaite cited by Tornetta et al. (1996) reported that 6.5% had obturator arteries arising from both origins (internal and external iliac systems), while we found that 5.4% had double origins and 9.6% bilateral anomalous obturator arteries.¹²

The incidences of arterial and venous *corona mortis* in our study were compared to other studies (Table 4). Venous *corona mortis* has been considered less important than the arterial form, even though the latter may be at greater risk of bleeding after pelvic injuries and surgery. Gray's and Moore's Anatomy mention the venous connection between the obturator and external iliac veins, but do not mention the risks associated with such cases during surgery.^{1,13}

Tornetta et al. reported that connections described as *corona mortis* comprise 34% arterial, 70% venous and 20% both.⁴ Berberoglu et al. reported the incidence of venous *corona mortis* was 96% of cases,⁵ whereas Okcu et al. reported it was 52%.⁷ Our study showed that 70.6% of subjects had a venous *corona mortis*, 17.2% had both an arterial and a venous *corona mortis*. Our study confirms that the incidence of venous *corona mortis* is greater than that of arterial *corona mortis* even though the frequency was variable (Table 4). The great variation may be due to regional differences in the development of the vascular system, genetics, different types of approach and the numbers of population studied.

We excluded vessels with the diameter lesser than 2 mm because they were less important as a potential source of bleeding. Karakurt et al. mentioned that during the pelvic osteotomies for acetabular dysplasia, using the medial approach and acetabular surgery for fractures using the ilioinguinal approach, vascular channels crossing over the superior *iliopubic ramus (corona mortis)* were at risk.¹¹ Daeubler et al. reported non-stop bleeding of a pelvic fracture even though the internal iliac artery was embolized with a microcoil.¹⁴ They found that the additional source of bleeding was from the anomalous obturator artery originating from the inferior epigastric artery and formed the *corona mortis*. Surgeons performing surgery on the anterior ring of the pelvis should, therefore, be cautious and look for the *corona mortis* to avoid potentially serious bleeding which may lead to limb-threatening complications.

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TABLE 4. Summary of reported incidences of arterial and venous corona mortis.

Author	Year	% arterial <i>corona mortis</i>	% venous <i>corona mortis</i>	% both
Teague DC	1996	43	59	
Tornetta, P	1996	34	70	20
Gilroy AM	1997	70-82	83-90	
Berberoglu M	2001	8	96	
Karakurt L	2002	28.5		
Sarikcioglu L	2003	14.81	20.37	
Okcu G	2004	19	52	
คำเกิง บุรณินทุ	1970	13.3		
Our study	2005	22.5	70.6	17.2

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บทคัดย่อ

ความแปรผันของต้นกำเนิดหลอดเลือดแดงออบทูเรเตอร์ (obturator) และโคโรนามอร์ติส (corona mortis) ในคนไทย

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วัตถุประสงค์: เพื่อศึกษาความแปรผันของต้นกำเนิดหลอดเลือดแดง obturator และความชุกของหลอดเลือดที่เป็น corona mortis ในคนไทยในภาคตะวันออกเฉียงเหนือ

วิธีการ: ซ้ำและอู้งเชิงกรานที่ผ่าครั้งจำนวน 204 ข้างในศพครูใหญ่คนไทยในภาคตะวันออกเฉียงเหนือที่มีอายุระหว่าง 20-95 ปีขณะเสียชีวิต ใช้ Chi-square test หาความแตกต่างทางสถิติ

ผลการศึกษา: พบว่าหลอดเลือดแดง obturator มีต้นกำเนิดจากหลอดเลือดแดง internal iliac 77.5% จากหลอดเลือดแดง inferior epigastric 22.5% (ซึ่งถือเป็นความผิดปกติ) และมีต้นกำเนิดจากทั้งสองทางในอู้งเชิงกรานข้างเดียวกัน 5.4% เมื่อเปรียบเทียบการมีต้นกำเนิดที่ผิดปกติระหว่างเพศชายและหญิงหรือระหว่างข้างซ้ายและขวาพบว่าไม่แตกต่างกัน ($P>0.05$) อัตราการเกิดหลอดเลือดแดง corona mortis 22.5% หลอดเลือดดำ corona mortis 70.6% และมีทั้งสองแบบอยู่ด้วยกัน 17.2% ในกรณีที่มีทั้งสองแบบอยู่ด้วยกัน ขณะผ่าข้ามขอบบนของกระดูก iliopectic พบว่าส่วนมากหลอดเลือดแดงอยู่หน้าหลอดเลือดดำ

สรุป: ความชุกของหลอดเลือดแดง obturator ที่มีต้นกำเนิดจากหลอดเลือดแดง inferior epigastric ซึ่งถือว่าเป็นหลอดเลือดแดง corona mortis 22.5% หลอดเลือดดำ corona mortis 70.6% พบทั้ง 2 แบบอยู่ร่วมกัน 17.2% เส้นทางเดินของ corona mortis ที่ผ่าข้ามขอบบนของกระดูก iliopectic เป็นบริเวณที่เสี่ยงต่อการได้รับอันตรายในการผ่าตัดบริเวณขาหนีบ (ilioinguinal approach) หรือบริเวณกระดูกเชิงกรานทางด้านหน้า