

A Morphometric Study on Anatomic Characteristics of Corona Mortis in South Indian Population

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ABSTRACT

Introduction: The Corona Mortis or the “crown of death” is the vascular anastomosis between the external iliac and obturator vessels in the retropubic region. If injured accidentally during laparoscopic inguinal hernia repair and certain minimally invasive gynaecological procedures such as midurethral or pubovaginal sling, can result in inadvertent haemorrhage. Recognising the anatomic characteristics of the corona mortis vessel is needed in order to prevent bleeding catastrophe.

Aim: To estimate the prevalence and location of corona mortis in South Indian population and to determine the frequency of occurrence and its morphometry in males and females.

Materials and Methods: This was an observational cross-sectional study conducted between December 2020 to August 2021 in the Department of Anatomy, Rajarajeswari Medical College and Hospital, Bangalore, Karnataka, India. Dissection of 55 adult cadavers (42 male and 13 female hemipelvises) was performed and corona mortis was observed on pelvic surface of superior pubic ramus, number of venous and arterial anastomosis were noted and photographed. In addition to diameter of the anastomotic vessel, the distance of corona mortis vessel from the pubic symphysis was measured using electronic digital caliper. Demographic data was expressed as frequency and percentage

and continuous data as mean and standard deviation. Z test and t-test were done using statistical software Statistical Package for the Social Sciences (SPSS) version 23.0 to deduce the results. A p-value of <0.05 was considered as significant.

Results: The corona mortis was observed in 35 out of 55 specimens (63.64%). It was seen in 29 male (69%) and six female hemipelvises (46%). In all the specimens, venous anastomosis was observed between the obturator vein and inferior epigastric or external iliac vein. Consequently, in the present study all the determined corona mortis were venous. The mean distance of corona mortis vessel from the pubic symphysis was 5.26±1.2 cm in males and 5.63±0.94 cm in females with p-value= 0.48, thus the distance of the anastomotic vessel remains consistent in both the sexes. Furthermore, diameter of corona mortis vessel (greater than 1 mm) was measured in both the sexes and found to be statistically not significant. Besides there was incidental finding, aberrant obturator artery was more prevalent in females in comparison to males (p-value=0.013).

Conclusion: Corona mortis was present in 63.64% of the South Indian population and no statistically significant difference was found in prevalence in males and females. The distance of corona mortis vessel and the diameter of the vessel was consistent in both males and females.

Keywords: Anastomosis, Arterial, Haemorrhage, Inguinal hernia, Venous

INTRODUCTION

The arterial supply to pelvic viscera is derived from internal iliac artery and its branches and venous drainage is by corresponding vein. The obturator artery (branch of Internal Iliac artery) runs in the lateral pelvic wall along with obturator vein and nerve. It exits the pelvis via the obturator foramen [1]. The corona mortis or “crown of death” is the vascular connection between the obturator and inferior epigastric or external iliac arteries or veins in the retropubic region [1]. This anastomosis can be arterial, venous or both. Vessels that cross the superior surface of pubic rami are named as communicating or pubic branches of the obturator or inferior epigastric vessels [2]. Although standard anatomy textbooks do not mention the nomenclature, Gray’s Anatomy refers to this vein as a thick vein that connects the obturator and external iliac veins [3].

Corona mortis vessel is situated on the superior ramus of pubis and is of surgical concern during laparoscopic Inguinal hernia repair and gynaecological procedures such as midurethral or pubovaginal sling for treating urinary stress incontinence [4,5]. Significant haemorrhage can occur over the posterior aspect of superior pubic ramus from the corona mortis vessel during the ilioinguinal exposure in inguinal hernioplasty [6]. Hence it is necessary to understand the vascular variability in retropubic region to prevent potential haemorrhage.

The venous type of corona mortis has been reported to be more prevalent than the arterial type as documented in a previous study

[7] where venous corona mortis in 70.6% was found as compared to arterial (22.5%). Only limited Indian studies exist in literature [8-10] further emphasising the need of this study specifically in South Indian population. The aim of this study was to evaluate the location and prevalence of corona mortis in south Indian population (Karnataka), to determine the frequency of occurrence and its morphometry in males and females and to evaluate its surgical importance.

MATERIALS AND METHODS

This observational cross-sectional study was conducted between December 2020 to August 2021 on 55 formalin preserved cadaveric hemipelvises procured from the Department of Anatomy, Rajarajeswari Medical College and Hospital, Bangalore, Karnataka, India. Since it was a cadaveric study, Ethical Clearance was exempted from our institution.

Sample size calculation: A pilot study was undertaken by authors which showed the proportion of presence of corona mortis vessel was found to be 70%. Pilot study was done on 20 specimens, out of which in 14 specimens, corona mortis vessel was present.

Hence sample size was calculated using below formula:

$$n = P(1-P)Z^2 \div D^2$$

$$P = 70\%$$

$$D = 0.12$$

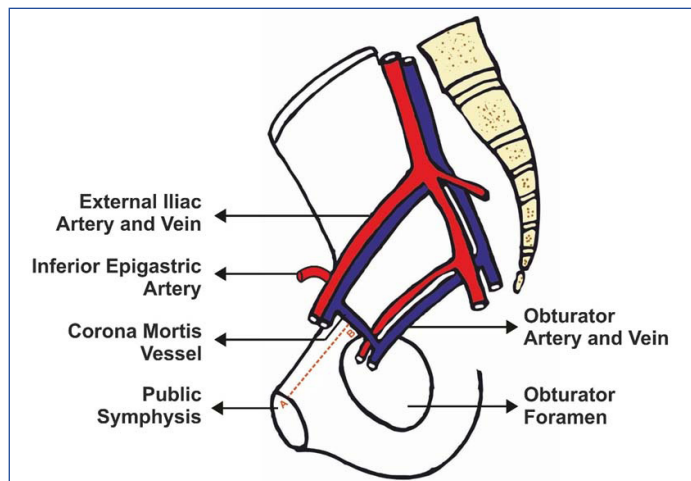
Confidence level= 95%
 By substituting,
 $n=(0.70)(0.30)(1.96)^2 \div (0.12)^2$
 $0.806736 \div 0.0144$
 $n=56$

Inclusion criteria: A total of 55 specimens were included for the study. Among the hemipelvises which were dissected 42 were males and 13 were females. The age of cadavers ranged from 30-70 years.

Exclusion criteria: The specimens which were damaged and diseased were excluded from the study.

Study Procedure

The lateral pelvic wall was dissected as per Cunningham manual of practical anatomy [11] and the obturator vessels, the external iliac vessels and inferior epigastric vessels were traced. Corona mortis vessel was observed on pelvic surface of superior pubic ramus, number of venous and arterial anastomosis were noted. The distance of corona mortis vessel (which is located on the superior surface of pubic ramus) from the pubic symphysis was measured using flexible measuring tape and expressed in cm as shown schematically in [Table/Fig-1].



[Table/Fig-1]: Schematic diagram showing corona mortis vessel (designed by artist Mr Suresh using Corel drawX5 and adobe Photoshop CS3).
 A: Pubic symphysis; B: Corona Mortis vessel
 Red dotted line (AB): Distance of corona mortis vessel from pubic symphysis

External diameter of vessel was measured using electronic digital caliper (0-150 mm, 0.01 mm resolution) aerospace and expressed as mm. The findings were recorded and corona mortis vessel was photographed using Sony cyber-shot DSC-HX400.

STATISTICAL ANALYSIS

Data collected was analysed using descriptive and Inferential statistics, using statistical software SPSS version 23.0 and MS Excel. By descriptive statistics, demographic data was expressed as frequency and percentage whereas continuous data was expressed as mean and standard deviation. By inferential statistics, Z test and t-test were used. All the statistical analysis was carried out at 5% level of significance and a p-value of <0.05 was considered as significant.

RESULTS

Anastomosis between the external and internal iliac system: The corona mortis vessel was found in 35 out of 55 specimens (63.64%). [Table/Fig-2] shows the prevalence of corona mortis and aberrant obturator artery in male and female population. In all the specimens, venous anastomosis was observed between the obturator vein and inferior epigastric or external iliac vein [Table/Fig-3].

In the present study all the determined corona mortis were venous. It was observed in 29 male (69%) and six female hemipelvises (46%).

Z test was applied and p-value was not found statistically significant implying that there is no difference in prevalence between the males and females.

Vessel	Male Hemipelvises	Female Hemipelvises	Z test	p-value
Venous corona mortis	29 (69%)	6 (46%)	1.499	0.1336
Aberrant obturator artery	4 (9.52%)	5 (38.46%)	-2.4646	0.0139*

[Table/Fig-2]: Vascular distribution in dissection.

p<0.05* statistically significant; 29 out of 42 specimens in males and 6 out of 13 specimens in females showed the presence of venous corona mortis



[Table/Fig-3]: Cadaveric dissection of left male hemipelvis showing venous corona mortis traversing superior ramus of pubis.

1. External Iliac artery; 2. External Iliac vein; 3. Venous corona mortis; 4. Obturator nerve
 5. Obturator artery; 6. Obturator vein; 7. Pubic symphysis; Black dotted line: shows the measurement taken from the pubic symphysis to the corona mortis vessel

In one specimen, double venous corona mortis was present at 6.3 cm and 7.2 cm distance from pubic symphysis respectively [Table/Fig-4].



[Table/Fig-4]: Cadaveric dissection of hemipelvis showing double venous connection between external iliac vein and obturator vein.

1. External Iliac artery; 2. External Iliac vein; 3. (3a & 3b) Venous corona mortis; 4. Obturator nerve; 5. Obturator artery; 6. Obturator vein; 7. Pubic symphysis
 White dotted line from point 7 to point 3a: measures 6.3 cm
 Yellow dotted line from point 7 to point 3b: measures 7.2 cm

Distance of corona mortis from pubic symphysis: The mean distance of corona mortis vessel from pubic symphysis was 5.26 ± 1.2 cm in males and 5.63 ± 0.94 cm in females. Unpaired t-test was done and has not shown significant difference in males and females. Vessels 1 mm or greater in diameter were noted in 14 out of 35 specimens. Mean diameter of corona mortis vessel in males was 1.67 ± 0.647 mm and in females was 1.2 ± 0.542 mm [Table/Fig-5].

Variables	Male Hemipelvises	Female Hemipelvises	t-test	p-value
Average distance of corona mortis vessel from pubic symphysis (cm)	5.26±1.2 (n=29)	5.63±0.94 (n=6)	0.70	0.4836
Average diameter of corona mortis (mm)*	1.67±0.647 (n=12)	1.2±0.542 (n=2)	0.96	0.3545

[Table/Fig-5]: Morphometry of corona mortis.

*diameter of corona mortis was measured in 14 specimens

Aberrant obturator artery: Incidentally there was aberrant obturator artery which was arising from common trunk with inferior epigastric artery. Normally, obturator artery arises from internal iliac artery [3] as was seen in 46 specimens, but in nine specimens, it arising from inferior epigastric artery [Table/Fig-6]. It was found in four males and five females with p-value of 0.0139 indicating that aberrant obturator artery is more common in females than males.



[Table/Fig-6]: Cadaveric dissection of hemipelvis showing the aberrant obturator artery (5) arising from the common trunk with inferior epigastric artery (external iliac artery).

1. External iliac artery; 2. External iliac vein; 3. Venous corona mortis; 4. Obturator nerve
5. Aberrant Obturator artery; 6. Obturator vein; 7. Pubic symphysis

DISCUSSION

The term “corona mortis” is derived from Latin word, consisting of ‘corona’ which is a crown-like eminence or encircling structure and ‘mortis’ means death [12]. A literature review was done to understand the prevalence of corona mortis in various ethnic groups which varied from 80% in Romania [1], 61% in Turkey [2] to 77% in North Indian population [10] as depicted in [Table/Fig-7] [1,2,9,10,13,14].

Study	Country	No. of hemipelvises	Reported Corona Mortis prevalence (%)
Rusu MC et al., 2010 [1]	Romania	40	32 (80)
Okcu G et al., 2004 [2]	Turkey	150	91 (61)
Nayak SB et al., 2016 [9]	India	73	37 (51)
Pillay M et al., 2017 [10]	India	48	37 (77.08)
Baena G et al., 2015 [13]	Colombia	28	22 (78.6)
Leite TFO et al., 2017 [14]	Brazil	60	27 (45)
Present study (2022)	India	55	35 (63.64)

[Table/Fig-7]: Prevalence of corona mortis across various countries [1,2,9,10,13,14].

In the present study, the prevalence of corona mortis was 63.64%. In this study, only venous corona mortis was found. Comparable results have been obtained by Sarikcioglu L et al., who stated only

venous type in 11 halves out of 50 cadaveric halves they dissected [15]. Drewes PG et al., performed dissection in 15 fresh female cadavers and observed that corona mortis was noted in 66.7%, which was predominantly venous (60%). They concluded that knowledge of this vascular anatomy is essential for surgeons to avoid vascular complications [16]. Similar to present study, many other researchers have estimated the prevalence of venous corona mortis which ranges from 50-80% [1,2,9,10,13].

In addition, the corona mortis is located at a variable distance from the pubic symphysis which ranged from 4-9.6 cm as reported by Darmanis S et al. The distance of corona mortis vessel from the pubic symphysis provides valuable input for the surgeon while operating in the retropubic region [17]. As per the authors knowledge, this was the only study that has analysed the differences of distance of corona mortis vessel in males and females and found no significant difference.

Leite TFO et al., performed dissection in 60 hemipelvises, arterial corona mortis was found in 45%. The caliber of corona mortis vessel was on average 2.7 mm [14]. Pillay M et al., did cadaveric study on 67 hemipelvises and observed corona mortis in 56 specimens (83.58%), arterial in 7/56 (12.5%) and venous in 34/56 (60.7%). They stated that variations in the venous system is more common than arterial [10]. When corona mortis is present, during the laparoscopic inguinal hernia repair while applying tacks to fix the mesh into cooper’s ligament, it can be damaged resulting in severe haemorrhage, often resulting in conversion to open surgery or retroperitoneal haematoma [18].

The obturator artery commonly arises from the internal iliac artery [3] which in present study was found in 46 specimens (83.64%). An aberrant obturator artery arises in common trunk with inferior epigastric artery (a branch of external iliac artery) [3] which was seen in nine specimens (16.36%) in present study. Although this was an incidental finding, it was observed commonly in females as opposed to males.

This study furthers points the presence of aberrant obturator artery which is essential since retractors which are placed in retropubic area can injure the accessory obturator artery resulting in haemorrhage as stated by Marsman JW et al., [19]. The vessels can be ligated if haemorrhage occurs in an abdominal procedure. Through a technique called coil embolisation, successful haemostasis of an injured corona mortis vessel has been done [19]. The corona mortis vessel is a frequently observed anastomosis over the superior ramus of pubis with a variable distance from the pubic symphysis and it was observed that the caliber of vessel is consistent in both males and females. On the other hand, aberrant obturator artery which was an incidental finding was observed more commonly in females than males.

Limitation(s)

The limitation of this study was inability to measure the diameter of anastomotic vessels less than 1 mm since veins were extremely thin and collapsed. Hence present study considered vessels more than 1 mm diameter for analysis. Further, it is proposed for future researchers to assess the diameter of the anastomotic vessel intraoperatively.

CONCLUSION(S)

Present cadaveric study revealed that corona mortis vessel was present in 63.64% of the South Indian population. Based on present study findings, we would like to conclude that corona mortis vessel was found to be highly prevalent in south Indian population and that there was no statistically significant difference in prevalence between the males and females. The distance of corona mortis vessel and the diameter of the vessel was consistent in both males and females. Adequate knowledge of corona mortis vessel is important to prevent inadvertent haemorrhage.

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