Narrative Review
Acta Medica Academica 2025;54(2):152-163
DOI: 10.5644/ama2006-124.480

Surgical Anatomy of Corona Mortis: A Literature Review and Its Significance in Minimally Invasive Surgery

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Received: 5 May 2025; **Accepted:** 26 August 2025

Abstract

Objective. This article reviews the literature on the anatomy, incidence, and clinical significance of the corona mortis, especially in minimally invasive surgery, where inadvertent surgical complications are more likely to occur. **Methods.** A systematic search was performed using the PubMed, Google Scholar, and ScienceDirect databases. Studies with the term "corona mortis" in the title and/or abstract published between 2000 and 2025 that were relevant to the aim of this study were included in this review. Studies published in languages other than English were excluded. The studies were analyzed using narrative data synthesis. **Results.** This study reviews the relevant literature and provides a thorough overview of the anatomy of the corona mortis vessels, including different classifications, incidence, location, and size of the vessels. There was a significant discrepancy in the reported prevalence of the corona mortis between studies, especially cadaveric and intraoperative studies. Both arterial and venous 'corona mortis' vessels have been reported, with a greater frequency of venous vessels, which are present in approximately 20% and 40% of hemipelvises, respectively. A number of case reports were evaluated regarding injury to the corona mortis vessels during minimally invasive procedures. These case reports highlight that current surgical practices and techniques seem to adequately prevent damage to these structures. **Conclusion.** While there is a relative scarcity of reports showcasing adverse events due to the corona mortis, the moderately high incidence of this variable vessel in approximately half of the hemipelvises necessitates detailed anatomical knowledge and consideration when planning a minimally invasive procedure in the retropubic pelvic space.

Key Words: Corona Mortis ▪ Surgery ▪ Anatomical ▪ Variation.

Introduction

The pelvic and abdominal wall vasculature are prone to anatomical variations. The embryological basis for these variations stems from the formation of this vasculature. An initial capillary network forms, which subsequently enlarges, atrophies, and disappears, resulting in the final vascular pattern. This occurs in both arteries and veins, with the venous vasculature being more irregular, as reflected by more anatomical variations. The obturator vein is formed by the transformation of the embryonic posterior cardinal vein into the iliac vein during weeks 6 and 7 of embryonic development (1).

As for the umbilical artery, its dorsal root forms two connecting arterial plexuses, the abdominal and the pelvic. The external and internal iliac arteries are formed from the pelvic plexus, whereas the obturator artery is formed from the varied anastomosis between these vessels (2). These variations are, in turn, reflected in the diverse definitions of the term corona mortis among authors. This review defines the corona mortis (CM) as a vascular connection between the obturator and external iliac or inferior epigastric arteries or veins occurring near the superior pubic ramus in the retropubic space (3). This connection can be arterial, venous, or, more rarely, both simultaneously (4). The corona mortis, Latin for 'crown of death', is aptly named as it constitutes a major source of bleeding if damaged (5) and is at risk during pelvic surgery and minimally invasive procedures such as laparoscopic hernia repair (5-9), minimally invasive groin exploration for chronic post-herniorrhaphy inguinal pain (10), laparoscopic procedures for gynecological malignancies (11), laparoscopic removal of deep infiltrating endometriosis of the obturator internus muscle (12), mid-urethral sling procedure (13), and robotic radical prostatectomy (14, 15).

A laceration of the corona mortis can lead to severe bleeding, as these vessels link high-volume systems and may retract into the obturator canal (16). Furthermore, injury to the corona mortis vessels may require conversion to open surgery (17), although it can still be managed without it (5). As more surgeries are performed laparoscopically or robotically, accurate anatomical knowledge is required to improve patient outcomes. The anatomy of the corona mortis is particularly relevant in the context of minimally invasive surgery, where a limited visual field and restricted tactile feedback increase the risk of inadvertent vascular injury. Unlike open procedures, where bleeding can be more easily identified and controlled, laparoscopic and robotic approaches offer less immediate access to bleeding sites, making preoperative knowledge of anatomical variations critical. Furthermore, common dissection planes in minimally invasive procedures—such as during hernia repair—bring the surgeon in closer proximity to the corona mortis compared to open approaches. CM has been widely studied due to its relevance in pelvic surgery, with a reported prevalence mainly ranging from 20% to over 60%, depending on the definitions and methodologies. The existing literature includes cadaveric, imaging, and intraoperative studies, systematic reviews and meta-analyses, and case reports of injury to the vessel. However, variability in terminology, particularly regarding anastomosing versus aberrant vessels, has led to inconsistent incidence rates. While anatomical details are well documented, few studies have linked these findings to surgical outcomes. This literature review presents the most relevant data where corona mortis was the main subject of study.

This review aimed to clarify the anatomical characteristics and incidence of this unique connecting vessel and highlight its importance during minimally invasive surgical approaches to the pelvis.

Materials and Methods

Search Strategy

A literature review was conducted using an online article search. The databases used were PubMed, Google Scholar, and ScienceDirect. The search term "corona mortis" was used, and studies were required to include this term in their title. For the PubMed and ScienceDirect databases, the search was expanded to include abstracts. The dates ranged from 2000 to 2025. Additionally, the references cited in the included studies were searched, and all relevant articles were incorporated into the review. A secondary search was then performed, combining the search terms 'corona mortis' and looking specifically at case reports, as well as a search combining the search terms 'corona mortis' and 'laparoscopic' or 'minimally invasive' or 'robotic' to gauge the impact of corona mortis on minimally invasive procedures specifically. From this secondary search, as well as the initial search, 15 case reports were included in this review.

Study Analysis

The number of articles found after the initial search was 271. Duplicates were then removed. The studies were then analyzed, and data were extracted. The inclusion criteria for this literature review were based on whether the study: (1) defined the corona mortis in line with this review's definition, (2) reported on the anatomical characteristics of the corona mortis, or (3) had a different definition of the corona mortis but presented a detailed analysis of the vessels discussed, from which data regarding the corona mortis with a definition in line with this review's could be extracted and used. Articles relevant to the aim of this study that fit the above criteria were included, while studies in languages other than English were excluded. Articles without online versions were also excluded. Additionally, the references of the studies

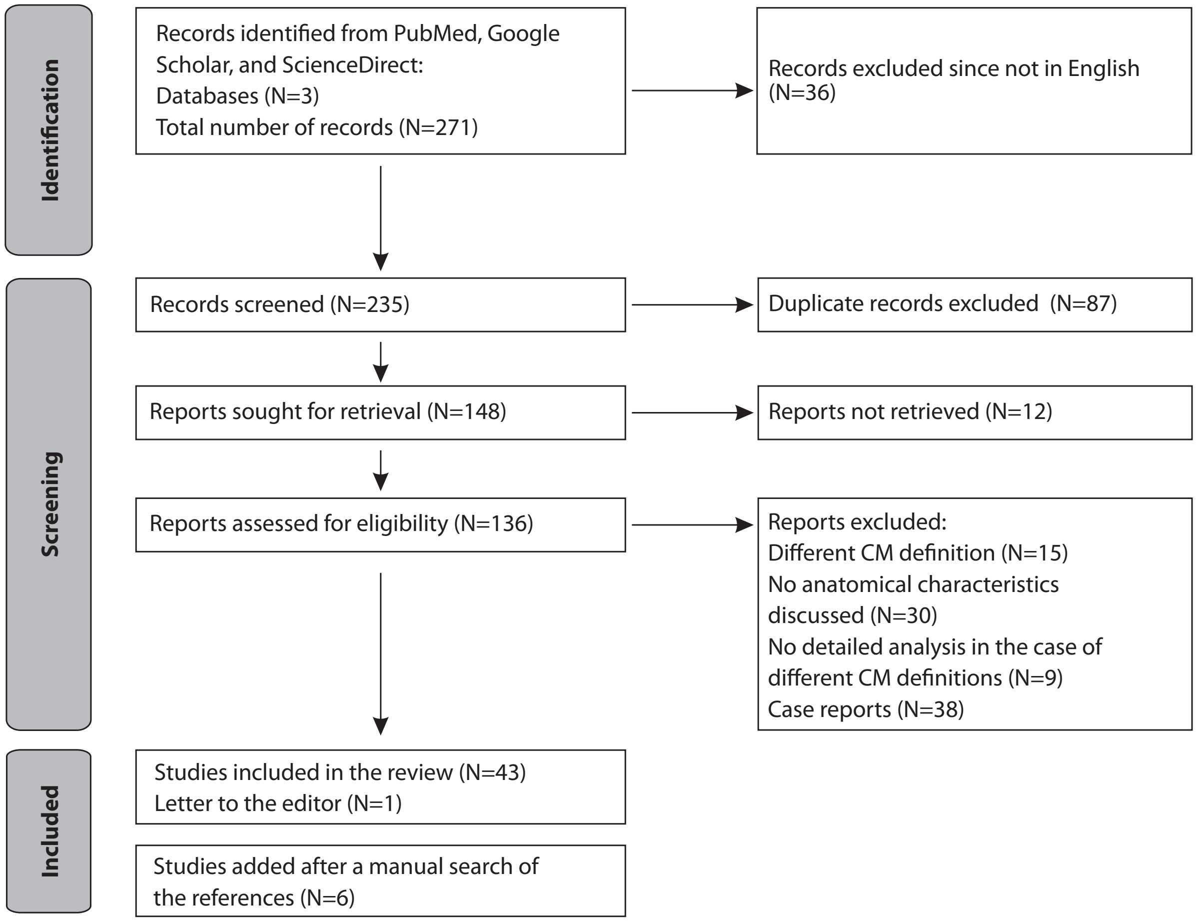

Figure 1. Flowchart of the included studies.

fitting the above-mentioned criteria were manually scoured, and any relevant articles were added to the review. Finally, 71 articles were included in this literature review. Of the articles that remained in this literature review, there was one meta-analysis, three systematic reviews, and the remainder were original studies and case reports. The original studies were cadaveric, intraoperative, or imaging studies, or, in some cases, a combination of the aforementioned studies. Finally, the studies were analyzed using narrative data synthesis.

Results

Anatomy Overview

CM has been described in most classical anatomy textbooks as an arterial anastomosis; however, since the name most accurately represents a structure with potential risk for the patient (18), the current literature accepts any vascular structure connecting the obturator and external iliac or inferior epigastric at the superior pubic ramus as corona mortis. For some authors, an aberrant obturator artery or vein is no different in this regard and could be considered as CM (18, 19). Specifically, in an intraoperative study, Ates et al. (18) proposed a classification system based on the thickness of the anastomotic vessels, where CM was classified as thin or thick with a cutoff of 2 mm, the same as the diameter of the dissector tip. In another in vivo study by Pellegrino et al. (11), vessels smaller than 2 mm in diameter were excluded altogether and could not be classified. This multitude of definitions, which varies between authors, is primarily caused by the obturator artery, which is known to have a highly diverse origin, especially for a vessel of its size (20). Different types of anastomoses have been documented in several articles, such as Rusu et al. (19), who distinguished four arterial and three venous subtypes of anastomotic vessels.

The different types are as follows:

- Type 1: The obturator artery originates from the external iliac artery.
- Type 2: The obturator artery originates from the inferior epigastric artery.
- Type 3: Anastomosis of the obturator and inferior epigastric arteries.
- Type 4: Pubic branch(es) from the obturator artery are unanastomosed to the external iliac system but cross over the superior pubic branch.

The venous corona mortis was categorized into three subtypes as follows:

- Type 1: The obturator vein drains into the external iliac vein.
- Type 2: The obturator vein drains into the inferior epigastric vein.
- Type 3: Venous anastomosis of the obturator and inferior epigastric veins.

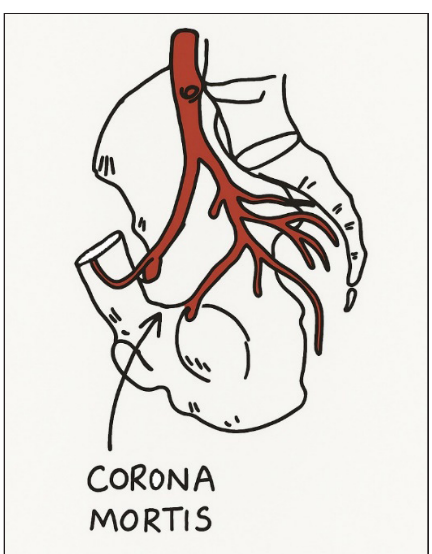

Figure 2. The classic definition of the arterial corona mortis is the connection between the obturator and inferior epigastric vessels.

In surgical practice, many patients have a combined pattern of CM, making such classifications less meaningful (21). The anastomosing vessels typically have a diameter between 0.8 and 4.9 mm, with a mean diameter of 2.8 mm (21); however, in most cases, the diameter ranges between 2 and 4.2 mm (22). In a systematic review by Cardoso et al., no relationship was found between the incidence of corona mortis and anthropometric characteristics (21).

Incidence

The highest reported incidence of both arterial and venous corona mortis was reported by Berberoglu et al., with 86% and 100%, respectively. This study included a total of 50 hemipelvises, of which 14 were cadaveric and 36 were intraoperatively examined while treated laparoscopically for hernia repair. The study reported on the Turkish population, but further anthropomorphic or sex-related differences were not described. In contrast, the lowest percentages were reported by Selçuk et al. (4% venous CM) and Pillay et al. (1% arterial CM). Selçuk et al. reported on a sample of 96 hemipelvises from a Turkish population examined intraoperatively for pelvic lymphadenectomies. No further anthropomorphic or sex-related differences were noted. Pillay et al. examined 67 cadaveric hemipelvises from an Indian population. The sample mainly consisted of male cadavers, with 63 of the 67 hemipelvises being from males. However, these studies are outliers, with most studies reporting an arterial prevalence of approximately 20-40% and a venous prevalence of approximately 40-60%. These results are represented in systematic reviews on the subject (4, 21, 23), with subsequent studies reporting comparable results.

The differences in the reported incidence could be attributed to the non-homogeneous definition of CM or the varying ethnic groups on which the different studies were performed. Another reason could be the secondary circulatory routes, which correlate with older age and cardiovascular disease, and most cadaveric studies have a relatively old mean age (24). These secondary arterial routes are created by arteriogenesis or angiogenesis. Angiogenesis is insignificant in the context of this review, as capillaries cannot be classified as corona mortis vessels. On the other hand, arteriogenesis, in the presence of peripheral arterial disease, the transformation of preexisting collateral arterioles into larger connecting vessels, could create a corona mortis (25). Finally, depending on the study type, several limitations may be inevitable; for example, imaging and intraoperative studies primarily report on arterial CM, whereas some cadaveric studies focus only on venous CM.

Location and Size

Of all the studies included in this review, 14 reported the size of the anastomosing vessel of the corona mortis, and 21 reported the distance from the pubic symphysis. Some studies differentiated between gender, others between left and right or arterial and venous, while a single study focused on different dissection protocols. The same was true for the reported distances. For completeness, these results were included, although they were not always directly comparable. The reported mean size ranged from 1.2 mm to 5 mm, with most studies reporting a mean size of approximately 3 mm. The distance from the pubic symphysis was between 33.4 mm and 71 mm, while most studies ranged from 50 mm to 60 mm.

Table 1 summarizes the results of the different studies (3, 4, 11, 16, 18, 19, 21, 23, 26-66), presenting the sample size (hemipelvises), arterial and venous prevalence, mean size of the anastomosis in mm, and average distance of 'corona mortis' vessels from the symphysis pubis (mm) in chronological order, including the country of origin and type of study. Among the included studies, there is a meta-analysis and two systematic reviews, which are presented first.

Table 1. Characteristics of the Studies and Summary of Their Results

Study	Year*	Country	Study type	Hemipelvises	Article type	Prevalence (%)		Size (mm)	Distance (mm)
						Arterial	Venous		
B. Sanna et al. (4)	2018	-	-	A) 1284 B) 850	Meta-analysis	A) 17	B) 42	-	Arterial: 59.9 Venous: 50.7
Cardoso et al. (21)	2021	-	-	3107	Systematic review	22	47	2.8	-
Noussios et al. (23)	2020	-	-	1455	Systematic review	25	42	-	-
Naicker et al. (26)	2024	South Africa	Imaging	145	Original article	13	29	2.83	SPS†: 61.7; PPS‡: 54.6
Khirul-Ashar N et al. (27)	2024	Malaysia	Cadaveric	164	Original article	49	51	2.86	54.7
Konarska-Włosińska et al. (28)	2024	Poland	Imaging	138	Original article	22	-	-	62.7
Naicker et al. (29)	2024	South Africa	Cadaveric	123	Original article	6	62	-	-
Schaible et al. (30)	2024	Switzerland	Intraoperative	210	Original article	22	76	Arterial: 3 Venous: 5	-
Atlihan et al. (31)	2023	Turkey	Cadaveric	20	Original article	25	60	-	-
Beya et al. (32)	2023	France	Cadaveric	24	Original article	21	46	Dissection protocol A) 2.75 Dissection protocol B) 3.08	Dissection protocol A) 58 Dissection protocol B) 60.9
Sambhav et al. (33)	2022	India	Cadaveric	62	Original article	40	65	-	-

Continuation of Table 1.

Study	Year*	Country	Study type	Hemipel-vises	Article type	Prevalence (%)		Size (mm)	Distance (mm)
						Arterial	Venous		
Sripadungkul et al. (34)	2022	Thailand	Cadaveric	68	Original article	10	19	2.98	45
Sengodan et al. (35)	2022	India	Cadaveric	40	Original article	18	78	-	55.6
Wada et al. (36)	2022	Japan	Cadaveric	113	Original article	28	76	>2 mm	47.7
Bharathi et al. (37)	2022	India	Cadaveric	55	Original article	-	64	Male: 1.62 Female: 1.2	Male: 52.6 Female: 56.3
Zorina et al. (38)	2021	Moldova	Imaging	197	Original article	27	-	-	-
Abbas et al. (39)	2021	Sudan	Intraoperative	30	Original article	40	30	4.33	-
Bhoil et al. (40)	2020	India	Imaging	200	Original article	14	-	Right: 2.6 Left: 2.3	Right: 54.55 Left: 54.26
Du et al. (41)	2020	China	Cadaveric	16	Original article	31	56	2.5	-
Güzel et al. (42)	2020	Turkey	Intraoperative	34	Original article	44	65	-	35.9
Kashyap et al. (43)	2019	India	Cadaveric	24	Original article	4	58	-	Arterial: 57 Venous: 41
D'Souza Dias and Patil (44)	2019	India	Cadaveric	50	Original article	4	40	-	Arterial: 42.7 Venous: 41.5
Selçuk et al. (45)	2018	Turkey	Intraoperative	96	Letter to the Editor	2	4	-	-
Pillay et al. (46)	2017	India	Cadaveric	67	Original article	1	46	-	54.5
Zhou et al. (47)	2017	China	Cadaveric	20	Original article	15	55	-	65.3
Han et al. (48)	2017	China	Imaging	660	Original article	14	51	Arterial: 2.56 Venous: 3.63	Arterial: 59.6 Venous: 66.8
Leite et al. (49)	2017	Brazil	Cadaveric	60	Original article	45	-	2.56	49.6
Steinberg et al. (50)	2017	Israel	Imaging	200	Original article	33	-	Right: 2.4 Left: 2.24	Right: 55.2 Left: 57.2
Nayak et al. (51)	2016	India	Cadaveric	73	Original article	-	45	-	-
Castellani et al. (52)	2016	Italy	Imaging	94	Original article	23	-	-	-
Pellegrino et al. (11)	2015	Italy	Intraoperative	50	Original article	16	36	-	-
Jensen et al. (53)	2015	Switzerland	Intraoperative	130	Original article	42	-	-	-
Ates et al. (18)	2015	Turkey	Intraoperative	398	Original article	28	-	-	-
Bible et al. (54)	2014	USA	Cadaveric	10	Original article	60	80	-	-
Stavropoulou-Deli and Anagnostopoulou (55)	2013	Greece	Cadaveric	70	Original article	11	17	Arterial: 3 Venous: 3.13	Arterial: 54.4 Venous: 46.7
Kacra et al. (56)	2011	Turkey	Cadaveric	10	Original article	20	40	-	-
Rusu et al. (19)	2010	Romania	Cadaveric	40	Original article	38	53	-	-

Continuation of Table 1.

Study	Year*	Country	Study type	Hemipel-vises	Article type	Prevalence (%)		Size (mm)	Distance (mm)
						Arterial	Venous		
Smith et al. (57)	2009	USA	Imaging	100	Original article	29	-	-	-
Pai et al. (58)	2009	India	Cadaveric	98	Original article	2%	-	-	-
Pathi et al. (59)	2009	USA	Cadaveric	24	Original article	-	67	-	-
Kawai et al. (60)	2008	Japan	Cadaveric	560	Original article	22	-	-	-
Darmanis et al. (3)	2007	England	Cadaveric	80	Original article	36	60	-	Arterial: 71 Venous: 65
Namking et al. (61)	2007	Thailand	Cadaveric	204	Original article	23	71	-	-
Drewes et al. (16)	2005	USA	Cadaveric	30	Original article	17	30	-	54
Okcu et al. (62)	2004	Turkey	Cadaveric	150	Original article	19	52	-	Arterial: 64 Venous: 56
Ersoy et al. (63)	2004	Turkey	Cadaveric	10	Original article	-	100	-	-
Sarikcioglu et al. (64)	2003	Turkey	Cadaveric	54	Original article	-	20	-	39.79
Karakurt et al. (65)	2002	Turkey	Angiography	98	Original article	28	-	-	Arterial: 33.4
Berberoglu et al. (66)	2001	Turkey	1) Cadaveric 2) Intraopera-tive	1) 14 2) 36	Original article	1) 86 2) 86	1) 100 2) 94	1) 3.3-Venous 0.98; Arterial 2) <1 mm	40.4 (Cadaveric)

*Publication; †Superior pubic symphysis; ‡Posterior pubic symphysis; Dissection protocol A (classic dissection); Dissection protocol B (pulsatile vascularization).

Discussion

Corona mortis vessels cross the pubic rami and, as such, are at risk in several different surgeries, mainly in urological, gynecological, orthopedic, and general surgery procedures. For some authors, such as Rusu et al. and others, any vessel coursing over the superior pubic ramus could be called corona mortis regardless of whether it is an anastomosing vessel or an aberrant or accessory obturator artery (19, 67-70). In turn, this creates further discrepancies in the reported incidence beyond the different ethnic groups and study methodologies, as discussed earlier.

In a systematic review by Marvanova and Kachlik (67), which defined corona mortis as any vessel coursing over the superior pubic ramus, the overall incidence of arterial corona mortis was 26%, while only approximately half were anastomosing vessels, with 54% of the total vessels found. Further studies could provide a better understanding of its true incidence, provided that a universal definition is adopted. Furthermore, another area of possible future research could be studies combining pre-surgical with intraoperative imaging, a type of combined study that is not widely explored but could provide valuable knowledge.

While the arterial corona mortis has been more widely researched, with more studies reporting on its prevalence either due to greater interest in cadaveric anatomical studies of the obturator artery or the inherent limitations of some intraoperative studies, the venous corona mortis is more prevalent. In a study by Kinaci et al., the pressure of the pneumoperitoneum played a significant role in the vessels, which could be identified intraoperatively and were, in turn, protected by lowering the pressure from 14 mmHg to 8 mmHg for at least their identification (17). Nevertheless, the incidence of the corona mortis vessels, either arterial or the more prevalent venous, suggests that such a connection should be expected in most hemipelvises.

These CM anastomosing vessels are prone to injury due to their positioning proximal to the hernial sac, either during dissection or tack fixation in laparoscopic hernia repair, specifically (24). A laceration of the corona mortis can result in massive hemorrhage, requiring transfusion protocols (3). It could also be unassuming, and if undetected and left unchecked, it could result in hematoma formation (65). Despite this almost inevitable encounter with the corona mortis when operating on the pelvis, there is a lack of case reports documenting life-threatening injuries to these vessels. Even when its presence was confirmed, the course of these patients was uneventful (52). Darmanis et al. (3) also reached a similar conclusion, with little correlation between hemorrhage and CM during pelvic operations. In an in vivo study by Ates et al. (18), injury to the corona mortis was a rare event occurring in 1.5% of TEP hernia repairs, mostly during tack stapling on the Cooper ligament during mesh fixation. The injured vessels were <2 mm in size. The authors of this study also concluded that the tacks should be stapled near the symphysis pubis to minimize this risk. In a study by Schaible et al. (30), in which patients underwent surgeries for pelvic ring injuries, acetabular fractures, or combined injuries, the corona mortis was injured in ten of the 185 cases due to prior trauma and in one case due to surgical manipulation. In all these cases, bleeding was controlled, and there were no unfavorable patient outcomes. Similarly, Jensen et al. (53) examined the relevance and outcomes of pelvic trauma and showed no correlation between the existence of the corona mortis and mortality or bleeding, and posed little threat to surgeons operating on the pelvis, as it could be managed even if damage occurred (53).

However, most life-threatening hemorrhages from the corona mortis vessels reported in the accessed case reports were associated with pelvic trauma (59, 62-64). Nevertheless, a detailed knowledge of the pelvic anatomy and possible vascular variations is a must for the surgeon operating in the area, as it is difficult to assess whether the absence of reported adverse events regarding minimally invasive pelvic procedures is because of the lack of correlation between corona mortis and these events or the extra attention and the accumulated technical prowess of the surgeons operating in the area. In clinical practice, recognizing the high likelihood of encountering corona mortis vessels during pelvic procedures should encourage routine anticipation rather than alarm. Although the presence of the vessel is not typically associated with adverse outcomes, its identification can guide safer dissection strategies. For example, placing mesh tacks closer to the symphysis pubis during TEP repairs, as recommended by Ates et al. (18), minimizes the risk of vascular injuries.

Similarly, intraoperative adjustments, such as reducing pneumoperitoneum pressure, as demonstrated by Kinaci et al. (17), can facilitate vessel visualization and protection. Understanding the course and variability of CM allows for early identification and control if bleeding occurs, contributing to greater surgical confidence and better patient outcomes. Ultimately, integrating this anatomical awareness into surgical planning and training supports better intraoperative decision-making and enhances patient safety. The main limitation of the assessed studies was the heterogeneity among them in terms of study type, ethnic group, and sample size, which was reflected in their results. A statistical comparison between them may introduce errors due to inherent differences when comparing cadaveric and intraoperative or imaging studies. Intraoperative studies are prone to bias arising from differences in surgical techniques, surgeon expertise, and institutional capabilities, variables that are rarely controlled for and are challenging to quantify.

Limitations of the Study

This review is limited by the number of assessed case reports, which stemmed from the number of databases utilized. Although a broader database search might have identified additional case reports, the studies included in this review are deemed representative of the current evidence.

Conclusion

The corona mortis is a widely researched anatomical variant, and many studies have documented its presence and characteristics. The high incidence of the corona mortis vessels, regardless of their definition, being present in approximately half of the population, underscores the vital role of excellent anatomical knowledge for surgeons operating in the retropubic space. Accordingly, the traditional designation "Crown of Death" appears to be a misnomer that does not reflect current surgical outcomes. Despite its prevalence, the low rate of documented intraoperative complications, as reflected in published case reports related to this vessel across various pelvic surgeries, suggests that its clinical significance may be overstated.

Surgeons should remain vigilant and could incorporate the following practical strategies into their operative planning and techniques:

- Preoperative imaging, such as contrast-enhanced CT or MRI angiography, when indicated, can help identify vascular variations in complex or high-risk cases.
- Meticulous dissection of the retropubic and superior pubic ramus regions is essential to avoid inadvertent injury, particularly during minimally invasive procedures.
- Prompt recognition and control of bleeding from a corona mortis vessel—should it occur
- Anatomical education and simulation training should include recognition of vascular variants, such as the *corona mortis,* to prepare surgeons for intraoperative identification and management.

In summary, emphasis should remain on meticulous dissection, thorough preoperative evaluation, and intraoperative vigilance to minimize the risk of injury, and its presence should not, in itself, necessitate changes to standard surgical approaches.

What Is Already Known on This Topic:
Corona mortis has been extensively reviewed, with many studies reporting on its incidence and other anatomical characteristics, primarily through cadaveric studies. Due to the anatomical nature of these studies, the impact of this anatomical variation on actual surgical complications is reflected more accurately in case reports of complications.

What This Study Adds:
This study begins with a comprehensive review of the available literature and then examines the available case reports. Some studies offer a different perspective on this topic, highlighting the scarcity of complications reported associated with the corona mortis, especially considering how commonplace these surgeries are.

Authors' Contributions: Conception and design: TP; Acquisition, analysis and interpretation of data: TP and ME; Drafting the article: TP and ME; Revising it critically for important intellectual content: TP and CD; Approved final version of the manuscript: TT and CD.

Conflict of Interest: The authors declare that they have no conflicts of interest.

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