STUDY PROTOCOL

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Study title: Systematic anatomical description of the relationships of the female pelvic retroperitoneum in cadavers: a descriptive study focused on gynecologic surgery

Sponsor: University of Barcelona (UB), Unit of Human Anatomy and Embryology. Department of Pathology and Experimental Therapeutics. Faculty of Medicine and Health Sciences.

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Study summary: An observational and descriptive anatomical study of the female pelvic retroperitoneum will be conducted through cadaveric dissection. The primary objective is to identify the main anatomical relationships among ureteral, vascular, and neural structures and describe the frequency of anatomical variability using a 10-item checklist. A secondary objective is to obtain anatomical photographs for the development of a teaching atlas.

Study type: Observational, descriptive, qualitative cadaveric study.

Design: Cross-sectional anatomical study based on dissection of the female pelvic retroperitoneum and assessment of an anatomical checklist.

Population: 20 adult female cadavers from the University of Barcelona body donation program (40 hemipelves).

Intervention: Anatomical dissection of the pelvic retroperitoneum, assessment of an anatomical checklist, and photographic documentation of findings.

Primary objective: To identify the main anatomical relationships of the female pelvic retroperitoneum and describe the frequency of anatomical variability for each of the 10 assessed items.

Secondary objectives: To obtain anatomical photographs for the development of a teaching atlas of the female pelvic retroperitoneum.

Duration: The planned study duration is 8 months, including planning, dissection, data analysis, and preparation of the results.

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1. Rationale

Gynecologic oncology surgery, and complex pelvic surgery in general, is performed within an anatomically dense environment such as the retroperitoneum, where large-caliber vascular structures, autonomic nerve plexuses, and lymphatic chains coexist. Precise knowledge of this anatomy is essential to reduce the morbidity associated with procedures such as radical hysterectomy or pelvic and para-aortic lymphadenectomy (1–3).

In this context, the pelvic autonomic nervous system plays a central role. The integrity of the hypogastric plexuses and pelvic splanchnic nerves is fundamental to bladder, rectal, and sexual function, and injury to these structures is associated with significant dysfunction after radical surgery (4,5). Several studies have shown considerable variability in the course, number of nerve roots, and anatomical relationships of these structures with surgical landmarks such as the promontory, iliac vessels, and ureter (4,6,7). This variability may explain persistent functional sequelae even after technically correct dissections.

Anatomical studies of female pelves have also described a complex organization of the inferior hypogastric plexus, closely related to the ureter and uterine vessels, as well as significant asymmetry between hemipelves (8) (9). These findings further support the presence of clinically relevant anatomical variability in the pelvic autonomic nervous system (7).

The evolution of surgery toward nerve-sparing approaches has highlighted the need for precise knowledge of nerve anatomy and its relationships with vascular and visceral structures. Current techniques emphasize identifying nerve branches before resection of the parametrium and paracervix, as well as using avascular spaces to reduce complications (10–12). Nevertheless, discrepancies remain regarding terminology and the definition of these spaces, reflecting a lack of anatomical standardization (2,13,14).

Regarding fascial anatomy, some models have proposed a compartment-based organization of the pelvic retroperitoneum using constant anatomical structures, although their practical application remains limited and has not been fully integrated into surgical practice (15,16).

Retroperitoneal vascular anatomy is another critical component. Variability in the branching of the internal iliac artery, the complexity of the venous plexuses, and the presence of variants such as the corona mortis, which has a high prevalence, have direct implications for hemorrhagic risk and surgical planning (1,3,17,18).

Despite these advances, most studies focus on isolated structures or small series, and few studies systematically and quantitatively integrate the anatomy of the female pelvic retroperitoneum and upper abdomen within the same reference framework.

In this context, a descriptive and morphometric cadaveric anatomical study focused on gynecologic surgery will provide quantitative data on distances, anatomical relationships, and variability. Integrating these findings with systematic photographic documentation will facilitate the development of an applied anatomical atlas to improve surgical planning, optimize nerve-sparing techniques, and strengthen training in gynecologic oncology.

2. General objective

To describe the main anatomical relationships of the female pelvic retroperitoneum through cadaveric dissection, with particular emphasis on structures relevant to gynecologic surgery.

2.1. Primary objective

To describe the frequency of the principal anatomical relationships of the female pelvic retroperitoneum and their variability using a 10-item anatomical checklist.

2.2. Secondary objectives

To obtain a photographic record of the anatomical structures studied for the development of a teaching atlas of the female pelvic retroperitoneum.

3. Study design

3.1. Study type

Descriptive cadaveric anatomical study based on dissection of the female pelvic retroperitoneum.

3.2. Study setting

The study will be conducted in the Dissection Room of the University of Barcelona, using cadavers donated for teaching and research, following approval by the corresponding Bioethics Committee.

3.3. Study population and material

- **Target population:** Adult female cadavers preserved in formalin or fresh.
- **Planned sample size:** Approximately 20 female cadavers (40 hemipelves).

3.4. Unit of analysis

Each hemipelvis will be considered an independent unit of analysis.

3.5. Study period

The planned duration of the study will be approximately 8 months, covering planning, dissection, data analysis, and preparation of results.

3.6. Data source and general procedure

Data will be obtained through:

- Anatomical dissection of the pelvic retroperitoneum.
- Assessment of a 10-item anatomical checklist.
- Photographic recording of findings.

In each hemipelvis, the anatomical structures necessary to complete the checklist and document any anatomical variants will be identified.

3.7. Observers

Dissections will be performed by gynecologists experienced in gynecologic surgery, with support from Dissection Room staff when necessary.

4. Selection criteria

4.1. Inclusion criteria

Female cadavers meeting **all** of the following criteria will be included in the study:

1. Female sex
2. Age ≥ 18 years
3. Good preservation
4. Intact pelvic and abdominal anatomy
5. Absence of alterations that could hinder dissection
6. Presence of both hemipelves
7. Authorization for use in research

4.2. Exclusion criteria

Cadavers meeting any of the following criteria will be excluded:

1. Male sex
2. Previous major pelvic or abdominal surgery
3. Previous radiotherapy
4. Advanced tumors affecting the retroperitoneum
5. Severe trauma
6. Poor state of preservation
7. Absence of a hemipelvis
8. Pregnancy causing distortion of the uterus

5. Materials and Methods

5.1. Study population

The study population will consist of adult female cadavers from the University of Barcelona body donation program who meet the inclusion criteria.

Each cadaver will contribute two pelvic units of analysis (right and left hemipelves).

At the abdominal level, the major retroperitoneal structures (aorta, vena cava, proximal ureter, and lymphatic chains) will be examined.

Sample size will depend on availability, with an estimated minimum of 20 trunks.

5.2. Materials and preparation

Cadavers will be preserved using standard formalin fixation or freezing techniques.

Before dissection, the following will be performed:

- Coded identification of each cadaver.
- Assessment of preservation status.
- Confirmation of anatomical integrity.

Dissections will be performed in the supine position through an anterior abdominal approach.

5.3. Procedures and techniques

Dissection will be performed **systematically and in a standardized manner**, following a **layer-by-layer sequence**:

1. **Abdominal opening.**

A midline xipho-pubic laparotomy will be performed, opening the abdominal wall layer by layer and identifying and separating, when necessary, the following structures: skin, subcutaneous tissue (Camper's and Scarpa's fasciae), anterior rectus sheath, rectus abdominis muscle, transversalis fascia, preperitoneal tissue, and parietal peritoneum.

2. **Access to the abdominal retroperitoneum.**

The abdominal cavity will be entered and the intestinal contents mobilized through incisions along the paracolic gutters, allowing exposure of the abdominal retroperitoneum.

3. **Identification of abdominal structures.**

The following structures will be identified:

- Abdominal aorta and its branches up to the level of the crossing of the left renal vein.
- Inferior vena cava and its tributaries, including the gonadal veins.
- Proximal ureter (abdominal course) on both sides.
- Para-aortic lymph node chains.
- Sacral promontory and superior hypogastric plexus.
- Aortoiliac bifurcation and common iliac vessels.

4. **Access to the pelvic retroperitoneum.**

The pelvic avascular spaces will be opened, starting with the pararectal spaces (medial Okabayashi and lateral Latzko spaces) and the medial and lateral paravesical spaces (obturator fossa), allowing exposure of the main pelvic retroperitoneal structures.

The following will be identified:

- Common, internal, and external iliac vessels.
- Iliopsoas muscle and genitofemoral nerve.
- Pelvic ureter on both sides, assessing its course, relationships, and variability.
- Branches of the internal iliac artery and vein (uterine artery, internal pudendal artery, obliterated umbilical artery, superior vesical artery, obturator artery, middle rectal artery, among others).
- Pelvic lymphatic structures, including Cloquet's node, the corona mortis, and deep circumflex iliac vessels.
- Inferior hypogastric plexus and pelvic splanchnic nerves.

5. **Exploration of the deep pelvis.**

Following systematic photographic documentation of each stage, selected structures will be divided to explore the deep pelvis and identify:

- Sacral nerve roots.
- Levator ani muscles.
- Obturator internus muscle.
- Urogenital fascia, endopelvic fascia, and presacral fascia.

5.4. Description of variables

5.4.1. Descriptive variables

The following variables will be recorded for each specimen:

- Cadaver identification code.
- Hemipelvis side (right or left).

5.4.2. Primary variable

The primary variable will be the assessment of each of the 10 items on the anatomical checklist.

Each item will be classified as:

- **Yes:** The reference anatomical pattern is identified.
- **No:** An anatomical variant relative to the reference pattern is identified.
- **Not assessable:** The anatomical relationship cannot be reliably assessed because of specimen alteration or dissection limitations.

The frequency of anatomical variability will be calculated for each item as the proportion of “No” responses out of the total number of assessable hemipelves (Yes + No).

The checklist items are detailed in Appendix 1.

5.4.3. Secondary variables

The availability of photographic documentation for each hemipelvis will be recorded. When an anatomical variant is present, a qualitative description will be made for inclusion in the anatomical atlas.

6. Ethical and legal aspects

Dissections will be performed exclusively on adult female cadavers from the University of Barcelona body donation program, in accordance with the applicable regulations governing teaching and research use. All bodies were donated during life through explicit consent.

The study will be conducted in authorized dissection facilities of the Department of Human Anatomy and Embryology, under the supervision of the responsible academic staff and with institutional authorization. The use of anatomical material will be strictly limited to the objectives of this protocol.

This study is submitted as a cadaveric anatomical research project, not as a doctoral thesis, Master’s thesis, or undergraduate dissertation. Accordingly, the documentation will be signed by the principal investigator/applicant and, where applicable, by the co-principal investigator, without requiring a thesis or dissertation supervisor’s signature.

The project will be conducted in accordance with the principles of respect, dignity, and confidentiality. No identifiable personal data will be collected, and cadavers will be handled anonymously using internal codes.

Photographic documentation will be used exclusively for teaching and research purposes and will not allow donors to be identified.

Because no personal data will be processed, informed consent from living participants or a specific personal-data management plan is not required, beyond general institutional security measures.

The study will be reviewed by the University of Barcelona Bioethics Committee (CBUB) and will begin after a favorable opinion has been obtained. Any relevant amendment to the protocol will be communicated to the committee.

The research team undertakes to comply with applicable legislation and international ethical recommendations concerning cadaveric anatomical research.

7. Analysis plan

A descriptive analysis of the data obtained will be performed.

Qualitative variables will be reported as absolute frequencies and percentages.

For each of the 10 anatomical checklist items, the frequency of the reference anatomical pattern (“Yes” response) and the anatomical variant (“No” response) will be calculated. “Not assessable” responses will be described separately and excluded from the calculation of variability frequency.

The frequency of anatomical variability for each item will be calculated as:

- Number of “No” responses / Number of assessable responses (“Yes” + “No”) × 100.

Results will be presented in tables of frequencies and percentages for each item assessed.

Anatomical variants identified will be described qualitatively and documented with representative photographs whenever possible.

Statistical analysis will be conducted using IBM SPSS Statistics® version XX (IBM Corp., Armonk, NY, USA) or equivalent software.

8. Expected results

The study is expected to provide a description of the main anatomical relationships of the female pelvic retroperitoneum and the frequency of anatomical variability for each item assessed.

The results will help identify the most frequent anatomical variants of structures relevant to gynecologic surgery and provide useful information for understanding the surgical anatomy of the pelvic retroperitoneum.

The photographic documentation obtained will also enable the creation of a teaching anatomical atlas to support training and surgical planning.

9. Resources and feasibility

The study will be conducted in the Dissection Room of the University of Barcelona using cadavers from the body donation program.

The facilities, dissection instruments, and resources necessary to conduct the study and document it photographically are available.

The research team comprises gynecologists experienced in gynecologic surgery and personnel specialized in anatomy and dissection, ensuring the technical feasibility of the project.

No additional resources are required, as the study will use the materials and infrastructure available at the University of Barcelona.

10. Plan for dissemination of results

The results will be disseminated through the publication of scientific articles in journals specializing in anatomy and gynecologic oncology.

They will also be presented at national and international conferences through oral or poster presentations.

The materials produced (photographs and diagrams) will be used for teaching purposes, in accordance with the principles of anonymization.

Author order will be determined by each investigator’s contribution.

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12. Appendices

12.1. Checklist

Cadaver code: _____

Hemipelvis: ☐ Right ☐ Left

Date: ____ / ____ / _____

Item	Yes	No	Not assessable
1. A single pelvic ureter is identified.	☐	☐	☐
2. The uterine artery crosses above the ureter.	☐	☐	☐
3. The uterine artery arises from the anterior division of the internal iliac artery.	☐	☐	☐
4. The superior vesical artery originates from the umbilical artery.	☐	☐	☐
5. The obturator artery originates from the anterior division of the internal iliac artery.	☐	☐	☐
6. The internal pudendal artery and inferior gluteal artery have a common trunk.	☐	☐	☐
7. The gluteal artery emerges between the lumbosacral trunk and the S1 nerve root.	☐	☐	☐
8. The obturator nerve courses cranial and anterior to the obturator vessels.	☐	☐	☐
9. The corona mortis is identified on the inner surface of the pubis.	☐	☐	☐
10. The deep circumflex iliac vein crosses above the external iliac artery.	☐	☐	☐

Notes

Photographic documentation

☐ Yes ☐ No