ORIGINAL ARTICLE

Morphometry and Relations of the Rectum to the Various Anatomical Landmarks: A Cadaveric Study

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Abstract:

Background: The present study aimed to calculate the length of the rectum, its anterior peritoneal reflection and to assess the relations of the rectum to the various anatomical landmarks in cadavers. Also, to observe any gender differences. *Material and Methods:* The present study was performed on 18 sagittal sections of the pelvis of adult human cadavers. The distances were measured from the anal verge to the midpoint of sacral promontory, anterior peritoneal reflection, S3 vertebra, the tip of the coccyx and the lower border of pubic bone. *Results:* The level of anterior peritoneal reflections was 7.70±1.15 cm and 7.59±1.69 cm respectively for males and females. There were no statistically significant gender differences. *Conclusion:* The average length of the rectum did not reveal any significant gender differences. The level of anterior peritoneal reflection for the rectum would aid as a landmark for surgeons operating at this site without exploring the peritoneal cavity.

Keywords: Rectum, Peritoneal Reflection, Sacral Promontory, S3 Vertebra

Introduction:

Accurate knowledge of pelvic anatomy is required to manage the pathologies of the rectum. The surgical length of rectum and its peritoneal reflections are crucial to define the treatment modality of rectal tumours. The rectum has its anatomical beginning at S3 vertebra, but surgically it begins opposite the sacral promontory. It upper and lower lateral curvatures are convex towards the right, and the middle is convex to the left. Internally they correspond to the Houston's valves. The dilated lower part of the rectum below the middle valve is known as the rectal ampulla [1].

The adult rectum is about 18–20 cm in length and is divided into three parts based on its peritoneal relations. The upper third has a peritoneal coat which covers the anterior and part of the lateral aspects; the middle third, whose anterior surface is covered by the peritoneum; and the lowest third, which has important relations to Denonvilliers' and Waldeyer's fasciae [2-6]. These layers act as barriers to prevent the spread of malignancy. Differentiation of intra- and extraperitoneal rectal cancers has an important implication in its treatment. The cancer located close to the ano-rectal junction has a higher risk of recurrence and has a poor prognosis [7]. The rectum extends from the recto-sigmoid junction, slightly below the sacral promontory. The peritoneal reflection serves as an anatomical landmark to distinguish between extra and intraperitoneal rectal carcinomas.

Surgically important landmarks of the rectum need emphasis as they play a major role during the management of rectal tumours. Therefore there are several studies describing the peritoneal reflections related to the rectum [8-10].

O'Beirne initially proposed the concept of a sphincter at the recto-sigmoid and was later supported by Mayo, Ballantyne and Longo [11-13]. However, it was denied by few other investigators who stated the existence of only a functional sphincter [14].

The present study aimed to calculate the length of the rectum, its anterior peritoneal reflection and to assess the relations of the rectum to the various anatomical landmarks in cadavers. Also, to observe any gender differences.

Material and Methods

The present cross sectional, descriptive study was carried out on 18 mid-sagittal sections of the pelvis of adult human cadavers (7 male, 11 female) procured from the Department of Anatomy. Only freshly cut sagittal sections were included in the study to avoid any loss of peritoneal relations. The distances were measured from the anal verge to the midpoint of sacral promontory, anterior peritoneal reflection, S3 vertebra, tip of the coccyx and the lower border of pubic bone using digital calipers and dividers (Fig.1). The location of the recto-sigmoid junction was observed for the presence of any sphincter. The data were analyzed using SPSS version 16. Unpaired t test was used to compare the all the mean distances between males and females.

Results:

The average length of the rectum was found to be 12.54±1.08 cm. The anterior peritoneal reflection was found to be at an average distance of 7.62±1.50 cm from the anal verge. The mean distances from the anal verge to the sacral promontory and the pubic symphysis were 15.78±1.41cm and 6.22±1.28 cm respectively. The mean and standard deviations of the all the measured parameters separately in males and females is shown in table 1. No statistically significant difference was observed in the parameters measured between males and females. A visible thickening of the rectal wall was appreciated in one specimen at the level of S3 vertebra.

Table 1: Mean and Standard Deviations of the Measured Parameters in Male and Female Specimens

Measured Parameters in cm	Male (n=7)	Female (n=11)
Anal Verge-Sacral Promontry	15.10±1.23	16.21±1.40
Anal Verge-Anterior Peritoneal Reflection	7.70±1.15	7.59±1.69
Anal Verge-S3 Vertebrae	11.99±0.91	12.90±1.07
Anal Verge-Pubic Symphysis	6.06±0.78	6.33±1.54
Anal Verge-coccyx Tip	5.77±0.69	6.00±1.77

Table 2: Comparison of Values Obtained by Yun *et al* and the Present Study

Measured Parameters in cm	Present Study (Cadaveric)		Yun *et al* (intraoperative)	
	Males (N=7)	Females (N=11)	Males (N=23)	Females (N=23)
Anal Verge-Sacral Promontry	15.10±1.23	16.21±1.40	16.50±2.20	16.1±2.20
Anal Verge-Anterior Peritoneal Reflection	07.70±1.15	07.59±1.69	08.8±2.20	08.1±1.70
Anal Verge-S3 Vertebrae	11.99±0.91	12.90±1.07	13.8±2.50	14.0±1.90
Anal Verge-Pubic Symphysis	06.06±0.78	06.33±1.54	Not measured	Not measured
Anal Verge-coccyx Tip	05.77±0.69	06.00±1.77	Not measured	Not measured

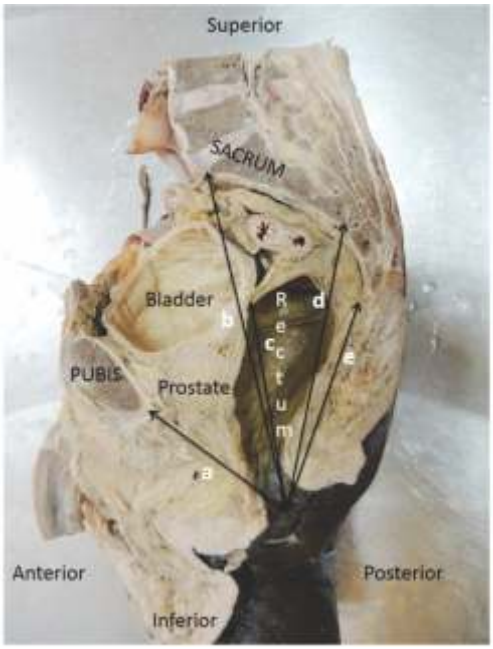

Fig. 1: Mid Sagittal Section of Pelvis Showing the Section of Rectum and the Anatomical Landmarks Used for the Morphometry.
A-Anal Verge to the Lower Border of Pubic Bone,
B- Anal Verge to the Sacral Promontory,
C- Anal Verge to the Anterior Peritoneal Reflection,
D- Anal Verge to S3 Vertebra
E- Anal Verge to the Tip of the Coccyx.

Discussion:

Abdominoperineal resection, low anterior resection and transanal local excision is some of the recent surgical approaches for treating rectal tumours. The radiologists have observed that the lesions within 15 cm from the anal orifice can be considered as rectal, and neoadjuvant treatment would be beneficial in such cases prior to the surgery [15, 16].

The useful functional and anatomical landmark, for the identification of the rectum, is the absence of the taenia coli and appendices epiploicae. The sigmoid mesocolon ends at the level of the S3 vertebra [17, 18].

Yun *et al.*[19] in an intraoperative study, reported that the mean distance from anal orifice to sacral promontory and the mean distance from the anal orifice to anterior peritoneal reflection were found to be more in males than that of females. However the mean distance from the anal verge toS3 was found to be more in females. Statistically significant difference was observed between males and females in the mean lengths of the lateral and anteriorperitoneal reflections to the anal orifice. There were no statistically significant

differences between the gender in the lengths of the peritoneal reflections and the termination of the taenia coli. Table 2 compares the values obtained by Yun *et al*., and the present study. The difference in the values could be due to the stature differences between the individuals.

Najarian *et al.* [10] described the peritoneal reflections of the rectum intraoperatively. The peritoneal measurements were statistically different from one another, regardless of gender.

Measurement of different parts of the large intestine was studied by Sadahiro *et al*. [20] after giving barium enema in Japanese patients which was found greater in females than in males. However, they did not measure any specific parameters in relation to the pelvic structures.

An attempt was made by Gerdes *et al*. [9] to locate the site of peritoneal reflection in relation to rectal lesions using transrectal ultrasound. However specific measurements were not included in the study.

A study using magnetic resonance imaging was carried out by Torkzad *et al*. [21] found that the rectum began at least 10 mm below S1-2 according to the attachment of sigmoid mesocolon.

Buess *et al*. [22] defined the length of the peritoneal reflections and found that the posterior reflection was deepest when compared to the anterior and lateral.

Several textbooks describe the second rectal valve as the reference for the locating the anterior peritoneal reflection, which approximately is 8 cm and 6 cm from the anal verge in men and women, respectively [2, 13, 23]. In the present study the parameters measured were confined to the rectum and important surgical landmarks. However, presence of an anatomical sphincter at the recto-sigmoid junction was not confirmed histologically. The aspects such as termination of taenia coli, appendicisepiploicae and the level of Houston's valves were also not assessed.

Conclusion:

The average length of the rectum did not reveal any significant gender differences. The level of anterior peritoneal reflection for the rectum would aid as a landmark for surgeons operating at this site without exploring the peritoneal cavity. Anatomical knowledge of rectum with respect to its location and its peritoneal reflections serve the surgeons in management of rectal tumours.

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