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COLOSIGMOID JUNCTION: MORPHOLOGIC, MORPHOMETRIC AND ENDOSCOPIC STUDY

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Abstract: Background: The surgical anatomy of the colosigmoid junction (CSJ) is not fully addressed in the literature. On the other hand, it has been reported that the passage of the endoscope through this junction is most difficult to the endoscopist and causes the greatest pain for the patient. These reasons prompted us to study the anatomical structure of the CSJ.

Methods: 15 cadaveric specimens were studied morphohistologically; a morphometric study was done in 10 / 15 specimens. The specimen consisted of descending colon (DC), sigmoid colon (SC) and CSJ. The histologic specimens were stained with H & E and Masson's trichrome stain. Morphometric studies used the image analyzer computer system. The CSJ was investigated endoscopically in 18 healthy volunteers.

Results: A narrow segment of a mean length of 5.2 ± 1.1 cm was identified both externally and internally between the DC and SC; we call this segment "colosigmoid canal" (CSC). The mucosal folds were crowded in the CSC. The lower end of the CSC formed a nipple in the SC and was surrounded by a fornix. Histologically, the mucosa of the CSC showed multiple folds and the circular muscle was thicker than that of the DC and SC as also proved morphometrically; the longitudinal muscle was thicker in only 4/10 specimens. Both narrowing and mucosal crowding were verified endoscopically.

Conclusion: The CSJ is a narrow segment between the DC and SC. Histologic, morphometric and endoscopic studies indicated the presence of a sphincter at the CSC. The colosigmoid sphincter is suggested to control the passage of colonic contents from the DC to the SC as well as to prevent reflux of SC contents to the DC upon SC contraction. Further studies are required to investigate the physiologic function of the colosigmoid sphincter and its possible role in defecation disorders.

Key words: Sigmoid colon; Descending colon; Sphincter; Colosigmoid canal

INTRODUCTION

All current studies stress the importance of screening for colon cancer as it saves lives by detecting pre- and cancerous lesions and reduces morbidity and mortality from this disease (Houlston, 1999; Jarvinen, 1992; Levin and Murphy, 1992; Maire et al., 1988). Colonoscopy is an effective screening technique (Aarnio et al., 1998; Hodgson et al., 1995; Semmeno et al., 2000). The colonoscope is inserted into the anus and advanced to the cecum or terminal ileum. The passage of the endoscope through the colosigmoid junction (CSJ) is most difficult for endoscopists and causes the greatest pain for the patient (Goldgar et al., 1994). Anatomically, the CSJ is a fixed area in the retroperitoneum. In many cases, an N or F loop forms in the endoscope when it is passed through this area (Anderson et al, 2000; Brooker et al., 2000; Painter et al., 1999). Studies have shown that flexible sigmoidoscopy failed to reach the CSJ in 24-62% of the subjects (Anderson et al, 2000; Brooker et al., 2000; Painter et al., 1999).

The above mentioned findings prompted us to study the morphohistologic and morphometric structure of the CSJ and to inspect it endoscopically. A study of the anatomic structure of the CSJ may shed some light on its function and simplify the endoscopic technique. The current communication embodies the result of this study.

MATERIAL and METHODS

Morphohistologic studies were performed in 15 cadavers, morphometric in 10, and endoscopic studies in 18 healthy volunteers.

Morphohistologic studies: The cadavers (mean age 44.3 ± 10.8 years, range 26-58; 10 men, 5 women) had a normal gastrointestinal tract. The cadaveric specimens consisted of the descending (DC) and sigmoid (SC) colon. They were examined after being fixed in 10% formalin. The SC was cut transversely 5 cm below the CSJ, allowing an overview of the CSJ similar to that presenting to the endoscopist; a magnifying loupe was used when necessary. The specimen was then opened by a cut along the tenia coli starting from the DC down to, and including, the SC, and morphological examination of the interior of the specimen was done with the help of a magnifying loupe, fine surgical instruments and bright light. After examination, the findings were photographed.

For histologic studies longitudinally-cut specimens were processed for paraffin sections of 5 µm thickness and stained with H & E as well as Masson's trichrome stains. The sections were examined histologically, photographed and morphometrically studied for the muscle thickness.

Morphometric study: Morphometric measurements were performed in 10 of the 15 cadaveric specimens using the Leica Qwin 500 image analyzer computer system (Leica Qwin, London, UK). The image analyzer consisted of a coloured video camera, coloured monitor, hard disc of an IBM personal computer, connected to the microscope and controlled by Leica Qwin 500 software. The image analyzer had first been calibrated to automatically convert the measurement units (pixels) produced by the image analyzer program into actual micrometer units. Adopting the interactive measuring menu the muscle thickness of both the circular and longitudinal layers was measured using an objective lens of magnification 4, i.e. a total magnification of 40. Ten readings were taken from each parameter in each specimen, i.e. 10 for the descending colon, 10 for the junction region and 10 for the sigmoid colon. The mean values were obtained and subjected to statistical analysis.

Endoscopic study: Eighteen healthy volunteers (mean age 37.3 ± 6.2, range 32-46; 11 men, 7 women) were enrolled in the study after giving an informed consent. They had no gastrointestinal complaint in the past or at the time of enrolment. They had a normal stool frequency. The endoscope used was the video-endoscope EC-200-LR (Fujinon, Osaka, Japan). After colonic preparation, the distal part of the DC, CSJ and proximal SC were examined and photographed. The colonoscopy was performed without pharmacologic covering nor sedatives, analgesics or antispasmodics. Before studying the CSJ we confirmed by pancolonoscopy that the volunteers had a normal colon.

Statistical analysis: Statistical analysis was performed with the one-way analysis of the variance using the Bonferroni test. Results were presented as mean values. For comparison, $p<0.05$ was considered significant.

RESULTS

Morphologic findings: Examination of the outer aspect of the CSJ showed a narrow segment lying between the DC and SC. It had a mean length of 5.2 ± 1.1 cm (range 4-7). Colonic succulations were less manifest in the SCJ than in the DC and SC. The tenia coli were closer together and in 3 specimens appeared to form a complete longitudinal layer surrounding the narrowed segment of the CSJ. Appendices epiploecae were less frequent in this area compared to the rest of the colon.

Table 1.

Mean values of inner circular (IC) and outer longitudinal (OL) muscle layers in descending colon, colosigmoid canal and sigmoid colon +

N	Colon		Colosigmoid Canal		Sigmoid	
	IC	OL	IC	OL	IC	OL
1	195.52±0.41	256.68±.0.34	917.56±0.2	368.51±0.41	240.71±0.38	199.34±0.13
2	190.35±0.38	231.51±0.24	901.62±0.37	341.52±0.31	233.51±0.24	233.64±0.21
3	127.76±0.51	129.61±0.26	617.5±0.22	306.27±0.36	170.81±0.40	163.4±0.32
4	131.58±0.68	131.56±0.38	685.18±0.57	147.34±0.32	179.34±0.24	140.69±0.38
5	256.56±0.29	28.44±0.2	488.42±0.30	76.99±0.22	281.08±0.38	136.56±0.3
6	213.51±0.61	51.68±0.44	501.35±0.52	96.01±0.31	273.52±0.31	132.66±0.27
7	697.26±0.38	377.29±0.39	1716.69±0.26	1089.87±0.3	1563.32±0.66	270.14±0.15
8	729.39±0.62	394.05±0.37	1321.15±0.4	1201.68±0.4	1153.02±0.41	1137.94±0.3
9	1168.45±0.15	399.07±0.33	1525.78±0.25	626.25±0.37	1261.84±0.85	531.37±0.41
10	1069.42±0.28	382.62±0.27	1472.03±0.61	586.74±0.29	1164.25±0.51	499.2±0.35

+ Values were given as the mean ± standard deviation.

When viewed from the cut end of the SC, the CSJ appeared as a narrow area between the DC and SC. The mucosal rugae were more crowded in the CSJ, and in 4 specimens appeared to obliterate the junction so that we could not visualize the DC through the SC. After cutting the colon along the tenia coli, the narrow segment at the CSJ was visible. It corresponded in length to that measured from the outer aspect of the colon. We call this narrow segment the "colosigmoid canal - CSC". The mucosal folds of the CSC were arranged longitudinally or transversely. The mucosal pattern of the CSC was different from that of the DC or SC so that the CSC could be identified by its mucosal arrangement. In 11 specimens the mucosa at the distal end of the CSC was sharply delineated and in 4 specimens protruded as a small nipple into the SC and was surrounded by a shallow fornix on each side of the nipple. The muscle layer of the CSC, as seen by the naked eye, was thicker than that of the DC or SC.

Histologic findings: Examination of the longitudinal section of the CSC revealed that they consisted of all the layers of the colonic wall: mucosa, submucosa and muscularis externa. The colonic wall structures continued in the CSC but with distinct histologic changes. The CSC had a mucosal covering of intestinal crypts and was thrown into multiple folds. The submucosa contained many blood vessels. The longitudinal muscle layer of the muscularis externa passed from the DC through the CSC to the SC with the same thickness. Meanwhile the circular muscle of the CSC was much thicker than that of the DC or SC.

Morphometric findings: Measurements of the muscle thickness in the DC, CSJ and SC have shown that the circular muscle layer of the CSJ was thicker than that of the DC or SC ($p<0.05$, $p<0.05$, respectively) in the same subject, and the difference in thickness was significant as evidenced by the results depicted in tables 1 and 2. However, the data obtained from the studied specimens showed individual variations in the thickness of the muscle layers. While the circular muscle of the CSC was significantly thicker than that of the DC or SC in all the specimens, the outer longitudinal muscle was significantly thicker in only 4 cadaveric specimens ($p<0.05$, table 1).

Endoscopic findings: As we proceeded with the endoscope from the SC to the DC, we encountered a narrow segment of 3-5 cm in length at the CSJ. It existed between the wider SC distally and DC proximally. The mucosal folds were crowded at this segment of the colon and constituted an obstacle in visualizing the proximal colon. However, the packed mucosa could be taken as a landmark for the CSC. The mucosal density in addition to the angulation at the CSJ and the narrowing of the CSC seem to be responsible for the difficulty in manipulating the colonoscope at this area and for obscuring its lumen. A gentle push with some pressure applied to the sigmoid wall helped to pass through the CSC blindly. When the lumen of the DC was visualized, the procedure was continued under vision.

Spontaneous spasm of the CSC with further narrowing of its lumen occurred occasionally during endoscopy. However, probing of the CSC induced spasm of the canal every time probing was done.

DISCUSSION

The CSJ represents a transitional area between the DC, which is considered as a conduct for the colonic contents, and the SC, which is a storage organ for these contents. The current study demonstrated certain features of this junction.

Table 2

Mean values of inner circular (IC) muscle layer of the 10 pecimens in the descending colon, colosigmoid canal and sigmoid colon

	Colon	**Colosigmoid canal**	**Sigmoid**
Mean	477.98±403.21	1114.73±457.79	652.14±557.37

P value < 0.05

It showed that the CSJ is not just a junction but an area of a mean length of 5.2±1.1 cm which is narrower than both the DC proximally and the SC distally; we call it the CSC. The mucosal folds crowded in the CSC as a rosette thus adding to the narrowing of the lumen of the canal. It appears that, during a colonic migrating mass contraction, the narrow CSC helps to slow down the passage of colonic contents from the DC into the SC. The SC mechanoreceptors, under normal physiologic conditions, are stimulated by excessive or sudden distension leading to SC contraction. The DC, when contracting, delivers its contents in one mass contraction to the SC. We postulate that, if there was no slowing down of the process of DC – SC delivery, the SC would be suddenly distended with a resulting stimulation of its stretch receptors which would lead to SC contraction and direct passage of SC contents to the rectum. This process may jeopardize the defecation mechanism and lead to defecatory urgency or even incontinence. We therefore believe that the narrow CSC acts to slow down the delivery of colonic contents to the SC so that the contents pass to the SC smoothly without abruptly distending the SC. Meanwhile also the presence of mucosal folds seems to assist in curbing the transit of colonic contents to the SC. The shelf-action of the mucosal rosette not only slows down the passage of colonic contents but might also prevent the possible traumatizing effect of the fecal column to the SC if the fecal consistency in the DC is firm, especially so as the SC is S-shaped and not a straight tube.

CSC sphincter: The thickened circular muscle layer at the CSC presumably denotes the presence of a “colosigmoid sphincter” (CSS). Although the circular muscle thickness showed individual variations, it was always significantly thicker than the circular muscle layer of the DC and SC in the same specimen as shown by the morphometric measurements. A mention of this muscle could not be traced in the literature. We do not know the function of this muscle. However, we suggest that it guards the end of the DC in a way similar to that of the sphincters at the end of the esophagus, stomach, ileocecal junction and rectum. We speculate that the thickened circular muscle at the CSC narrows the junction but may also control the passage of the colonic contents to the SC, thus preventing their traumatizing effect during colonic mass contraction. Moreover, it might act to prevent regurge of SC contents to the DC during SC contraction expelling its contents to the rectum. The current study therefore suggests the presence of an anatomical CSS; physiologic studies are required to investigate the possible function of this sphincter.

Besides the thickened circular muscle, another evidence of the sphincteric function of the CSC is that probing of the canal during colonoscopy led to its contraction which could be so complete that the endoscopist had to wait for a few minutes until the canal relaxed. The narrowing, followed by the widening of the CSC upon mechanical stimulation, seems to be another evidence of a sphincteric function of the thickened circular muscle at the CSC.

In 40% of the examined specimens, the longitudinal muscle coat of the CSC was thickened. We do not know the functional significance of this finding in the CSC. A longitudinal muscle has no sphincteric function; its contraction presumably shortens the CSC. Does this thickened longitudinal muscle support the CSC? Further studies are required to investigate this point.

Endoscopy and CSC: Endoscopists always find it difficult to advance the colonoscope through the CSC. They relate this difficulty to the relative fixity of the junction. However, the colonoscope, while being passed through the CSC, might cause mechanical stimulation of the canal with a resulting CSS contraction closing or narrowing the canal. It is recommendable for the endoscopist to wait for a few minutes until the canal opens again before he or she continues colonoscopy. The narrowing of the CSC and the crowded mucosal folds as well as the presence of a CSS at the CSC may add to the difficulty in passing the colonoscope through the junction.

In conclusion, the study has shown that the CSJ is a narrow segment between the DC and SC. A sphincter could be identified at the CSC as evidenced histologically, morphometrically and endoscopically. The CSC narrowing as well as the presence of mucosal folds and a CSS are suggested to control the passage of colonic contents from the DC to the SC and prevent reflux of SC contents to the DC. The understanding of these findings is important to the endoscopist. Further studies are needed to investigate the physiologic function of the CSS and its possible role in defecation disorders.

Acknowledgement: Waltraut Reichelt and Margot Yehia assisted in preparing the manuscript.

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