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The mesocolon: a prospective observational study

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Abstract

Aim The aim of this study was to characterize formally the mesocolic anatomy during and following total mesocolic excision. Total mesocolic excision may improve survival in patients with colon cancer. Although this requires a detailed knowledge of normal and variant mesocolic anatomy, the latter is poorly characterized. No studies have prospectively characterized the anatomy of the entire mesocolon.

Method Total mesocolic excision was performed in 109 patients undergoing total abdominal colectomy. The mesocolon was maintained intact thereby permitting a precise anatomical characterization from ileocaecal to mesorectal levels. Two- and three-dimensional schematic reconstructions were generated to illustrate *in situ* conformation.

Results Several previously undocumented findings emerged, including: (i) the mesocolon was continuous from ileocaecal to rectosigmoid level; (ii) a mesenteric confluence occurred at the ileocaecal and rectosigmoid junction as well as at the hepatic and splenic flexures; (iii) each flexure (and ileocaecal junction) was a complex of peritoneal and omental attachments to the colon centred on a mesenteric confluence; (iv) the proximal rectum originated at the confluence of the mesorectum and mesosigmoid; and (v) a plane occupied by Toldt's fascia separated the entire apposed mesocolon from the retroperitoneum.

Conclusion When the mesocolon is fully mobilized during a total mesocolic excision of the colon, several anatomical findings that have not been previously documented emerge. These findings provide a rationalization of the surgical, embryological and anatomical approaches to the mesocolon. This has implications for all related sciences.

Keywords Mesocolon, mesocolic excision, Toldt's fascia

What is new in this paper?

This paper documents several anatomical findings in relation to the mesocolon that become apparent once the mesocolon has been fully mobilized. They have not been previously documented.

Introduction

Recent advances in the management of colon cancer identify total mesocolic excision as a potential determinant of survival following oncological resection [1–4]. The relationship between complete planar resection and survival highlights the importance of accurately understanding mesocolic anatomy. Surprisingly, no study has formally characterized mesocolic anatomy from ileocaecal to rectosigmoid levels. In addition, discrepancies exist between surgical, embryological and anatomical descriptions of the mesocolon.

The mesocolon and mesorectum are the adult remnants of the dorsal mesentery, in which the colon was suspended from the posterior abdominal wall during intrauterine development [5,6]. Current embryological teaching is based on the anatomical findings of Sir Frederick Treves and holds that the dorsal mesentery of the right and left colon become apposed to the posterior abdominal wall by a process of 'fixation' [7,8]. The right and left mesocolon are then 'obliterated' [9] through a process of 'fusion' [10] with the retroperitoneum. Treves identified 'a mesocolon' on the left side in 36% and on the right side in 26% of all cadavers he examined [11]. Given that the transverse and sigmoid mesocolon persist into adulthood, the implication is that the mesocolon is thus discontinuous in adulthood [12]. In keeping with this, the ascending and descending colon are frequently erroneously described as retroperitoneal [13].

In contrast, surgical mobilization of the colon relies on a complete mesentery and entering a plane between the colon and retroperitoneum [14,15]. Continuing

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'mobilization' towards the midline separates a fatty structure in which vessels supplying the colon and associated lymph nodes are contained [16]. Thus Goligher described colonic mobilization as 'stripping the mesentery back towards the midline' and the 'no touch' technique of Turnbull emphasized the same approach [17].

Surgical findings reflect those of Carl Toldt, who proposed that the mesentery of the right and left colon persist into adulthood and that they remain separated from the posterior abdominal wall by a connective tissue plane he termed the lamina mesenteria propria (later called 'Toldt's fascia of fusion' by Goligher) [18,19]. Toldt's findings were separately confirmed by Congdon and Zuckerandle, and conform more closely to surgical findings than the descriptions laid out by Treves [20]. Despite this, Toldt's fascia and the mesocolon continue to receive minor mention in reference anatomical and embryological texts, while the findings of Treves continue to provide the basis for almost all detailed appraisals of mesocolonic anatomy [11–15].

The principal aim of the study was to characterize formally the mesocolonic anatomy in patients undergoing a total mesocolonic excision of the entire colon. In total mesocolonic excision the mesocolon is separated *en bloc* with the colon, thus preserving structural integrity. When this is done, several anatomical findings emerge that have not previously been documented in relation to mesocolic anatomy. The aims of the study were to characterize mesocolonic anatomy in terms of intrinsic features and relationships with peritoneal, omental and underlying fascial attachments.

Table 1 Patient demographics.

	Acute (n = 34)	Chronic (n = 75)
Age (years)	25 (14–63)	57 (26–69)
Gender (male/female)	19/15	48/27
Years UC(SD)	3.5 (4.2)	13 (11)
BMI (SD)	23 (7)	28 (6.5)

UC, ulcerative colitis; BMI, body mass index.

Method

Approval was obtained from both the Institutional Review Board at the Cleveland Clinic, Ohio, USA, and from the Ethics Committee at the Graduate Entry Medical School, University of Limerick, Ireland. Adult patients (n = 109) undergoing open, elective total abdominal colectomy (in the interval from July 2009 to April 2011) were included (Table 1). Any patient in whom a previous resection led to mesocolic or retroperitoneal disruption (i.e. appendicectomy, partial colectomy, nephrectomy) was excluded. Anatomical observations were recorded during the surgery and on the postoperative specimen. Intra-operative photographs were taken at various stages, as were photographs of the postoperative specimen. Observations focused on the colon, mesocolon, retroperitoneum, the plane of Toldt's fascia, as well as on relevant omental and congenital peritoneal attachments.

Surgical technique

Surgery was carried out using a standardized technique. The right colon was mobilized by sharp peritoneal

Table 2 Summary of terms and abbreviations.

Term	Abbreviation	Anatomical structure
Toldt's fascia	TF	Lamina mesenteria propria
Mesofascial interface	MI	Interface between mesocolon and Toldt's fascia
Retrofascial interface	RI	Interface between Toldt's fascia and retroperitoneum
Colofascial interface	CI	Interface between overlying colon and underlying Toldt's fascia
Mesofascial separation	MS	Separation of mesocolon from Toldt's fascia
Colofascial separation	CS	Separation of the colon and Toldt's fascia
Adipovascular pedicle	AP	Complex formed by mesenteric fat encasing a blood vessel
Interpedicular mesentery	IM	Mesenteric region positioned between two adipovascular pedicles
Ileocolic mesenteric confluence	ICMC	Mesenteric confluence between small bowel mesentery and RMC
Right mesocolon	RMC	Mesenteric entity mobilized on right side continuous with ICMC
Hepatic mesenteric confluence	HMC	Mesenteric confluence between RMC and transverse mesocolon
Attachment of right mesocolon	ARM	*True* anatomical attachment of right mesocolon
Splenic mesenteric confluence	SMC	Mesenteric confluence between transverse mesocolon and LMC
Left mesocolon	LMC	Mesenteric entity mobilized on the left side continuous with mesosigmoid
Mesosigmoid	MSG	Mesentery associated with sigmoid colon

division just medial to the white line of Toldt. The interface between Toldt's fascia and the colon (the colofascial interface) and the mesocolon (the mesofascial interface) were sharply divided thereby separating the components of this interface. 'Colofascial separation' represents separation of the colon and Toldt's fascia, while 'mesofascial separation' represents separation of the mesocolon from Toldt's fascia (Fig. 4). The ileocaecal junction was mobilized by sharp division of the inferior and lateral peritoneal folds followed by colo- and mesofascial separation. The hepatic flexure was freed by first dividing the lateral peritoneal fold and superior omental attachments. Next, sharp colofascial and mesofascial separation led to mobilization of colon and mesocolon from Toldt's fascia. A high ligation was conducted on all major branches as the aim was to maintain the integrity of the entire mesocolon. The splenic flexure and mesentery were mobilized in the same manner. Both the left colon/mesocolon and sigmoid/mesosigmoid complexes were freed from retroperitoneum through sharp division of peritoneal attachments (medial to the white line of Toldt) followed by colo- and mesofascial separation. Mesosigmoid mobilization was continued to the pelvic brim.

Schematic reconstructions

As the mesocolon is mainly an adipose structure the *in situ* three-dimensional conformation is lost once it has been mobilized. The *ex vivo* mesocolonic conformation bears little resemblance to the *in vivo* topography. To counter this, schematic diagrams and sectional illustrations of the *in situ* mesocolon were generated for the three flexures (i.e. ileocaecal, hepatic and splenic) as well as for the right, left and sigmoid mesocolon. A summary of the terms and abbreviations used throughout the article and diagrams can be found in Table 2.

Results

The process of colofascial and mesofascial separation enabled observations relating to the mesocolon and attachments at successive stages of mobilization. Mobilization of the mesocolon in this manner (i.e. the entire mesocolon remains intact and the underlying fascia is retained) facilitated observations related to mesocolic composition and fascial distribution. A fully resected colon with intact mesocolon is demonstrated in Fig. 1. The following relate to mesenteric anatomy at the ileocaecal junction: ascending colon, hepatic and splenic flexures, descending colon, sigmoid colon and rectum, in that order.

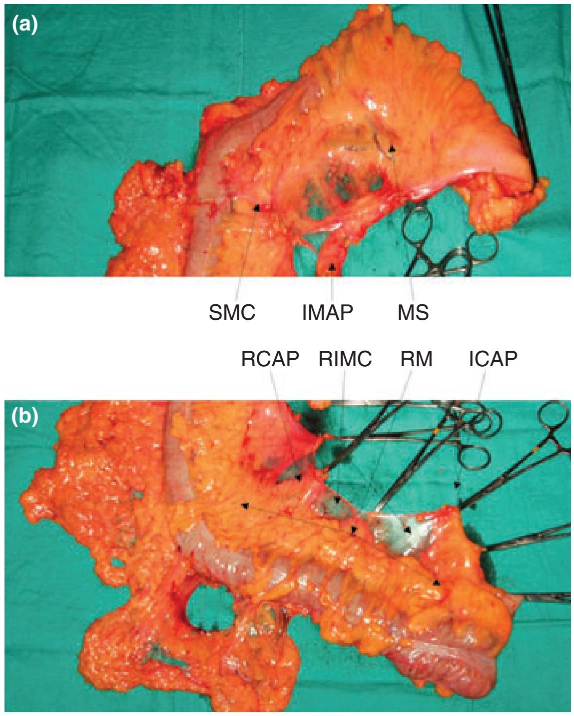

Figure 1 *Ex vivo* specimen following total mesocolonic excision of the colon with the mesocolon intact. The colon has been divided at transverse colon for illustration (a and b). Ileocolic adipovascvular pedicle (ICAP), right interpedicular mesocolon (RIMC), right mesocolon (RM), right colic adipovascular pedicle (RCAP), hepatic mesenteric confluence (HMC), splenic mesenteric confluence (SMC), inferior mesenteric adipovascular pedicle (IMAP) and mesosigmoid (MS) are demonstrated.

Mesenteric anatomy at the ileocaecal flexure

In all patients the ileocaecal flexure comprised the ileocaecal junction, right mesocolon, small intestinal mesentery, inferior and lateral peritoneal folds (Fig. 2a). An anatomical confluence was always evident between the terminal ileal mesentery and the right mesocolon (Fig. 2a), and this was termed the ileocaecal mesenteric confluence (ICMC). The medial and lateral borders of the ICMC were formed by the terminal ileum and caecum, respectively (Fig. 2b–d). As a result the confluence had an apex at the ileocaecal junction. The ileocaecal mesenteric confluence was variable in apposition to the retroperitoneum; in 14 patients it was not adherent and could thus be described as 'mobile'. In the remaining patients it was apposed to the retroperitoneum and thus 'non-mobile'. In cases of ileocaecal flexure mobility, lateral and inferior peritoneal folds were replaced by a single inferolateral peritoneal fold that was obliquely oriented across the posterior abdominal wall in the right iliac fossa.

In all patients mesocolic fat was prominent around major blood vessels creating an adipovascular pedicle, e.g.

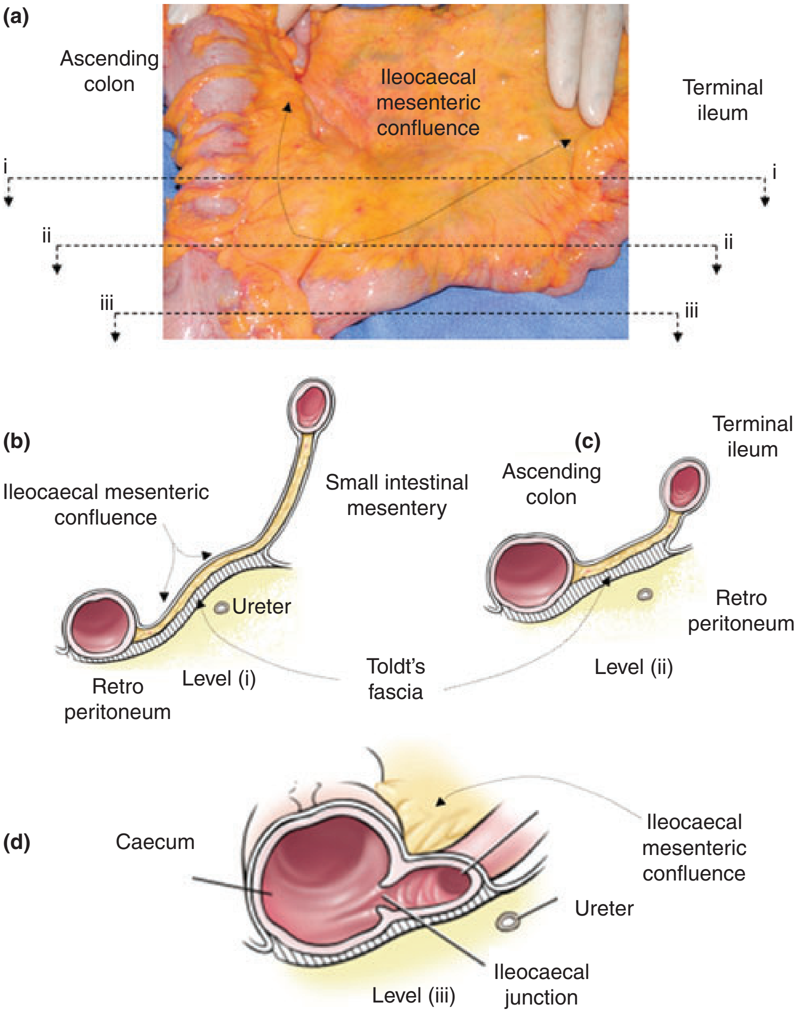

Figure 2 (a) Intra-operative photograph of the mobilized ileocaecal mesenteric confluence (ICMC). The small bowel mesentery is continuous with the right mesocolon (RMC) around the ICMC. (b) Schematic diagram illustrating a transverse section through the ICMC at 'level (i)', illustrating the relationship of the small bowel mesentery, right mesocolon, Toldt's fascia (hachured area) and retroperitoneum. Toldt's fascia has been exaggerated for demonstration purposes. *In vivo* the fascia comprises a hairline interface between mesocolon and retroperitoneum. (c, d) Schematic illustrations of the structures corresponding to 'level (ii)' and 'level (iii)' (a), and demonstrating successive narrowing of the ileocaecal mesenteric confluence towards the flexure. The relationship between ileocaecal junction, mesocolon, retroperitoneum and Toldt's fascia is illustrated.

the ileocolic adipovascular pedicle contained the ileocolic vessel (Fig. 1b). In the majority of patients (n = 80) differences in adipose bulk meant interpedicular and pedicular mesocolic regions were readily differentiated. In eight patients (mean body mass index of 22) fat was absent at the interpedicular mesocolon which here comprised peritoneum; in these cases the interpedicular mesocolon was translucent and 'window-like' (Fig. 1b). In seven patients (mean body mass index 33) the interpedicular mesentery was indistinguishable from adjacent adipovascular pedicles due to the extent of adiposity.

The hepatic and splenic flexures

Continuity between the right and transverse mesocolon was apparent in every case. The mesenteric confluence between the right mesocolon (apposed to retroperitoneum) and the transverse mesocolon (mobile) was termed the hepatic mesenteric confluence (HMC). The confluence was narrowest at the flexure, and comprised interpedicular mesocolon, which contained the arterial arcade. Thus in every patient the hepatic flexure demonstrated three core structures: (i) the lateral flexural attachment (i.e. the lateral peritoneal fold); (ii) the superior flexural attachment (i.e. the hepatocolic ligament); and (iii) the medial flexural attachment (comprising colon and mesenteric confluence). In 32 patients the hepatocolic ligament comprised a condensation of greater omental adiposity. In 56 patients the ligament was a cephalad continuation of the lateral peritoneal fold. In the remainder of the cohort, the ligament was a peritoneal fusion between omental fat and lateral peritoneal fold.

Continuity was evident between the transverse and left mesocolon in all patients, at a splenic mesenteric confluence (SMC). This confluence meant that the splenic flexure mirrored the hepatic flexure with three core constituents: (i) the lateral flexural attachment comprising the lateral peritoneal fold; (ii) the superior flexural attachment comprising the splenocolic ligament; and (iii) the medial flexural attachment comprising colon and mesenteric confluence. In 91 patients the superior flexural fold (i.e. the splenocolic ligament) comprised mainly a condensation of omentum. In the remaining 18 patients the superior flexural attachment comprised a peritoneal fusion between a cephalad extension of the lateral peritoneal fold and greater omental fat. A prominent peritoneal fold was observed in 30 patients immediately distal to the splenic flexure. When present, this fold extended transversely from the lateral aspect of the descending colon to the adjacent abdominal wall, at a level corresponding to the distal limit of the splenic mesenteric confluence.

The left mesocolon

Within the left mesocolon adipovascular pedicles were observed in relation to the inferior mesenteric artery, the left colic artery and the superior rectal artery. Interpedicular mesocolon could be differentiated in 17 patients (mean BMI of 23) (Fig. 1). In the majority of cases interpedicular mesocolon could not be differentiated from the adipovascular pedicle due to adipose bulk and the close proximity of inferior mesenteric, left colic and superior rectal vessels. In 50% of patients peritoneal adhesions occurred between the fourth part of the duodenum and adjacent areas of left and transverse mesocolon.

The mesosigmoid

The mesosigmoid is a complex structure with dramatic differences in the conformation of the *in situ* (Fig. 3) and the mobilized structure. In all cases the mesosigmoid was continuous with the left mesocolon above and the

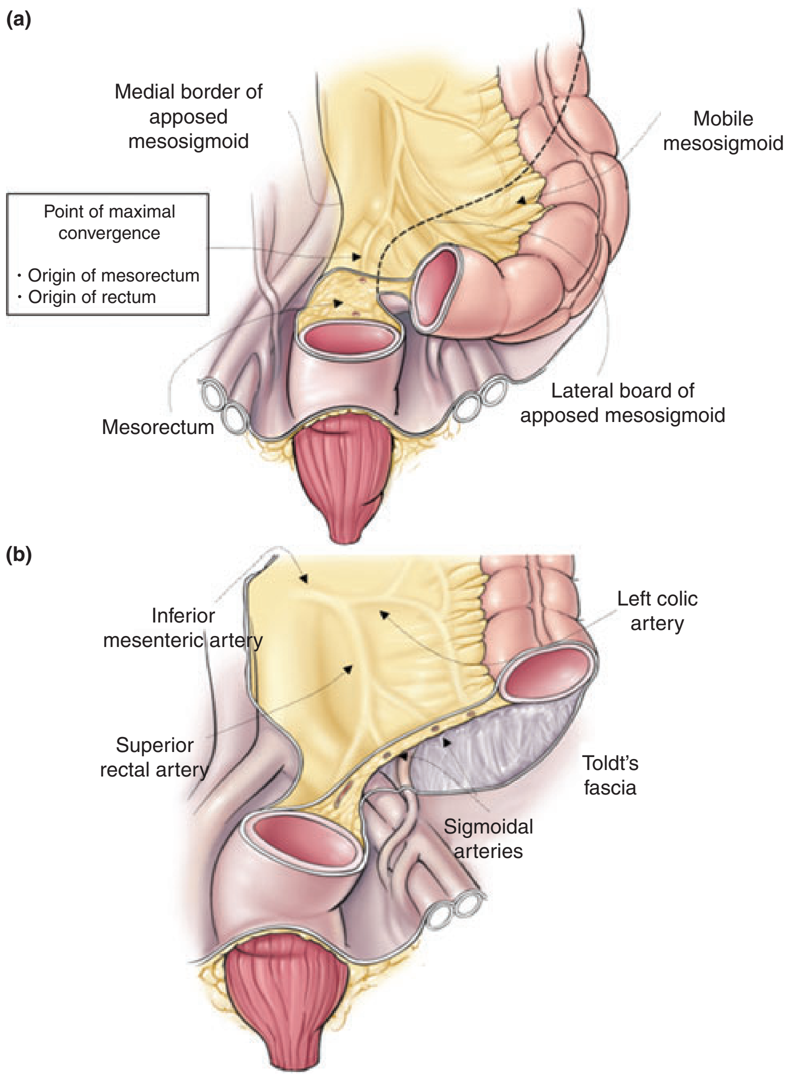

Figure 3 Schematic illustrations of the mesosigmoid. (a) The undisturbed mesosigmoid is continuous with the left mesocolon proximally and the mesorectum distally at the convergence of the mobile and apposed components of the mesosigmoid. This convergence occurs at the rectosigmoid junction which also corresponds to the level at which the apposed component of the mesosigmoid is shortest in transverse diameter ('point of greatest proximity'). The borders of the apposed component are indicated. (b) Schematic diagram of major vessels contained in the left mesocolon, mesosigmoid and mesorectum. The entire sigmoid and most of the mobile component of the mesosigmoid have been conceptually removed to better illustrate mesocolic contents and relations. This depicts the most frequently observed vascular pattern (in 75% of patients) and it illustrates how major vessels pass uninterrupted from left mesocolon into mesosigmoid and into mesorectum. The relationship to Toldt's fascia (and by definition the retroperitoneum underlying the fascia) was as indicated.

mesorectum below. While the left mesocolon is fully adherent to the retroperitoneum, this is only the case with the medial portion of the mesosigmoid; the lateral portion being mobile. The apposed portion of the mesosigmoid tapers distally, the point of maximal convergence was found to be at the pelvic brim; thereafter the mesentery widens to become the mesorectum. This point of convergence also corresponded to the level of the merging of the taenia coli, and thus represented the proximal origin of the rectum.

Toldt's fascia

In all patients the fibres of Toldt's fascia formed a plane between the apposed portions of the mesocolon and the underlying retroperitoneum (Fig. 4). A white line becomes apparent at the interface between Toldt's fascia and the overlying mesocolon which can be followed medially from the lateral peritoneal reflection as mobilization advances. On the right side the plane was bounded superiorly by the hepatic flexure, medially by the root of the small bowel mesentery and laterally by the lateral peritoneal fold. The inferior boundary was dependent on the extent of ileocaecal fixation. On the left side similar medial and lateral limits were observed, with the upper limit corresponding to the splenic flexure. From here the fascia extended inferiorly, forming a continuous plane underneath the left mesocolon and the apposed portion of the mesosigmoid, following which it became continuous with the fascia between the mesorectum and the pelvis.

Discussion

Complete excision of regional draining lymphatics is a core component in surgical management of solid organ

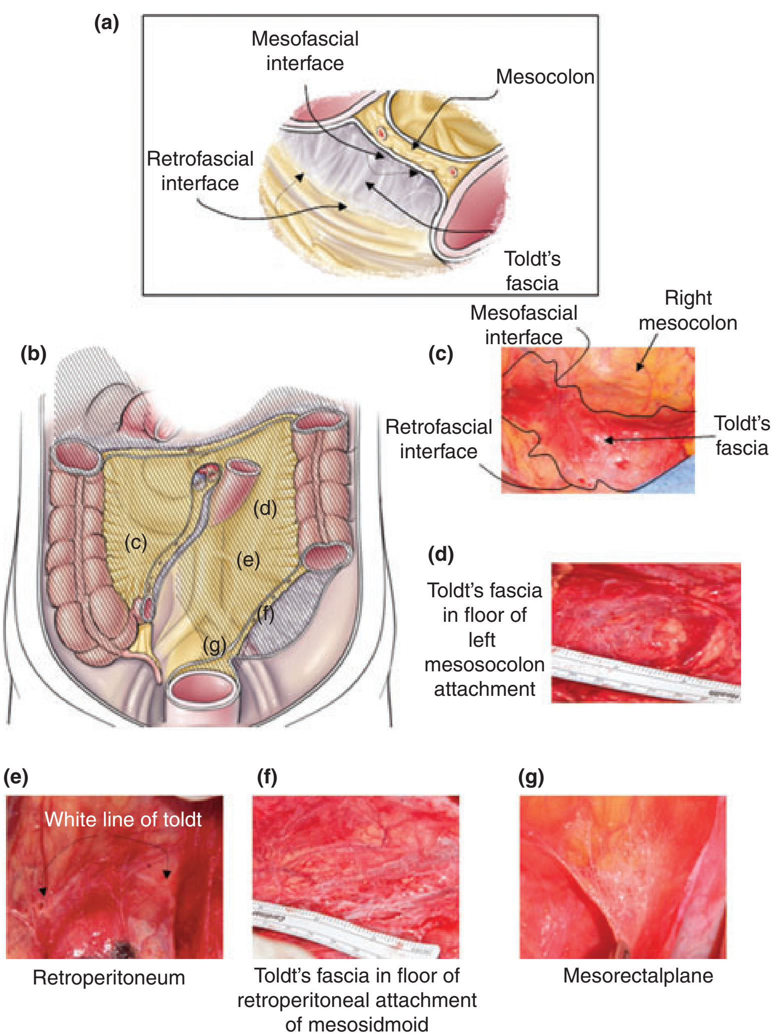

Figure 4 (a) Schematic illustration of the general relationship between mesocolon, Toldt's fascia and the retroperitoneum. The interface between fascia and mesocolon (the mesofascial interface) is depicted as a white line, corresponding to *in vivo* observations. (b) The distribution of Toldt's fascia (indicated by the hachured area), as relevant to colonic mobility. (c–g) Intra-operative photographs demonstrating the fascia in each of the locations indicated in (b). (c) 'Right mesocolon', demonstrating the fascia as well as meso- and retrofascial interfaces. (d) 'Mesocolon attachment' demonstrates Toldt's fascia overlying the retroperitoneum to which the left mesocolon is apposed *in situ*. (e) 'White line of Toldt', demonstrates that the white line is not confined to the lateral peritoneal folds and occurs wherever the fibres of the mesofascial interface condense, in this case related to the left mesocolon. (f) Intra-operative image demonstrating Toldt's fascia overlying the mesosigmoid attachment to the retroperitoneum, after the sigmoid colon and mesosigmoid have been removed. (g) 'Mesorectal plane': intra-operative image showing Toldt's fascia at the mesorectal level.

tumours [16,21,22]. Total mesocolic excision appears to be associated with improved survival in patients undergoing colectomy for colon cancer, when the colon and its mesentery, including the lymphovascular supply, are resected together as an intact package [1–4]. These observations are analogous to those related to total mesorectal excision in patients with rectal cancer [23,24]. Removal of an intact section of mesocolon draining a particular colonic segment is likely to be as important as mesorectal excision in the setting of rectal cancer [1,25].

The increasing focus on surgical technique as an independent variable in the outcome of cancer surgery highlights the need for detailed knowledge of the underlying anatomy. This study demonstrates that, following total mesocolic excision, several findings are apparent that address the discrepancies between anatomical and surgical approaches to the mesocolon [26–33]. The mesocolon was continuous from ileocaecal to rectosigmoid level. A mesenteric confluence occurred at ileocaecal and rectosigmoid junction as well as at hepatic and splenic flexure. Each flexure (and ileocaecal junction) was a complex of peritoneal and omental attachments to colon centred on a mesenteric confluence. The proximal rectum originated at the confluence of the mesorectum and mesosigmoid. The plane of Toldt's fascia separated the entire apposed mesocolon from the retroperitoneum.

The demonstration of mesocolic continuity, combined with the presence of Toldt's fascia, interposed between the apposed portions of the mesocolon and the retroperitoneum, rationalize planar dissection in colonic resection. By addressing these anatomical features through mesofascial separation the entire colon and mesocolon can be mobilized intact.

Considering the colon in terms of its mesocolic anatomy clarifies several anatomical features. The proximal origin of the rectum (i.e. loss of taenia coli) corresponds to the level of convergence of the apposed and mobile portions of the mesosigmoid. Conceptualizing the flexures as comprising three core components (i.e. mesenteric flexure, lateral peritoneal fold and the relevant ligament) simplifies their mobilization. The lack of mesocolic fixity at each mesenteric confluence explains the difficulty often encountered in the endoscopic navigation of the flexures. The data presented describe mesocolic anatomy and thereby provide a rational basis for complete mesocolic excision.

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References

1 Editorial. Surgical planes of dissection influence survival in patients treated for colon cancer. *Nat Clin Pract Oncol* 2008; **5:** 686.

2 Hohenberger W, Weber K, Matzel K, Papadopoulos T, Merkel S. Standardized surgery for colonic cancer: complete mesocolic excision and central ligation – technical notes and outcome. *Colorectal Dis* 2009; **11:** 354–64; discussion 64–5.

3 Bokey EL, Chapicis PH, Dent OF, Mander BJ, Bisset IP, Newland RC. Surgical technique and survival in patients having a curative resection for colon cancer. *Dis Colon Rectum* 2003; **46:** 860–6.

4 West NP, Morris EJ, Rotimi O, Cairns A, Finan PJ, Quirke P. Pathology grading of colon cancer surgical resection and its association with survival: a retrospective observational study. *Lancet Oncol* 2008; **9:** 857–65.

5 Banister LH. (1995) Anatomy of the large intestine. In: *Gray's Anatomy: The Anatomical Basis for Medicine and Surgery*, 38th edition (ed. Banister LH), pp. 1774–87. Churchil Livingstone, New York.

6 Brookes M, Zietman A. (2000) Alimentary tract. In: *Clinical Embryology, a Color Atlas and Text* (eds Brookes M, Zietman A), pp. 148–52. CRC press, Florida.

7 Gallot D. Anatomie chirurgicale du côlon. In: *Techniques Chirurgicales – Appareil Digestif* 2008; 40–535. DOI: 10.1016/S0246-0424(06)43514-7.

8 Jorge JMN, Habr-Gama A. (2007) Anatomy and embryology of the colon, rectum and anus. In: *The ASCRS Textbook of Colon and Rectal Surgery*, 3rd edition (eds Church JM, Garcia-Aguilar J, Roberts PL), pp. 1–22. Springer, New York.

9 Figiel LS, Figiel SJ. Volvulus of the cecum and ascending colon. *Radiology* 1953; **61:** 496–515.

10 Small A. The surgical correction of anomalies in fixation of the ascending colon. *Ann Surg* 1937; **106:** 230–41.

11 Treves SF. Lectures on the anatomy of the intestinal canal and peritoneum in man. *Br Med J* 1885; **1:** 415, 70, 527, 80.

12 McMinn RH. (1994) The gastrointestinal tract. In: *Last's Anatomy: Regional and Applied*, 9th edition (ed. McMinn RH), pp. 331–42. Langman group Ltd, London.

13 Agur AMR. (1998) The abdomen. In: *Grant's Atlas of Anatomy* (ed. Agur AMR), pp. 77–147. Williams and Wilkins, New York.

14 Standring S. (2008) Large intestine. In: *Gray's Anatomy: The Anatomical Basis of Clinical Practice*, 40th edition (ed. Standring S), pp. 1137. Churchill Livingstone, Philadelphia.

15 Ludwig KA, Touloukian C. Open left colon resection. *Operative techniques in general surgery* 2003; **5:** 199–213.

16 Jamieson JK, Dobson JF. VII. Lymphatics of the colon: with special reference to the operative treatment of cancer of the colon. *Ann Surg* 1909; **50:** 1077–90.

17 Goligher J. (1984) Treatment of carcinoma of the colon. In: *Surgery of the Anus, Rectum and Colon*, 5th edition (ed. Goligher J), pp. 485–589. Balliere Tindall, London.

18 Toldt C. Bau und Wachstumsveranterungen der Gekrose des menschlischen Darmkanales. *Denkschrdmathnaturwissensch* 1879; **41:** 1–56.

19 Toldt C. (1919) *An Atlas of Human Anatomy for Students and Physicians*, Revised edition, pp. 407–9. Rebman Company, New York.
20 Congdon ED, Blumberg R, Henry W. Fasciae of fusion and elements of the fused enteric mesenteries in the human adult. *Am J Anat* 1942; **70:** 251–79.
21 Cohen AM. (2001) Colorectal tumours. In: *Oxford Textbook of Surgery* (eds Morris PJ, Wood WC), pp. 1471–511. Oxford publications, Oxford.
22 Corman ML. (2005) Carcinoma of the colon. In: *Colon and Rectal Surgery*, 5th edition (ed. Corman ML), pp. 767–903. Lippincott Williams and Wilkins, New York.
23 Heald RJ, Husband EM, Ryall RD. The mesorectum in rectal cancer surgery – the clue to pelvic recurrence? *Br J Surg* 1982; **69:** 613–6.
24 Heald RJ. The 'Holy Plane' of rectal surgery. *J R Soc Med* 1988; **81:** 503–8.
25 West NP, Sutton KM, Ingeholm P, Hagemann-Madsen RH, Hohenberger W, Quirke P. Improving the quality of colon cancer surgery through a surgical education program. *Dis Colon Rectum* 2010; **53:** 1594–603.
26 Moore KL. (2003) The digestive system. In: *The Developing Human*, 7th edition (ed. Moore KL), pp. 211–41. Philadelphia Saunders, Philadelphia.
27 Romanes GJ. (1998) Thorax and abdomen. In: *Cunningham's Manual of Practical Anatomy*, 15th edition (ed. Romanes GJ), pp. 83–175. Oxford publications, Cambridge.
28 Sadler TW. (2003) The digestive system. In: *Langman's Medical Embryology*, 9th edition (ed. Sadler TW), pp. 285–321. Lippincott Wilkins and Williams, Philadelphia.
29 Fredet P. Peritoine. Morphogenese et morphologie. Fascia d'accolement. *Traite d'Anatomie Humaine* 1900; **4:** 869–1016.
30 Richer JP. (1993) Morphologie de l'ensemble viscéro-péritonéal: évolution du péritoine dans ces rapports avec le développement du tube digestif. Ontogenèse chez l'homme et anatomie comparée. Mémoire de DEA d'Anthropologie Biologique, Morphologie, Evolution. pp. 96–8. Paris, Tome I.
31 Hasegawa S, Kawamura J, Nagayama S, Nomura A, Kondo K, Sakai Y. Medially approached radical lymph node dissection along the surgical trunk for advanced right-sided colon cancers. *Surg Endosc* 2007; **21:** 1657.
32 Kessler H. (2006) Total abdominal colectomy. In: *In Laparoscopic Colorectal Surgery* (eds Milsom JW, Bohm B, Nakajima K), pp. 203–29. Springer, New York.
33 Leroy J. (2005) *Sigmoidectomie*. In: Websurg.com. Websurg, Strasbourg.

Commentary on Culligan *et al.*

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'Back to Basics: Surgical Anatomy and Physiology' is the theme of this year's Annual Congress of the Royal Belgian Society for Surgery (Van de Stadt J, Bertrand C, Personal communication) indicating renewed interest in anatomy. Why, however, it should be 'back' to something that has been established and accepted for so many years is difficult to comprehend. Has anything been lost or ignored in the recent years or decades? Nevertheless, the paper in the present issue on the surgical anatomy of the mesocolon from the Department of Colon and Rectal Surgery of the Cleveland Clinic, Ohio, is timely, since the practical anatomy of the fascial planes associated with the rectum and now with the colon has become important to surgeons in their conduct of operations for large bowel cancer.

The Belgian initiative represents a laudable new trend in surgery to allow us to reflect once again upon our surgical roots, mainly anatomy. Surgery in recent years has been hugely influenced by the development of minimally invasive techniques, although at the beginning at least, and still to some degree, its evidence base as an advance on open surgery has not been easy to demonstrate. Laparoscopic surgery has been driven too much by industry and has not always been objectively promoted. It has nevertheless contributed a great deal to the reduction in surgical trauma, although in colorectal surgery this may have been less so than in other disciplines. A final judgement is still awaited, again mainly in the case of colorectal surgery.

Back to anatomy! In colon cancer surgery, the 'story' of the new reassessment of the importance of anatomy and embryology started about 10 years ago when it was realized that the cancer-specific outcome after treatment for rectal cancer surpassed that for colon cancer [1], which was surprising, since historically survival of the latter had been better than with the former by 10–15%. It began to be appreciated that in colon cancer some surgeons had much better results especially with long-term survival than others [2–5], much as had already been demonstrated for rectal cancer. Preservation of the planes