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Editorial

Surgical anatomy and anatomic surgery – Clinical and scientific mutualism☆

Surgical anatomy and anatomic surgery

The word "surgery" is derived from the Greek word "cheirourgia" (cheir refers to "hand" whilst ergos or urgos refers to "work"). Unfortunately the primary role of the surgeon is frequently obscured by myriad administrative, educational, service and research-based activities. Surgeons address diseases with specific anatomic properties. For example, in carotid artery stenosis due to atherosclerosis, the primary anatomic abnormality is a narrowing that is amenable to surgical correction. In general, the surgical approach to disease modification often involves removal or reconfiguration of an anatomic structure. Whatever the primary aim, surgery involves a restoration of anatomic conformation to as near normal as possible (in order to minimally disrupt function). Hence the central components of surgical technical practice (removal, reconfiguration, restoration) can be regarded as fundamentally anatomic-based.

The importance of anatomy in surgery goes beyond this. Anatomic surgery adheres to a planar roadmap laid down during embryologic development. Planes are the interface between two contiguous structures.[1] In anatomic surgery, deviation from a plane into a contiguous structure is directed and targeted such that trauma can be minimised. As a result, the fundamental principles of anatomic surgery are also those of safe and minimally traumatic surgery.

It is not surprising then, historically, that surgical research was primarily anatomic in focus. The second half of the twentieth century saw a dramatic shift toward a spectrum spanning from the purely molecular to health policy implementation. Just as there was a move toward early pipeline molecular research (driven largely through the identification of the molecular basis of disease) there was a trend away from anatomic-based research. The resultant tendency has been towards acceptance of classic anatomic teaching, even in circumstances where discrepancy exists between that which we do surgically, and that which we are taught classically. A prime example of this discrepancy relates to the small intestinal and colonic mesentery (i.e. the mesocolon). Conventional teaching is the mesocolon is fragmented; the small intestinal mesentery, transverse and sigmoid mesocolon all "*terminate*" at their "*insertion*" into the posterior abdominal wall.[2–4] However, gastrointestinal surgical practice has crucially relied on mesenteric contiguity from ileocaecal to mesorectal levels, for the past century (Fig. 1).

The anatomic properties of the intestinal mesenteric attachments were established by Sir Frederick Treves in 1889 and thereafter perpetuated in almost all reference embryologic, anatomic and surgical texts.[2,5–7] This remains the case to the present and is exemplified by descriptions of the small intestinal mesentery as "*terminating*" at its "*insertion*" (Fig. 2A). Such is the level of acceptance of this dogma, it surprises clinicians to hear that Carl Toldt described an alternative set of anatomic properties ten years prior to that of Treves, in 1879.[8,9] Although Toldt's findings correspond with astonishing accuracy to the anatomic principles of abdominal gastrointestinal surgery, they remain largely ignored by reference literature.[2–10]

In the following sections I outline recent advances in gastrointestinal anatomy and explain how these, in clarifying mesenteric structure, provide numerous opportunities across multiple scientific and clinical specialties. These advances highlight the importance of the mutualistic relationship between surgical anatomy and anatomic surgery.

Mesocolic anatomy

To address the discrepancy between practice and teaching our group recently described the anatomic features of the mesocolon as they become apparent during total mesocolectomy (i.e. where the entire colon and mesocolon are mobilised and excised *en-bloc*).[11,12] The findings contrast dramatically with those of Treves, and correspond precisely with those of Toldt (Figs. 1, 2A & B). Firstly, and perhaps most importantly, the mesocolon on the right and left persist into adulthood. Once persistence is acknowledged then it becomes apparent that the small intestinal and colonic mesenteric attachments are in fact contiguous to the level of the mesorectum. Although mesenteric contiguity was depicted in illustrations by Da Vinci, this observation, and implications thereof, have never been formally acknowledged.[11,12]

Next, the small intestinal and colonic mesentery do not "*insert*" into the posterior abdominal wall (and "*terminate*") but rather become apposed to the retroperitoneum, with a

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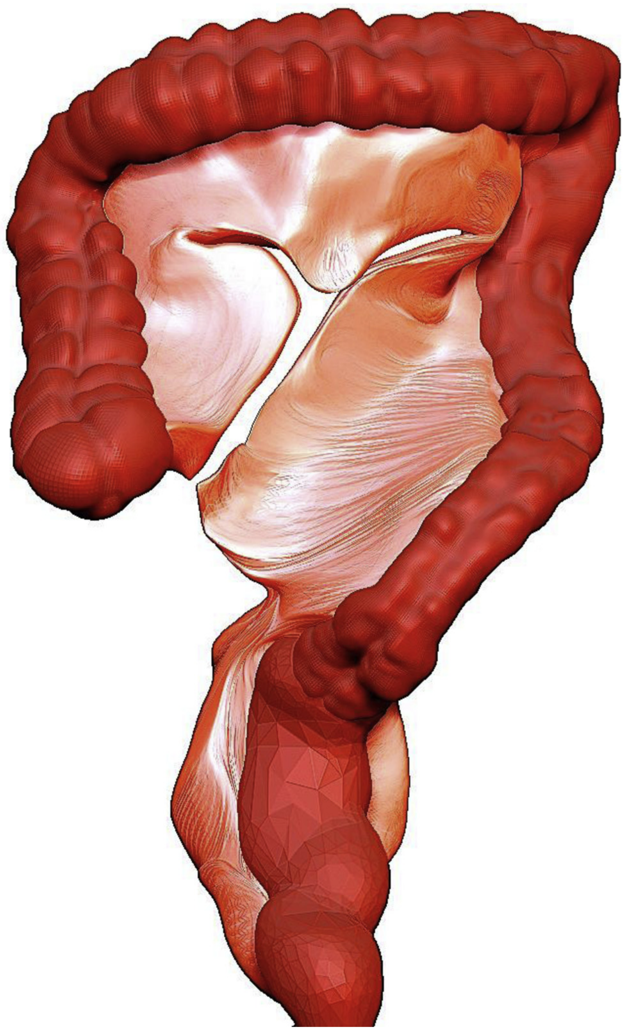

Figure 1 – Two and a half dimension (2.5D) rendition of the colon and rectum together with associated mesenteric attachments. The small intestine and associated mesentery has been conceptually removed for the purposes of clarity. The 2.5D image is derived from a 3D model generated from a human mesocolon, in Zbrush (Pixologic©).

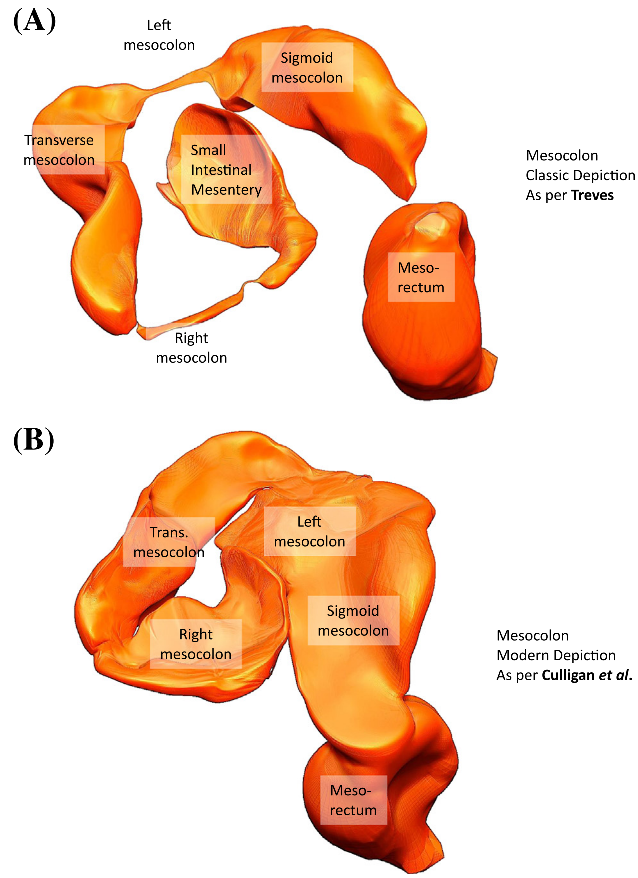

Figure 2 – (A): Zbrush-generated two and a half dimension (2.5D) rendition of the mesenteric attachment of the colon and rectum as depicted by Treves, with the colon and rectum conceptually removed for the purposes of clarity. The point of view is from the right side looking left and downward. The right and left mesocolon are "vestigial" or "absent" and the transverse mesocolon and mesosigmoid "insert" into the posterior abdominal wall along their root. (B) Zbrush-generated 2.5D rendition of the mesenteric attachment of the colon and rectum as is currently understood, with the colon and rectum conceptually removed for the purposes of clarity. The point of view is from the right side and looking left and downward. The mesocolon is contiguous throughout from ileocaecal to mesorectal levels.

connective tissue layer (i.e. Toldt's fascia) interposed between the two. In certain regions (i.e. the transverse mesocolon and the mobile component of the mesosigmoid) the mesocolon is non-apposed to the retroperitoneum and is thus mobile. When the small intestinal mesentery, right and transverse mesocolon are mobilised off the retroperitoneum, a central point of suspension becomes apparent at the origin of the superior mesenteric artery. It is from this point that the entire small intestinal and colonic mesentery fans out to adopt the adult conformation involving apposed and non-apposed regions (Fig. 1).

There are several additional observations that are beyond the remit of this article (eg. the mesosigmoid is contiguous proximally with the left mesocolon and distally with the mesorectum (Figs. 1, 2 and 4)). Importantly, a compilation of these and the above observations clarifies the macroscopic structure of the mesenteric attachments of the gastrointestinal tract. This provides a standard against which abnormalities of structure (and hence of function) may be better understood.

Mesocolic histology

Just as deficiencies persisted in relation to macroscopic mesocolic structure, similar deficiencies ccur regarding microscopic structure. Surprisingly, the histologic appearance of the normal mesocolon has, until recently, been ignored. Although mesocolic and mesenteric lymph nodes remain the focus of considerable oncologic and immunologic research, the surrounding structure is largely unchartered in terms of scientific endeavour. To redress this, our group conducted a