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ORIGINAL ARTICLE

Evaluation of small bowel measurement in alive patients

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Abstract
Introduction Based on the importance of bowel length in massive bowel resection, the aim of this study is to evaluate the small bowel length in patients who had laparotomy.
Methods In this study, 100 consecutive adults (age ≥ 20 years old) who underwent laparotomy were studied. Patients with peritonitis, intra-abdominal infection, bowel obstruction and ascitis were excluded. For comparison we used 30 cadavers as control group after case control matching. Under general anesthesia and after opening of abdomen, bowel length was measured by an umbilical tape from Treitz' ligament to ileocecal valve, antimesentrically. Data such as age, sex, height, weight and bowel length were measured and analyzed.
Results Between May 2007 and December 2007, 100 patients (54 males and 46 females) aged 20–43 years were studied. The small bowel length was 459.6 ± 78.47 cm in patients and 632.5 ± 88.9 cm in cadavers ($P < 0.01$). Small bowel length was 452.2 ± 79.36 cm in males and 468.2 ± 80.44 cm in females (P = NS). Jejunum length was 140.2 ± 45.4 cm in males and 138.6 ± 40.2 cm in females (P = NS). Ileum length was 286.3 ± 34.7 cm in males and 289.9 ± 37.8 cm in females (P = NS).
Conclusion In this study, we report a measurement of the length of small bowel more accurate than the estimation given by the classical anatomic books. In our study, there was no correlation between bowel length and age, gender, height and weight.

Keywords Small intestine · Short bowel syndrome · Small bowel length · Bowel measurement

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Introduction

Short bowel syndrome (SBS) (defined as the presence of <200 cm of residual small bowel in adult patient) occurs due to removal of a large portion of the small intestine. In the vast majority of cases, it leads to malnutrition, weight loss, steatorrhea and diarrhea [5]. Although the survival for adult patients with more than 50% of residual small bowel is routine, its resection of 50–80% is prone to complications [12]. Therefore, definition of normal length of small bowel will be very important for general and trauma surgeons who are involved in the care of patients with small bowel pathologies.

Although in anatomy textbooks, normal length of small bowel is reported, these data are based on cadaver studies and not suitable for practical management [1–9].

In Weser et al. [14] study, length of small bowel was reported as 350 cm in alive and 600 cm in cadavers.

Therefore in this study, we measured small bowel length in patients who need laparotomy and had no abnormality in small bowel and compared this measurement with cadaver small bowel length.

Materials and methods

In this study, 100 consecutive adults (age ≥ 20 years old) who underwent laparotomy were studied. Patients with peritonitis, generalized intra-abdominal infection, small bowel pathologies and adhesion bands were excluded. For comparison, we used 30 fresh cadavers as control group after case control matching.

Operative procedure was performed under general anesthesia. After opening the abdomen and before excessive manipulation of viscera, the length of small bowel was

Fig. 1 Small bowel measurement technique

measured with an umbilical tape as in Gary et al. study [7]. Umbilical tape is a hard non-elastic tape and its length is 5 m. For measurement, tape was placed on antimesentric side of bowel from Treitz' ligement to ileocecal valve (Fig. 1). Jejunum was differentiated from ileum. Features evident on gross inspection that were more characteristic of the proximal than distal small intestine include larger circumference, thicker wall, less fatty mesentery and longer vasa recta.

Measurement was performed immediately after abdominal wall opening to decrease the effects of cold exposure and depth of anesthesia on bowl length.

After operation, patient details, operative diagnosis, jejunum and ileum lengths and patient height were recorded. Data were reported as mean + SD. For comparison of bowel length in patients and cadavers and between males and females *t*-test analysis was used. For evaluation of correlation of small bowel length and patient height, age, and weight, we used regression analysis. SPSS software 15 was used for analysis and $P < 0.05$ was considered significant.

Results

Between May 2007 and December 2007, 100 patients (54 males and 46 females) aged 20–43 years were studied. Sixty-four patients (64%) presented with gall stone disease, 23 patients (23%) presented with peptic ulcer disease and 13 patients had spleen disease. For comparison we used 30 fresh cadavers as control group after case control matching.

The small bowel length ranged from 285 to 620 cm (mean 459.6 ± 78.47) in patients. It was 632.5 ± 88.9 cm in cadavers ($P < 0.01$). Small bowel length was 452.2 ± 79.36 cm in males and 468.2 ± 80.44 cm in females (P = NS). Jejunum length was 140.2 ± 45.4 cm in males and 138.6 ± 40.2 cm in females (P = NS). Ileum length was 286.3 ± 34.7 cm in males and 289.9 ± 37.8 cm in females. (P = NS). There was no correlation between bowel length and patient height, age, and weight in our cases.

Discussion

The small intestine is the major digestive and absorptive portion of the gastrointestinal tract. Any pathologic process that disrupts the normal function or length of the small intestine profoundly affects the normal growth and metabolism. SBS is a term that is used to define the pathophysiologic disorders that result from the removal of a large portion of small intestine. Because of the difficulties in SBS management and death associated total parenteral nutrition (TPN)-induced hepatic dysfunction in these patients, surgeons should resect as short as possible the length of small bowel and the knowledge of normal small bowel length should be reconsidered for proper management. In anatomy textbooks, normal small bowel length has a wide range. Snell et al. [12] and Larsen [10] reported 6 m for small bowel length. In Tortora et al. [13] study, jejunum and ileum length were 1 and 2 m, respectively. In Drake et al. [3] and Moore et al. [11] studies, small bowel length was 6–7 m. In Ellis study [4], it was ranged from 3 to 10 m. He also noted that small bowel length was 6.5 m in male. In Gary et al. study [7], bowel length was 499.9 ± 31.2 cm in alive cases.

Our study shows that measurement of small intestine on alive cases is different from cadaver measurement. Although Fanucci et al. [6] showed the feasibility of indirect measurement of small bowel length by radiography, the direct measurement as we used is more accurate.

The circular muscles of the small intestine appear at 6 weeks' gestation. Visceral smooth muscle is characterized by the instability of its membrane potential and by the fact that it shows continuous, irregular contraction that is independent of its nerve supply. This maintained state of partial contraction is called tonus or tone. It appears that tonicity of small bowel smooth muscle can decrease its length in alive in comparison of cadaver [8]. However, for establishment, we need experimental animal study on smooth muscle of bowel. There was no correlation between bowel length and patient heights in our cases as opposed to Guzman' study.

Two of the most important limitations of this study were the effects of cold and anesthetic agents on bowel length. Opioid effects on the intestine are complex. Opioids increase tone and decrease propulsive activity in most of the intestine. On the other hand, parasympathetic activation of acetylcholine can cause smooth muscle constriction in gastrointestinal tract. In this study, measurement was

performed immediately after abdominal wall opening to decrease the effects of cold exposure and depth of anesthesia on bowl length.

In summary, in this study, we report a measurement of the length of small bowel more accurate that the estimation given by the classical anatomic books. In our study, there was no correlation between bowel length and age, gender, height and weight.

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