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COMMENTARY

"Cecal Resection with Bipolar Sealing in a Rat Model": A Promising Approach for Future Human Studies

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There have been several encouraging initiatives to assess the feasibility of energy sealing devices adapted for the creation of sealing bowel [1,2]. However, almost every study on this topic has come to the same conclusion – when compared to hand-sutured and stapled anastomoses, energy sealing device anastomoses have lower bursting pressures [2,3]. In fact, one study conducted on pigs recommended against the use of the LigaSure™ bipolar sealing device to fuse intestinal tissue in a clinical setting. This was due to higher rates of tissue fusion failures, air-leaks, and even longer operative times in the LigaSure™ cohort compared to the endoscopic stapler cohort [3]. Conversely, the application of energy sealing devices was found to be a sufficient stand-alone method for bowel transection in specific scenarios, also using a porcine model [4].

The authors of a recent study, "Cecal resection with bipolar sealing devices in a rat model," examined the differences in outcomes of different sealing devices (Ligasure™, Enseal™, Nightknife™, Marseal™, and a linear stapling device TA30™) after cecal resections in rats. Their research is unique in that they compared energy devices against each other, in addition to comparing energy devices with a stapling device. The energy devices were further analyzed based on the reusability of the device – single-use (Ligasure™ and Enseal™) versus reusable devices (Nightknife™ and Marseal™). They measured bursting pressures and hydroxyproline levels (as indirect markers of collagen content), and evaluated the seal histopathologically for inflammation, growth, and ischemic necrosis [2].

The results of their study were quite intriguing. As expected, stapling devices provided higher bursting pressures than energy devices ($p < .01$), though the use of stapling devices was correlated with higher ischemia levels compared to the energy devices ($p < .01$). Additionally, single-use energy devices produced seals that withstood higher bursting pressures compared to reusable devices at postoperative day zero. However, at postoperative day seven, there was no significant difference. The study concluded that cecal resection in rats with a bipolar device is achievable regardless of the type of device used and that increased strength in colonic stump sealing would be necessary to transfer this to human appendectomies [2].

Interestingly, these studies raise the following questions: are colonic seals that withstand higher bursting pressures necessary to produce better patient outcomes? Are there other areas of the gastrointestinal (GI) tract with varying physiological intraluminal pressures which could be treated more effectively using different devices? Physics tells us yes. Laplace's Law states that "in a long pliable tube, the site of the largest diameter requires the least pressure to distend" [5]. By applying this law, we would expect that a minor change in pressure would cause the cecum to distend, as opposed to other parts of the GI tract (assuming a competent cecal valve) [5]. This theory encourages conducting studies with energy sealing devices on the cecum due to its large diameter, and if successful, this could be applied to bowel with smaller diameters. Furthermore, because the diameter of the appendix is smaller in comparison to other areas of the bowel, we theoretically have a higher chance to achieve fusion and a stronger seal in the stump of the appendix. Therefore, experimental appendectomies

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using energy sealing devices would be a great first step toward assessing the feasibility and safety of their usage in colonic anastomosis.

A recent meta-analysis estimates that there were 378,614 cases of diagnosed appendicitis in 2015 in the United States and Canada combined [6]. Additionally, the risk of appendicitis in the United States has been cited as 10 per 10,000 person-years [7]. The cost of an appendectomy can vary based on operative approach, ranging from $5,182 to $7,841 United States Dollars (USD) [7,8]. Any effort to standardize surgical practices would have a significant impact on potential savings to both patients and hospitals. Using a single device that could not only seal vessels but also resect an appendix would save time and operative room associated expenses.

The benefits of energy sealing devices are not limited to cost and time, they also extend to ease of use associated with energy sealing devices, as many surgeons are already trained in operating with them. For those new to the field, the speed with which one can be trained in the technique provides additional cost-saving and training benefits. These devices can be used in a surgical training setting in Bioskills labs where bursting pressures can be measured to assess the quality of the sealing in animal models or cadavers [9]. Given the simplicity of the application, the use of energy sealing devices has the potential to reduce the number of mini-laparotomies performed when bowel anastomosis is needed during a laparoscopic case. In addition, energy sealing devices may be more applicable when conducting single port laparoscopy (SPL) or natural orifice transluminal endoscopic surgeries (NOTES). Space is limited with these types of operations so, therefore, using one device would be beneficial [10].

"Cecal resection with bipolar sealing devices in a rat model" invites future research regarding the application of energy sealing devices first in experimental animal models and then in clinical human settings. We hope to soon be able to study all stages of the GI anastomosis healing process in humans after using a bipolar energy sealing device. Also, it would be interesting to see if modifying commercially available bipolar or ultrasonic devices to seal larger diameters can help fuse colonic anastomosis more effectively.

DECLARATION OF INTEREST

The authors report no conflicts of interest.

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