Update and lessons learned regarding the ex vivo bovine large bowel ESD training model

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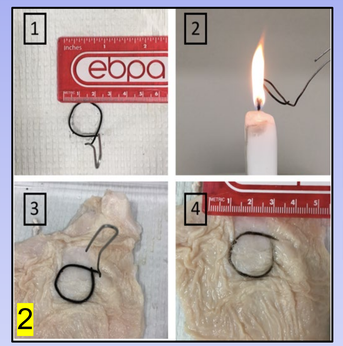
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Background/Aim

In the United States it is a challenge to learn advanced colonoscopic skills such as bowel wall injection (tattooing, and mucosal lift), endoscopic mucosal resection (EMR), endoscopic submucosal dissection (ESD), and wound closure. If experience is gained only in the clinical arena where the volume of training opportunities is unpredictable it can take years to complete the training. However, if inanimate and ex vivo animal models are used then the training can be carried out in a well-defined period of time according to a schedule. Further, these non-clinical models allow for the component skills and composite procedures to be repeated numerous times in a single or multiple sessions which also leads to more rapid skill acquisition.

The authors have formulated and been utilizing a sequential training system that includes both inanimate and ex vivo animal tissue models. The final and most challenging model is the intact ex vivo bovine large bowel ESD model. Intact rectum (with anal sphincter attached) and colon is used and multiple complete ESD cases done. Up to 5 lesions per colon can be completed. Over the course of the last 6-7 years the method used to prepare and preserve the bovine colon has evolved in an effort to provide the best tissue quality so that the most authentic ESD cases possible can be carried out. This poster presents the current preservation and preparation method for bovine large bowel as well as other recommendations regarding this model.









Figures:

1) Antibiotic & protease inhibitor
2) Colon branding tools
3) Colon branding technique
4) Ex vivo colon setup
5) Ex vivo model in use
6/7/8) Scope view during ex vivo ESD
9) Dissected bovine tissue pelts
10) ESD/EMR success in conjunction with ex vivo training

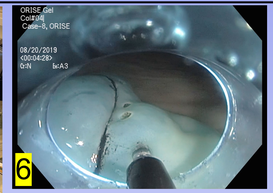
Methods

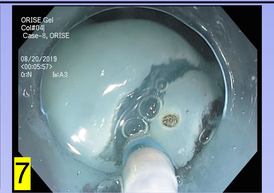
Bovine large bowel (2-2.5 feet long) is obtained from a slaughterhouse and attached organs or tissue removed. The anal sphincter is preserved. In the lab, after it is mechanically cleansed, the colon is instilled with antibiotics and anti-protease solution after which both ends of the large bowel are closed with zip ties and then stored overnight at 7-8° C. The fluid is then drained from the colon which is then placed in -80 ° C freezer. The evening before use the frozen colon is; thawed on ice x 10 hours. Lesions are "branded" onto the mucosal surface with a heated circular wire via a longitudinal anti-mesenteric colotomy that is subsequently suture closed. The colon is affixed via rubber bands to a Peg board just proximal to the sphincter. The proximal end is closed with a zip tie. The colon's shape (straight or curved) can be altered. ESD is then carried out to remove the branded lesions. Cases are videoed/timed.

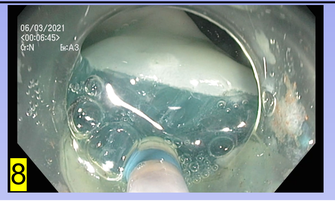
Results

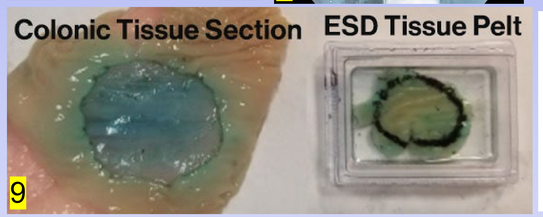
It is clear from over 400 cases that tissue quality varies from colon to colon. Poor quality tissue impacts the ability to make submucosal injections and mucosal lifts which greatly impacts ESD. It is difficult to make mucosal lifts and to do ESD in poor quality tissue. Mucosa with poor integrity bursts when the submucosa is injected, and lift duration is brief; ESD dissection in poor tissue is difficult and more injections are needed. Therefore, we strove to improve the tissue quality. The addition of the antibiotic and anti-protease solution and the subsequent change in concentration of the solution elements is an example. Over the 5-year period the concentration of the anti-protease inhibitor was increased and a second inhibitor added to the mix. These changes resulted in an increase the percentage of colons that were judged to be good quality. Also, in the beginning we prepped and utilized the colons on the same day, however, we learned that the tissue quality was better if the specimens are frozen to – 80° C prior to use. Also, we learned that the quality varied based on the distance from the anus and that tissue quality is inversely related to distance from the anus (likely related to wall thickness). Thus, results differences may be due to lesion location and tissue quality rather than other factors. Only the distal 30 cm should be used; 2-3 lesions should be placed circumferentially at each distance from the anus to control for tissue quality & to allow best comparisons and colon utilization.

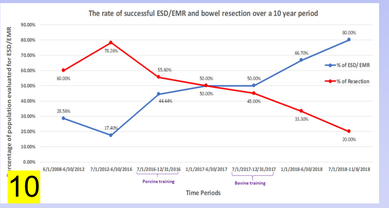












Conclusion

The ex vivo bovine colon model is a good advanced training and research tool. A freeze thaw cycle is advised after antibiotic/anti-protease treatment. Use for ESD should be limited to the distal 30 cm and 2-3 lesions should be placed circumferentially at each level to best utilize each colon. Prompt use after final thawing is recommended.

References

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