ADVANCES IN ENDOSCOPY

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Management of Perforation During Polypectomy

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G&H What is the risk of polypectomy-related perforation depending on location (especially colon vs duodenum)?

GR It is important to appreciate the thickness of the mucosal wall, starting from the esophagus to the stomach, small intestine, colon (and within the colon, the cecum, or right side of the colon, and the left side of the colon), and ending with the rectum. The esophagus is very thick as are portions of the stomach. The thinnest portions are the duodenum, the cecum, the ascending colon, and the transverse colon. Those areas are at higher risk for perforation. The actual measurement of the colon wall is between 3 and 5 mm in thickness—approximately the width of 2 dimes put together. When the colon is distended with a lot of air, it becomes even thinner. As for polyp location, both the duodenum and cecum are at very high risk for perforation, compared with the esophagus, stomach, left side of the colon, or rectum.

G&H What can endoscopists do to minimize perforation risks?

GR The first step when trying to remove a polyp is to have control of the endoscope. Once a polyp is seen, the endoscopist should maintain the polyp within a few millimeters from the tip of the endoscope. Like a photographer positioning a subject in the upper one-third, middle one-third, or lower one-third of the visual field, the polyp should be positioned in the lower one-third of the screen. Being able to maneuver and control the endoscope tip in this way is necessary when performing a cut. The polyp should not be so far out that one is pole vaulting, so to speak, with the endoscope because any movement will become magnified. The second step is to identify where the polyp is, whether in the valley in between the intercostal folds or on the top of the haustral fold. When performing a cut, the endoscopist is going to slice horizontally across. If the polyp is in the valley, when cutting across, the endoscope is still going to be parallel to the wall. When the endoscope is parallel to the wall, the polyp will be sliced horizontally. The endoscopist is not going to trap the muscle. On the other hand, if a polyp is on top of a fold, cutting across horizontally can cut through the wall. The third step is to preserve the submucosa. The colon wall has 4 layers: an outer layer, muscle layer, submucosal layer (a connective tissue layer, which is like a cushion and is the strongest layer), and the mucosal layer on which polyps develop. As long as the submucosa is preserved and the muscle layer is not damaged, a perforation should not occur. For context, when surgeons are placing a suture, they want to make sure that the suture goes through the submucosa because that is the layer that holds tissue together. Thus, when cutting a polyp, it is important to prevent damage to the muscle layer.

G&H How do you prevent damage to the muscle layer?

GR The endoscopist can either cut very superficially or separate the muscle from the submucosa layer by injecting some fluid into the second layer. This is the technique of submucosal injection. When removing a large polyp that requires taking a snare and cutting, more electrical current is needed. When a cut requires more current, the current is going across and is also going to go deep. When the current goes deep, it will damage the muscle. When the muscle is damaged, the patient will develop a perforation. To protect the muscle, injecting a little bit of fluid between the polyp on the mucosa and the muscle lifts

the polyp away and separates the muscle from the polyp. This creates a buffer to prevent cutting the muscle. Once the cut is made, it is also important to identify its depth. A little bit of coloring agent, typically indigo carmine, is added to the saline solution. When the saline with indigo carmine is injected into the mucosa, this connective tissue takes the dye and stains blue. Muscle does not take the dye. After a cut, the area should be a nice blue. If the cut is too deep, white muscle may be seen or even a hole.

G&H What early signs help you recognize when a perforation has occurred?

GR For gastroenterologists, whenever performing a cut, even a small cut, it is very important to see if the depth of the cut is limited to the submucosa, or if it has gone into the muscle, or gone through and through. That is the first basic safety step that should be followed. If the depth of the cut is in the submucosa, it is fine to move on performing more cuts. If the depth of the cut reaches the muscle, the endoscopist should at least make a note stating, "this area is where the cut is deeper and may need to be reinforced with a clip." Otherwise, that muscle may melt and lead to perforation 24 hours to a few days later. If when cutting, a hole through and through is observed, it is clear that a hole was created during endoscopy, and one can see the hole, and if the colon is already distended with a lot of gas, the gas will escape through that perforation into the abdomen. The patient will develop a distended abdomen. The tension in the abdomen can also affect the vitals, with sudden tachycardia or sudden decrease in blood pressure or in oxygen saturation. If a perforation is suspected, the first step is to feel the abdomen. If it is still soft, that is lucky because not much carbon dioxide has escaped. On the other hand, if the abdomen is distended and tense, then the vitals should be checked. If the blood pressure has dropped, the procedure should be stopped. The endoscope does not need to be pulled out. Decompressing the abdomen by inserting a needle and venting out the air in the abdomen will help stabilize the patient's blood pressure as the pressure in the abdomen is relieved. The defect can then be closed with clips.

G&H What are the general principles of managing perforations?

GR It is critical that everyone who performs a polypectomy understands how to identify the depth of the perforation (ie, the depth of the resection). Generally, the first principle is to perform the procedure with a clean bowel preparation. It is not ideal to cut a polyp in a colon that has not been prepared well. If there is a lot of stool, and the stool escapes into the abdominal cavity, the patient can develop peritonitis to the point that a surgeon may need to wash it out and then create a colostomy bag. A second principle is to make sure there is no fluid in the colon, in the upstream segment or downstream segment. This is because when cutting and there is a contraction wave, fluid can flow through that perforation into the peritoneal cavity. Having a dry segment of operation is important. Another management principle is to always be prepared and have clips readily available in the room and open in the case of a difficult cut when a perforation is a possibility.

If a perforation occurs and the defect is closed in a very clean colon, and there was no escape of fluid into the abdomen, the patient can be observed for an extended period in the recovery area. A young patient with no other medical problems could potentially be allowed to go home with, if need be, antibiotics. It is better to admit the older patient, especially one with lots of medical problems and unknown social structure, even when the perforation is closed and the patient is doing well. At discharge, it is important to know the patient's social structure, that the patient is reliable, can be contacted by phone, and is willing to return if needed. However, every time a perforation happens and can be closed, the endoscopist can play it safe and admit the patient overnight for 24-hour observation. During that time, the patient is treated with antibiotics and should be examined every few hours, and blood count and inflammatory markers should be checked. It is best to manage the patient with the help of a surgeon. A computed tomography scan can be considered to see whether the perforation has sealed off.

Immediately after closing a perforation, it is important to take multiple photos from different angles to document the closure. It is also important to keep in mind that clips can loosen and fall apart. When closing a perforation, the endoscopist has to make a deep approximation. Inadequate clip application can leave a gap in between the 2 blades that will result in the clip falling off very quickly. On the other hand, a clip that is applied at a good depth that leaves no visible gap between the blades should remain in place until the wound heals, which takes about 5 to 7 days. Applying more than one clip a few millimeters apart ensures that if one clip loosens, there is another clip keeping the defect closed.

G&H How do you decide which perforations are amenable to endoscopic therapy?

GR For colonoscopic perforations that happen during polyp resection, the current endoscopic techniques could be used to close most of these perforations because they tend to be small and can be closed with clips. Such a perforation, when closed well and documented that it

is closed, most likely can be managed without the need for surgery, as long as the patient is showing signs of improvement (eg, in vitals, pain, blood counts, inflammatory markers) within the next 12 to 24 hours. On the other hand, a perforation that occurs during insertion, as the endoscope is being pushed through the colon, can be very long and difficult to close. These endoscope perforations need immediate surgical attention.

G&H How do you determine which tools to use for the different types of perforations?

GR If a perforation happens in front of the endoscope, then it is preferable to use a tool that can go through the endoscope. With a through-the-scope device, the endoscope can remain in place, keeping the perforation in the field of view. With an over-the-scope device, the endoscope must be removed in order to attach the tool on top and then reinserted. In the meantime, the fluid can leak and cause complications. Currently, there are 2 types of tools that can go through the endoscope: a clip and a suturing device. Most gastroenterologists likely use the clips on a routine basis, and clips should be able to close the defects well. My choice is the clip because that is what I use routinely for bleeding control, and the endoscopy team at my clinic is well-versed in clip application. The suturing device is harder to use in the sense that more training is required. Clips can take care of the perforation that can happen with a polyp resection.

The key is to avoid leakage of fluid into the peritoneal cavity through the perforation.

G&H Could you share a few technical tips for closing perforations?

GR The key is to avoid leakage of fluid into the peritoneal cavity through the perforation. To summarize the principles mentioned earlier, the first principle is to make sure that the colon is clean, and both segments above and below the resection area are dry before a polyp resection. Second, do not cut without having control of the endoscope. If the endoscope tip is not under control and getting into a good position is a struggle, ask someone else or a surgeon to perform the procedure. The third principle is to inject enough saline solution to lift the polyp away from the muscle, so that there is a lot of cushion between the cut and the muscle, and to try to identify the depth of the resection. The fourth principle is to make sure all the accessories necessary are in the room or nearby and already opened to avoid wasting time if a perforation were to happen. For closing a perforation with clips, it is important to learn how to apply clips in different settings and to use deep approximation to keep the clips in place. Finally, take multiple photographs to convince everyone—the surgeon especially—that the defect is closed satisfactorily.

G&H After successful closure of a perforation, how should patients be managed?

GR Immediately following successful perforation closure, generally the patient is admitted to the hospital and given broad-spectrum antibiotics, and the surgeon is notified. The patient should be watched carefully for signs of peritonitis or improvement. If there are signs of peritonitis, it is better to go to surgery early to fix the contamination without the need for a colostomy. The patient who is doing well (ie, the tenderness, white blood cell count, and inflammatory markers are decreasing, and bowel sounds are returning) can be switched from nothing by mouth to a clear liquid diet, as long as they have good bowel sounds and a soft abdomen. If the diet is tolerated, the patient can be switched to full liquids. It all depends upon how the patient is doing in the recovery phase. Most of the time, decisions on patient management can be made within the first 24 hours.

Disclosures

Dr Raju has no relevant conflicts of interest to disclose.

Suggested Reading

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