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Pitfalls in Polypectomy: From Gene to Cure

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Unsuspected problems are commonly encountered during colonoscopic polypectomy. This paper identifies the most frequent difficulties and describes solutions to them. One of the most important pitfalls is overlooking a lesion or tumour in the colon; this can only be solved by better training, experience and care, although it may happen in the best of hands with the most knowledgeable colonoscopist. Other pitfalls addressed include the stuck snare, use of a gastroscope for the difficult sigmoid polyp, and methods to aid discovery and retrieval of the polypectomy specimen.

Key words: colonoscopy, polypectomy, snare, polyp retrieval

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INTRODUCTION

PITFALLS are unsuspected difficulties, dangers or errors that one may fall into. During colonoscopic polypectomy, such difficulties or dangers are commonly encountered. The term "pitfall" does not include complications, which are untoward events that befall the patient or endoscopist during the examination. There are a variety of pitfalls varying from missing a lesion during colonoscopy to losing a polyp after it has been resected. A litany of the most frequently encountered pitfalls is discussed in this review.

A MISSED COLON POLYP

It must be the goal of every endoscopist to fully examine each colon when seeking and removing a polyp, lest an important lesion be overlooked because of inadequate examination. The adequacy of each colonoscopy implies that the colon is prepared fully and clear of debris and faecal matter that may obscure vision. Every examination should include intubation through the entire large bowel to the caecum. The entire colon has not been examined unless the caecal pole is entered, the appendiceal orifice seen, and the ileocaecal valve inspected on both its superior and inferior aspects.

Overlooked lesions are not uncommon [1]. It is the flat polyp, partially or completely hidden under a pool of fluid or buried between two deep haustral folds of the right colon, which challenges the capability and acumen of any endoscopist. Hidden lesions may be missed by even the most experienced colonoscopists because they are hidden from view at the time that the instrument passes by that area.

It is not uncommon for the endoscopist to see a polyp during intubation that cannot be found during scope withdrawal. This is due to several factors, including straightening of the colon, a shift in spatial relationship of the instrument tip relative to the luminal orientation and the effect of over or under-inflation on the colon contours. In order to minimise the possibility of missing polyps because of any of the above conditions, it is suggested that small polyps be removed whenever identified during intubation, and that medium-sized polyps in a good

position during colonoscopic insertion should also be resected when first seen [2]. Small polyps seen on intubation may not be seen again during withdrawal because they may be on the opposite side of a fold or in a position on the wall that is not readily revisualised by the endoscopist. A medium-sized polyp will almost always be found again on withdrawal, but may require considerable effort to obtain the proper position for snare capture. Large polyps should not be removed during intubation, because their removal may be time-consuming or difficult, and other circumstances may affect the decision for polypectomy. If a cancer or a larger polyp is found in the colon further up in the large bowel, surgery will be required in any event, and colonoscopic polypectomy is unnecessary. There is no risk in passing the colonoscope over a flat polypectomy site and performing total colonoscopy.

SNARE STUCK ON A POLYP

In order to cut through a polyp, two forces must act simultaneously. One of the forces is the heat supplied by the electro-surgical unit, and the other is the shearing action produced when the assistant closes the wire loop by squeezing the snare handle assembly. Either of these two forces acting alone will not result in satisfactory polyp transection. Heat without the mechanical force of wire transection will not result in polyp transection. Guillotine force alone may result in severing the polyp, and for small polyps there is no problem with haemostasis [3]. However, for polyps over 6 or 7 mm, cheesewiring will not cause haemostasis as does heat sealing blood vessels. Any electro-surgical unit will provide sufficient energy to resect any polyp. When adequate guillotine force cannot be achieved during wire loop closure, the snare will not cut through the polyp tissue in spite of adequate heat being delivered. The lack of sufficient shearing force to pull the wire through the captured tissue will then result in a stuck snare. In order to ensure sufficient guillotine force, it is important that the tip of the snare wire retract at least 1.5 cm into the sheath when the slide-bar on the handle is fully closed [4]. When the wire loop is being tightened around a firm polyp, the polyethylene sheath tends to buckle and, therefore, becomes shorter in length. When the tip of the wire loop does not have a 1.5 cm margin of retraction inside the sheath tip when the slide-bar is fully closed, shortening and compression of the sheath

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may result in part of the wire loop remaining outside the sheath tip when it is closed around a large polyp, even though the snare handle is completely closed. In this case, the endoscopist and the endoscopy assistant assume that the wire is withdrawn inside the tip of the sheath because the handle is completely closed, but this may not be true. When this occurs and a part of the wire loop cannot be retracted into the sheath because of sheath buckling, thermal energy causes the tissue protein within the captured loop to become desiccated, dry and fibrous, resulting in an incarcerated snare. The incarcerated snare was a common occurrence before endoscopists were aware of the problems of sheath compressibility during a difficult polypectomy. The gastrointestinal assistant should retract each snare before its use to confirm that, with the snare handle closed, the tip of the wire loop retracts at least 1.5 cm within the tip of the sheath. If that amount of retraction is not achieved, the snare should be discarded, since it will not afford sufficient guillotine force to shear through a thick polyp base in spite of application of electrocoagulation current.

CAPTURE OF LARGE SEGMENTS OF POLYP

Another pitfall of polypectomy is to grasp too large a segment of polyp within the snare loop, to grasp a polyp tangentially resulting in a large portion of tissue ensnared within the closed snare loop, or inadvertently to capture a piece of mucosa in the snare tip as it is being closed. These mishaps can be almost completely circumvented by marking the snare handle so that the endoscopic assistant is always aware of the approximate volume of tissue contained within the closed snare loop.

The assistant should fully open the snare and slowly close the slide-bar of the handle until the tip of the wire loop retracts to the tip of the plastic sheath: this is the tip retraction point [5]. This corresponds to the point where, once the wire loop is placed around a polyp, further retraction of the slide-bar will result in application of guillotine force to the tissue, resulting in polyp transection as the wire retracts into the sheath. The assistant makes a mark on the handle's shaft to identify the position corresponding to the snare tip retraction point. This line can be drawn with a pen or pencil and need not be indelible. In closing a snare on a polyp, the endoscopy assistant should always stop at that line in order to prevent "cold-cutting" through a polyp before electrocautery current is applied. This line would not be needed if all the events surrounding snare closure were visible, and eye-hand coordination could be used to ensure that retraction of the slide-bar would stop just as the loop reached its smallest diameter around the polyp. Unfortunately, the angles between the scope and the polyp may obscure the closure events as the loop tightens. Therefore, this mark on the snare handle will be used as the point for stopping further closure once a polyp has been captured, and the same mark can also be used by the assistant to estimate the approximate volume of tissue caught within the wire loop.

With the wire loop around a moderate-sized polyp, the assistant will feel a "closure sensation" or a "springiness" as the slide-bar is closed. Once this sensation is felt, the endoscopy assistant can estimate the volume of tissue captured within the snare loop by noting the distance in millimetres between the actual location at which the slide-bar met resistance and the previous mark made on the handle. Usually, the greatest acceptable distance is approximately 3 mm between the slide-bar and the previously made mark. If the distance is larger, the endoscopist must make an estimate as to whether the loop has captured extra tissue or whether to continue to resect the

ensnared tissue, with the knowledge that the volume encompassed by the loop is unusually large. The closure sensation is not usually felt when the loop closes on a small polyp, but if the assistant always stops slide-bar retraction at the mark, the wire loop will not over-retract and sever a polyp prematurely.

Another technique which can be used for ensuring that extra tissue is not caught within the snare loop is to observe the wall of the colon adjacent to the polyp while moving the polyp, and if the wall moves in concert with the motion of the sheath, it may imply that tissue is caught behind the polyp and repositioning of the snare is necessary.

During closure of the snare loop, it is important to watch carefully the pointed tip of the snare as it retracts toward the snare sheath. Attention should be directed to the mucosa over which the pointed tip of the snare is sliding, to detect whether mucosa will be caught and will bunch up behind the polyp within the closed snare sheath. The mark on the handle will be of some help if a large portion of mucosa is caught, but may not be of significant benefit if only a small knuckle of mucosa is entrapped.

MALFUNCTION OF THE SNARE AND CAUTERY APPARATUS

Heat sealing of transected blood vessels will be accomplished by the technique of coaptation and thermal energy. Tightening of the snare around a polyp base will result in cessation of blood flow, and heat applied to the empty blood vessels will readily seal the strangulated vessel, preventing bleeding. To ensure that electrocautery current will be applied to the tissue when desired, the connections should be checked prior to polypectomy, and the snare "sparked" on a piece of metal prior to insertion of the snare into the patient for polypectomy. This can be accomplished by placing the open wire loop on to a piece of metal while the foot switch is being depressed. A spark can be seen if the snare wire is touched to a piece of metal, indicating that transmission of electrical energy has occurred. The endoscopy staff should perform this "test" every time an electrothermal device is attached to the electrosurgical unit prior to use. This not only ensures that the electrical circuitry is connected, but that the electrosurgical unit itself is turned on and functioning properly.

The spark seen prior to polypectomy will also permit the endoscopic assistant and the endoscopist roughly to assess the power output of the particular electrosurgical unit, particularly important if they are not familiar with the machine. Many endoscopists prefer to use pure coagulation current instead of a blended current. This results in good haemostasis, but may require longer current application for tissue severance than when a blended current is applied. A recent study demonstrated that late bleeding occurred more often if pure coagulation current was used, but bleeding at the time of polypectomy was seen more frequently if a blended current was employed [6].

POLYP IN POOR POSITION FOR CAPTURE

It is not uncommon for endoscopists to attempt removal of a sigmoid polyp, and find that the polyp is almost impossible to snare because of acute angulation in the bowel. The angulation controls may be maximally twisted in a particular direction, but a good position cannot be accomplished. This situation occurs because a loop is present in the instrument, as always occurs during the intubation phase of colonoscopy. It is necessary to remove the loop by pulling back and straightening the scope. The instrument should then be advanced considerably beyond the polyp and, during withdrawal, the scope will straighten and

the control mechanisms restored to their usual mobility. In fact, it is usually best to perform total colonoscopy, removing polyps on the withdrawal phase when the instrument is straight.

Since the snare enters the visual field at the 5 o'clock position, a polyp located in the 5–11 o'clock axis is in the best position to be captured by the open snare loop. If, however, a polyp is at the 12–2 o'clock position, or at the 8 o'clock position, it may be extremely difficult to encircle with the snare loop. When this happens, an attempt should be made at torquing the instrument to alter the relationship between the polyp and the tip of the instrument. Once again, during the intubation phase, this may be extremely difficult to achieve because of a loop in the shaft, but can be readily accomplished during the withdrawal phase of colonoscopy when the instrument is straight and torque can be used to greatest advantage.

POLYPECTOMY IN AN AREA NARROWED FROM DIVERTICULAR DISEASE AND/OR ADHESIONS

Polyps may occur in extremely angulated and narrowed portions of the colon, such as the sigmoid segment. In this circumstance, it may be difficult to manipulate the instrument to capture the polyp. A gastroscope can be used to tremendous advantage in such a situation, since the "nose" portion (from the tip of the bending section to the tip of the endoscope) is relatively short, and the radius of curvature is much tighter than that of a colonoscope. The gastroscope is also much narrower than a colonoscope, affording a better scope diameter/lumen diameter ratio than is possible with a colonoscope [7–9]. All snares can be easily placed through a gastroscope, and polyps may be removed in the usual manner. It should be remembered that accessory instruments enter the lumen from the 7 o'clock position in a gastroscope rather than the standard 5 o'clock position with a colonoscope. At first, this may seem somewhat awkward to the endoscopist, but experience will rapidly permit colonic polypectomy with the standard gastroscope.

SPECIAL CONSIDERATIONS

Contrecoup burn

Theoretically, a contrecoup or contralateral burn may result in a perforation of the colon at the burn site. A contrecoup burn occurs when electrocautery is used to snare and remove a polyp, but the tip (or any portion) of the polyp touches an opposite wall; electrical current will flow across the contact point between the polyp and the adjacent wall, creating a thermal injury to the wall. If the injury is sufficiently deep, it could eventually necrose through the wall and cause a perforation. This is, however, a theoretical possibility rather than a reality. It is not uncommon to see a slight whitening of the wall on the side opposite a polyp following polypectomy. However, perforation from this type of burn never occurs.

The post-polypectomy syndrome

During polyp removal, thermal energy is delivered into the polyp base and colon wall causing coagulation necrosis of cells. When localised to the mucosa or submucosa, thermal damage is focal and readily repaired. However, if the burn is deep, and penetrates the muscularis propria to reach the serosa, then a zone of injured tissue involves the serosal surface. The reaction to this thermal damage is the same as if a spontaneous inflammatory response occurred, as in acute diverticulitis or acute appendicitis [10]. There may be abdominal pain, fever, direct tenderness, rebound tenderness, and all of the signs and symptoms of spontaneous inflammation. This symptom complex occurs in

approximately 1% of polypectomy cases [11]. It is usually self-limited, with only a small portion of patients requiring hospitalisation. Treatment should be individualised, and reflecting the amount of discomfort associated with the post-polypectomy syndrome. A mild ache or discomfort in the area of the polypectomy site is not uncommon, and will usually subside without any therapy. The discomfort may not start until 6–12 h post-polypectomy, and, if mild, lasts less than 48 h. Severe pain associated with other signs and symptoms of localised inflammation will require hospitalisation. Since the symptoms and signs of post-polypectomy syndrome may mimic those of a perforation, an X-ray seeking free air in the abdomen is mandatory. In the absence of perforation, patients should be treated expectantly with intravenous fluids, antibiotics and bedrest. Even severe symptoms and signs usually subside within 48 h, following which the patient may resume a normal diet. The post-polypectomy syndrome does not represent a "mini-perforation," although serositis with fluid in the peritoneal cavity can accompany a thermal inflammatory response in the post-polypectomy syndrome.

The patient on anticoagulants

This situation requires special attention. If anticoagulation is absolutely mandatory, as in patients with a prosthetic heart valve, it is necessary to change the patient's medication from warfarin to heparin. This usually requires discontinuation of warfarin for 1 day, then admission to the hospital the following day, where heparin is started. When the prothrombin time falls to normal levels, the heparin may be discontinued for 4 h, at which time colonoscopy with polypectomy can take place. If the polypectomy is uneventful, heparin can be restarted within 4 h and warfarin started again that night. The patient remains in hospital on heparin until the prothrombin time returns to therapeutic ranges. Because this means a week in hospital for patients requiring substitution of one anticoagulant for the other, the need for this therapeutic manoeuvre must be thoroughly evaluated prior to colonoscopy. If a colon polyp had been removed in the past and the indication is for surveillance examination, it may be in the patient's best interests to perform the interval colonoscopic examination while the patient is still on oral anticoagulants. At that time, if no polyp is found, no adjustment of anticoagulant dosage is necessary. If a small polyp is found, a further colonoscopy may be planned for 2 or 3 years hence, at which time evaluation can be made of whether the polyp has grown sufficiently in size so that it will require hospitalisation with a substitution of anticoagulants for polypectomy. If a large polyp is found at the initial examination, then a short interval recolonoscopy will be necessary. In spite of all the efforts to avoid post-polypectomy bleeding, the fact is that patients rarely bleed while in hospital under supervision during anticoagulation substitution. If bleeding occurs, it is most likely to happen between 10 days and 2 weeks later, when the patient is fully anticoagulated and has left hospital.

INABILITY TO LOCATE POLYPECTOMY SITE OR LESION

Precise location of the tip position during colonoscopy becomes important when there is a need to relocate a lesion or an area of the colon at a later time. It may be desirable to know the precise site at which a polyp has been removed in pieces, so that the area can be readily identified at the next follow-up colonoscopy. Site identification becomes necessary when a specific portion of the large bowel requires surgical resection and

the lesion may not be readily apparent by visual or palpatory exploration [1]. Following endoscopic removal of a malignant adenoma, the site may heal completely in 8 weeks, and a locator mark may assist the pathologist in identifying the place where the lesion had been. The most effective method for marking the colon is Indian ink injections [12,13].

Sterile diluted Indian ink (in a volume per volume ratio of 1:100 with saline) results in a concentration of ink which is readily visible by either the endoscopist or the operating surgeon. Therefore, greater concentrations need not be employed.

A standard sclerotherapy needle is utilised, but should be long enough to be inserted through the entire length of a colonoscope, and sufficiently strong to withstand being forced through the biopsy port, especially when the tip of the instrument is deep in the colon and the colonoscope shaft has several convolutions and loops. Ideally, the needle should enter the mucosa at an angle to permit injections into the submucosa rather than to have the needle pierce the bowel wall. The edges of intrahaustral folds should be targeted. If, during an injection, a submucosal bleb is not immediately seen, the needle should be pulled back slightly, since the needle tip may have penetrated the full thickness of the wall and the ink may be injected into the peritoneal cavity. An intracavity injection is not a clinical problem, but can scatter dark pigment around the abdominal cavity, which may be disconcerting for the surgeon.

Since the colonoscopist cannot know which portion of the bowel is the superior aspect, multiple injections should be made circumferentially in the wall around a lesion to prevent a single injection site from being located in a "sanctuary" site, hidden from the surgeon's sight as the abdomen is opened with the patient lying supine. Each injection should be of sufficient volume to raise a bluish bleb within the mucosa at the injection site. The injection volume may vary from 0.1 to 0.5 ml. With 1:100 dilution of Indian ink, endoscopic visualisation is still possible should some of the ink spill into the lumen, whereas, with the more concentrated solutions, the endoscopic picture becomes totally black when ink pools on the colon walls.

The Indian ink is a permanent marker, with endoscopic visualisation of the tattoo site being possible in every case on follow-up examination without diminution in colour up to an interval of 10 or more years following initial injection.

RETRIEVAL OF RESECTED POLYPS

Resected polyps must be retrieved for histopathological evaluation. The polyps that are removed and fulgurated with hot biopsy forceps are almost always available for histopathological evaluation, with only 0.2% of specimens being damaged by thermal energy [14]. Since most polyps are relatively small, those that are removed with a snare can be retrieved into a special trap placed between the instrument and the suction apparatus. A dedicated polyp trap, specifically for retrieval of small polyps, is available. It has four different mesh cylinders into which suctioned polyps are directed. Once polyps from a certain section of the colon have been retrieved, a mechanism on the trap can be turned to provide another compartment into which sequestered polyps from a different colonic segment can be placed.

A snare may be utilised for retrieval of medium to large-sized polyps. If it is held 3–4 cm away from the instrument tip, visualisation of the colon can take place during the withdrawal phase. This is especially useful when a large polyp is removed from the right side of the colon, since a thorough colonic evaluation can be accomplished even though a polyp is being

retrieved by the snare. Should another polyp be seen, the original polyp can be dropped, the second polyp removed, and, if small enough, it can be suctioned through the suction port and the original polyp regripped and removed. In the event that two or three polyps need to be removed, they can frequently be removed simultaneously utilising a large snare. This method is easier if the scope is rotated so that the dependent portion of the colon is at the 6 o'clock position. The polyps will fall, because of gravity, and line up in one area. The largest one may be picked up with the snare. If the snare is pulled snugly into the sheath, the polyp will remain impacted toward the tip of the snare as the snare loop is opened. The open loop may then be placed over another portion of the polyp (or another previously resected polyp), tightened, and then manoeuvred over a third portion.

A recently introduced and novel polyp retrieval device is the "Roth basket". The basket is a mesh attached to a snare loop, which can grasp several portions of polyp (even more than a dozen) by repeatedly closing and opening the basket. With this technique, it is also desirable to have the polyp on a dependent area of the colon at the 6 o'clock position to facilitate basket entrapment. Another technique is to repeatedly cold-cut (or cheesewire) an already resected polyp into several fragments to enable suction-collection of all the small fragments.

THE LOST POLYP

When polyps are removed and disappear from view, they can usually be found by employing water as a seeking tool. If the instrument tip is placed near the polypectomy site, and water is injected through the biopsy/suction channel, the jet of water should be observed. If a stream of water is seen coming out of the tip of the instrument, it usually indicates that the polyp has gone beyond the tip of the colonoscope and the colonoscope must be introduced further to find the polyp [15].

If, however, a blurred image is seen as water is introduced, this usually means that water is flowing over the lens of the instrument and dripping down along the instrument shaft, and the scope should be pulled out to find the polyp. Of course, if water pools near the polypectomy site, then the polyp is usually in the first pool of water encountered, and suction will almost always reveal the hidden polyp.

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