How to approach and manage difficult polyps

Juan Ricardo Márquez Velásquez,[1] Carlos Mario Escobar Vélez,[2] Fabián Juliao Baños.[3]

1 Coloproctologist at the Instituto de Coloproctology (ICO), Clínica Las Américas in Medellín
2 Gastroenterologist at the Clínica Las Américas Medellín
3 Gastroenterologist at the Hospital Pablo Tobón Uribe

Abstract

If asked when to remove a polyp, the answer should always be ALWAYS! The answer became this emphatic after polyps acquired such importance because they are largely responsible for the genesis of colorectal cancer. 80% of polyps are adenomas which have risks of malignancy which increase as their size increases. This risk is especially high when they are larger than 20 mm. Nevertheless, overall only 5% to 10% generate cancer. In this paper we intend to present the best practical approach and a range of strategies for resection for polyps considered to be difficult because of their morphological characteristics such as size, type, morphology, quantity and location. Polypectomy is a major medical advance of the twentieth century. In experienced hands, it is very safe, highly effective (90-97%) and decreases incidence of proven colorectal cancer by 80%.

Key words

Difficult polyp, colorectal polyp, adenomas, polypectomy, colorectal cancer.

A polyp is a macroscopically visible circumscribed tumor or lump which projects into the mucosal surface. The word is derived from a Greek word which means "many feet" which is used to characterize the tentacles of an octopus. This entity acquired clinical importance after description of adenoma – carcinoma and the proposal by Vogelstein (1) popularized by Muto (2) that, because of the natural history of polyps, failure to eradicate a polyp in a timely manner would most likely imply degeneration into cancer. A study published by the national group of polyps in the United States has made clear that the removal of adenomas reduces the incidence of colorectal cancer (CRC) by between 76% and 90% (3).

By definition, all polyps are dysplastic, (3) and according to the Vienna Classification dysplasia should be divided into low and high risk. High risk dysplasia is severe dysplasia or carcinoma in situ (34). Even small polyps can accommodate flat adenomas, especially adenocarcinomas.

Here are some basic but practical facts that one must know about polyps. 80% of them are adenomas and 70% of them are flat. 80% are less than 10 mm in diameter. 19% are between 10mm and 35 mm. Only 1% of them are larger than 35 mm in diameter. These large polyps are certainly adenomas and are especially located in the right colon (4, 44). The problem with size is that those that are 20 mm or larger have a 20% risk of malignancy, and risk increases exponentially as the diameter increases. Nevertheless, only 5% to 10% of all polyps have a real potential of malignancy. Whenever a polyp is found, there is a 50% chance of a second polyp and a 10% chance of a carcinoma (5, 44). Therefore it is essential to evaluate the entire extension of the colon through a colonoscopy rather than just displaying the distal segments of the colon with a sigmoidoscopy, a practice which I am very critical of because it gives a false sense of security about the status of the colon's health.

Colonoscopic removal of colorectal polyps is one of the major advances in medicine in the twentieth century (44), although there are studies in which 27% to 31% of incidental cancers were diagnosed after having colonoscopy with ineffective polypectomy. Because of the possible of ineffective polypectomies, colonoscopists must be highly efficient and have a high level of expertise for endoscopic resection (39).

We consider that the classification of polyps should be simple and practical, so we use a classification based on macroscopic appearance which divides polyps into standard protruding polyps (pedicled - sessile) and flat polyps. For pedunculated polyps the highest concern is whether the stem is thick or thin, but for sessile or flat polyps the most important concern is to determine if there are matted tumors with lateral extensions and if they have a central depression or ulceration (Table 1).

Table 1. Comparison of Polyp Classifications standard vs. News.

Polyp Morphology	Standard	Paris-Japanese
Pedicled	Pedicled	Protruding polypoid, pedicled Type I
Sessile	Sessile-TEL	Protruding polypoid, sessile, Type I
		Superficial polypoid lesion
		Pedicled (0-Ip)
		Sessile (0-Is)
		Mixed (0-Isp)
	Flat-TEL	Superficial, non-polypoid lesion
		Slightly elevated (0-IIa)
		Completely flat (0-IIb)
		Mildly depressed (0-IIc)
		Superficial, mixed types
		Elevated and depressed (0-IIa + IIc)
		Depressed and elevated (0-IIc + IIa)
		Sessile and depressed (0-Is + IIc)

It has been shown physiologically that the colon in its ground state is one of the most poorly irrigated organs of the body. Its two thickest segments, the rectum and the sigmoid can give a false sense of security to the endoscopist. Although the thickness along the entire length of the organ is between 1.4mm and 2.3 mm (38), in practice this is extremely thin. It becomes especially critical in the cecum and the ascending colon which is how those of us who manipulate the colon intraoperatively normally perceive it.

According to this, the answer to the question, "When should we remove a polyp?" becomes **ALWAYS!!** This question must be answered emphatically by taking strong action (logically within human, technical and logistical limitations).

Throughout history both surgical and endoscopic methods have been used for polyp removal, but since the 1970s the advent of flexible endoscopy has converted endoscopy into the primary choice for evaluation of the colon and for removal of polyps.

Although polypectomy is considered to be an high risk advanced endoscopic procedure, in experienced hands it is very safe and highly effective (90-97%) at decreasing the incidence of colorectal cancer by 80% (3,6). It has no increased risk of bleeding in patients who routinely take NSAIDs, aspirin or clopidogrel (24, 42). It does require moderately complex infrastructure because it needs a large room with a safe hospital bed whose height can be adjusted and because it requires a video and image storage system (Figure 1). Ideally there should be several models of colonoscopes (pediatric, standard variable flexibility, etc...) available, but I personally prefer a pediatric colonoscope with a single working channel. Sometimes other endoscopes are required (very useful for sigmoid polyps amidst diverticular disease) that are thinner, have neck flexibility closer to the tip, which allow more acute angulation, and which have a working channel that emerges at 7 o' clock (14,43) (Figure 2).

Figure 1. An advanced endoscopy unit contains a monitor of the patient's vital signs, a video and image storage system, an electro-surgical unit, and argon plasma equipment.

Figure 2. Colonoscope Types include adult, pediatric and conventional endoscopes.

There should be a wide range of biopsy forceps with or without possibility of electrocautery devices, polyp removers (tripod forceps, baskets, polyp suction containers compartmentalized for separation), sclerotherapy needles, different substances such as dyes, solutions for infiltration and tinting (Chinese ink is the one we use in our country) (Figure 3). Most importantly a wide range of loops of different sizes should be available. These include mini loops 3 cm long x 1 cm wide which are the most common in daily practice since 80% of polyps are less than 1 cm in diameter. Available loops must also include standard sized loops, 6 cm long x 3 cm wide, and different shaped loops including oval, crescent, and hexagonal. Hexagonal loops are very practical for resecting polyps and for performing multiple punch type mucosectomies (14) (Figure 4).
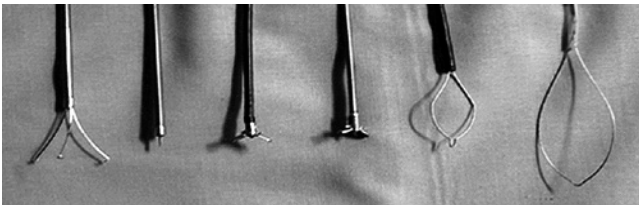

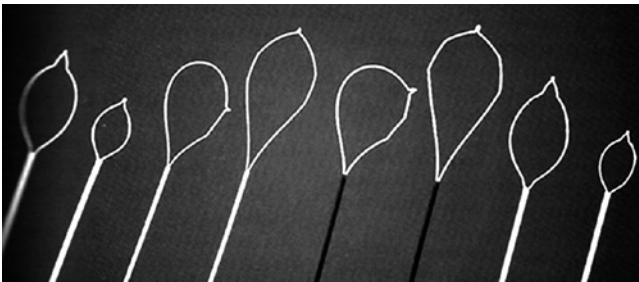**Figure 3.** Endoscopy Instrumentation.

Figure 4. Polypectomy Loops.

Regardless of the size and shape of the loops they all use two mechanisms: shearing to cut the mucosa and electric current to coagulate and seal vessels and to vaporize tissues (7, 43, 44).

The room should contain a monopolar electrosurgical unit and, ideally the latest in sophistication, an argon plasma coagulation unit. Finally we require tools that will help us ensure adequate hemostasis especially after highly complex resection procedures. These tools include endoloops to strangle the pedicle polypoid 9-11 mm endoclips to staple the denuded mucosa. The size is important since they must pass through the 2.8 mm working channel of the endoscope.

But let's define what a difficult polyp is. Someone might answer, simplistically but pragmatically, that it is any polyp which is hard for an endoscopist to resect. The answer would be quite right, but there are some features that a polyp should have to be considered difficult. These features are related to variables such as size, type, morphology, amount and location.

Size

Giants polyps larger than 20 mm in diameter are considered difficult to resect. They account for 10% of all polyps. Polyp and stem size (if there is a stem) must first be calculated using references such as the 2-3 mm loop and the 6-8 mm of an open clamp (8,9).

Morphology

In 1996 Dr. Kudo (25) used high magnification imaging equipment to describe six morphological patterns according to the arrangement of crypts on the surface of polyps. Each cryptoglandular pattern determines histology (adenoma vs. hyperplastic) and its varieties, but more importantly it predicts a the probability of malignancy. The six morphological patterns are:

- Type I:
    - Characteristics: Rounded depressions.
    - Histology: Normal.
- Type II:
    - Characteristics: Stellar or papillary crypts which are larger than normal.
    - Histology: Hyperplastic or serrated adenomas.
- Type III:
    - Characteristics: Tubular or rounded crypts which are smaller than normal.
    - Histology: Adenomas, carcinoma.
- Type IIIL:
    - Characteristics: Most tubular crypts are larger than normal.
    - Histology: Adenomas.
- Type IV:
    - Characteristics: Rows, ramifications or giriform patterns of crypts.
    - Histology: Villous adenomas.
- Type V:
    - Characteristics: Irregular or non-structured.
    - Histology: Carcinoma.

In my understanding, independently of which cryptoglandular pattern we find (Remember that this can only be done with high-magnification.), most experts recommend that all polyps larger than 10 mm in diameter should be resected (26). If this is not possible, the site should be tinted for later treatment. There are authors who criticize the mere idea of leaving a polyp larger than 10 mm because it

has a cryptoglandular pattern (26,27). There are also other morphological characteristics that can be detected using basic equipment which may indicate a malignant polyp. These include the following (38):

Malignant

- Small red or pale lesion interrupting villous pattern.
- Flat depressed lesion with a central depression or letter C.
- A lesion which does disappear with insufflation.
- Folds converge around the lesion.
- A lesion which loses its folds upon application of indigo carmine.
- Non-granular laterally extending tumors.
- Lesions with no signs of lifting.

For practical purposes there are four characteristics that may indicate malignancy in a polyp (18). They can be remembered with the mnemonic "NIFU" (**N**o lift, **I**nduration, **F**riability, **U**lceration).

The different histological types of polyps may have 2 or 3 of the patterns described by Kudo in common making the certainty of diagnosis for a particular pattern totally subjective which results in varying rates and rather low sensitivity and specificity. The predictive value of the cryptoglandular pattern has been questioned because of a tendency to over or under stage lesions with this technique (26 -28). In addition, endoscopists spend additional time evaluating these characteristics.

To tell the truth, standard endoscopy does not detect between 1% and 26% of polyps. High magnification endoscopy increases detection rates between 4 and 5 times for polyps smaller than 1 cm and in the left colon (10). Nevertheless this has not increased the rates of detection in cancer screening. To meet this deficiency techniques such as chromoendoscopy (indigo carmine 0.1 to 0.8%) and more recently virtual chromoendoscopy have been used. Virtual chromoendoscopy is the electronic manipulation of the reflective properties of the mucosal tissue using techniques such as Narrow Band Imaging (NBI) and Fujinon intelligent chromoendoscopy (FICE). It has a sensitivity of 90.9% and a specificity of 97.1% for differentiating non-neoplastic lesions from hyperplastic lesions (4).

Laser endoscopy provides a resolution at micron levels focuses through thousands of optical fibers bonded together. It has been increasingly used to classify polyps. It has a sensitivity of 76% and a specificity of 72% for differentiating neoplastic from non-neoplastic lesions (4). Although these techniques have failed to increase the rate of polyp detection, they have improved the delimitation of flat lesions (29).

In conclusion I believe that no reasonable endoscopist should leave a colon polyp if it is possible to resect it. Even when morphological characteristics indicate a hyperplastic polyp a route to malignancy from hyperplastic polyp to serrated adenoma to carcinoma has been described. In addition, in our environment of standard endoscopy units, high magnification equipment for routine evaluation and resection of polyps is not needed.

Quantity

The sole fact of finding over ten polyps with different characteristics in a colon does mean there is a difficult polyp, but rather indicates a difficult polypectomy. There are three reasons for this. First, resection of several polyps simultaneously is complex and significantly increases the risks inherent in a polypectomy. In addition, removal is wasteful although a net can be used. Second, the pathologist should know the specific sites where the different polyps were resected. Third, sometimes a patient with multiple polyps requires mucosectomy. If one polyp is located in the cecum, it is recommended that it be resected first, leaving the most distal polyps for later resection because of the theoretical risk of perforation resulting from the hyperinflation required for resection of these remaining polyps (5).

Therefore when images show polyposis (more than 7 polyps), and when for some reason surgical resection cannot be considered, a complete polypectomy must be performed. Seven to ten polyps can be resected at a time) staggered and with sessions of 15-20 days between each one of them.

Location

The **location** within the colon of polyps is important from a morphological point of view since peristalsis and movements of matter, induced by "pacemakers" located in the transverse colon, occur mostly in the descending and sigmoid colon. Because of the propulsion mechanism of polyps, they are pedunculated in these areas, unlike those which originate in the right colon which are mostly sessile. In the rectum, villous adenomas occur frequently.

After analyzing the previous variables such as **size, type, morphology, amount and location** we can identify polyps have with certain characteristics that make them really difficult, sometimes even impossible, to resect. The following types of polyps have been identified as difficult:

- Size > 3 cm (head and thick pedicles).
- Occupy > 30% of circumference.
- Lateral Tumor Extension.
- Oyster shaped lesions. It is almost impossible to resect portion of the polyp which remains between folds.
- Polyps located on the ileocecal valve and/or the appendiceal orifice.

- Sessile polyps in diverticular areas of the sigmoid colon.
- Polyps located in difficult positions associated with difficult colonoscopy.
- Polyps with features of malignancy.

How to resect a difficult polyp

Resection of polyps is classified as advanced polypectomy. It has a high rate of successful resection in experienced hands, avoiding colectomies in 58% of all cases (22). Nevertheless, the rate of complications is high (30). Several strategies for resection of a difficult polyp are described below (14):

- Straighten the colonoscope: Entry of the colonoscope frequently leads to formation of loops which make bending the tip of the instrument for examinations inefficient because the cables that are responsible for this movement are strained to their limit. The result is inability to apply proper torque and loss of control of the deflection of the tip of the endoscope which combine to create difficulty in maneuvering the loop to position it around a polyp (43). Therefore, after identifying the polyp it is recommended that, when movements of the endoscope are not one to one, the colonoscopist should proceed to move the colonoscope up the cecum and then start to exit by retracting the colonoscope. This allows removal and correction of loops which helps approach the polyp in the plane of the polyp.
- Position the polyp between 5 and 7 o'clock: The working channel of the colonoscope is located on this axis, so any instrument (forceps biopsies, loops, etc.) will emerge at this level which will allow the polyp to be more easily addressed and resected.
- Align the loop cover with the cutting axis: This allows you to tackle the polyp linearly in the same plane.
- Mark the loop control grip at the point which closes the loop (41). Since there is about 2 cms stored within the Teflon sheath when the loop is fully closed, it is important to mark the exact spot on the control grip where the loop just creeps out of its sheath. This is very important, especially for bulky polyps with thick stems where it is essential to know at what level to cut (Figure 5).
- "U Maneuver": This retroflection maneuver is occasionally necessary to tackle polyps located in the cecum or rectum. Logically all spatial relationships are altered for output shafts of the instruments extending from the colonoscope and therefore for maneuvers necessary for a polypectomy.

ENDOSCOPIC DISSECTION TECHNIQUES

The endoscopic mucosal dissection or mucosectomy was designed by Rosenberg in 1955 and subsequently by Deyhleen in 1973 to raise mucosa prior to resection thus facilitating resection of large flat mucosal lesions (> 15 mm. - Is / Isp / II a, b , c) (18). Hypertonic agents (3% saline solution, 50% dextrose in distilled water, hyaluronic acid, methylcellulose + methylene blue, etc.) are injected to creating a cushion of one of these substances that separates the mucosa and submucosa to avoid transmural burns when these lesions are resected. A recent study showed that injections with 50% dextrose solutions are superior to those with saline solution because they allow better resection in blocks (35).

Performance of endoscopic mucosal dissection (mucosectomy) has seven basic principles (5, 37, 40, 43):
1. Place polyp in position (5 o'clock).
2. Inject solution into the proximal edge of the mucosa of the lesion.
3. The needle must penetrate only slightly (tangential) into the mucosa at the polyp base at a 30^0 angle. It must be retracted smoothly. It is not necessary to infiltrate the 4 quadrants if a good size welt has resulted from the injection.
4. Agents for injection:
   - Rectum: SSL 3% + 50% + DAD epinephrine 1:20,000.
   - Cecum: SSL 0.9% + epinephrine 1:20,000
5. Light bleeding can be controlled because high frequency cauterization of nearby tissue obliterates the vessels that cause bleeding after resection.
6. When tinting is required a welt must be induced by injection of 1 cc of saline solution before injecting this dye. This prevents transmural punctures and peritoneal irritation.
7. Always coordinate maneuvers with the assistant.

Figure 5. Marking the control grip locking the loop in place. When the loop is fully closed about 2 cms is stored within the Teflon sheath.

Ideally a lesion should be removed in a block, but this happens in only 7% to 34% of the time whereas endoscopic submucosal dissection achieves block resection rates of 85% (18). The advantages of endoscopic mucosal dissection are its low cost, the fact that it only requires basic instrumental equipment for dissection and electrosurgery, and that it is by definition ambulatory with low rates of complications such as bleeding (0.7 to 24%) and perforation (0.2%) (15).

Endoscopic submucosal dissection has been described for resection of large lesions (> 20 mm. - Is / Isp / II a, b, c). This technique requires great expertise and high levels of training. The physician must infiltrate the submucosa with inert materials with low absorption rates such as dextrin or hyaluronic acid to ensure lifting and prolonged persistence of the welt. It requires both special dissection and electro-surgical equipment. The process takes a very long time: its average duration is 5 to 6 hours, and it results in block resection with R0 margins in 62.9% of cases (36). The only higher rate is found with mucosal resection. This technique is contraindicated for polyps located in the proximal colon and in angled positions. It has a complication rate of 5% (24% for bleeding) and a perforation rate of 5% to 15% (16). The vast majority of perforations are corrected immediately with endoscopic suture clips. Average hospital stay is 7 days in centers that specialize in this technique (16). I believe that this technique is reasonable for the upper gastrointestinal tract, but not for the colon where the wall is much thinner, has multiple angles, and has many folds. In addition, in the colon peristalsis makes it very difficult to maintain a constant position of the endoscope. All of this makes for a complex procedure with high morbidity rates, a very steep learning curve, and high costs.

In contrast, the laparoscopic approach is safe, minimally invasive, short in duration, and has the advantage that the colonic segment containing the polyp is resected in a single procedure. This is unlike endoscopic resections which often require multiple sessions (14). Laparoscopic resection has low morbidity and mortality rates and high levels of therapeutic performance. This type of resection for lesions which are unresectable with the traditional endoscopic approach is cost effective in our environment. For lesions located in the rectum, the traditional trans-anal resection meets requirements for safety and cost-effectiveness, and can ensure disease-free margins and consequently can ensure healing with minimal morbidity.

The most common complication of these procedures is bleeding (0.85% -24%) which is divided into early bleeding (<12 hrs) and late bleeding (> 12 hrs-30 days). Early bleeding is more common when pure cutting has been used whereas delayed bleeding is more common when using coagulation or mixed currents (4). Advanced age and polyps located in the cecum are two factors that are associated with bleeding (17).

Post polypectomy syndrome occurs with a frequency of 7% between the first 4 hours and 7 days following the procedure. The clinic picture is indistinct from that of a puncture because there is a burn which reaches the muscle but which is not transmural. It causes pain, fever, and elevated levels of acute phase reactants, but without peritoneal irritation or pneumoperitoneum (18).

Perforation, which occurs 0.3% (1 in 1000-2000 colonoscopies), is caused by factors such as direct trauma by the colonoscope, barotrauma, electrocautery and by the depth of the polypoid resection itself (4). This complication is more common after polypectomies which require time consuming electrocautery and after resection of large polyps or those laterally extended tumors, especially those located in the cecum. Overall mortality due to this procedure is 5% (19). Transmural burns or post polypectomy syndrome occurs most often when using coagulation, especially in the cecum (33).

In the event of post polypectomy bleeding the first thing to do is not to panic. There should be plenty of water irrigating the zone to evaluate the real volume of bleeding. The best maneuver (41,42) is to wrap the loop around the pedicle and then use it as a tourniquet to close the lesion for 5 minutes. If the bleeding continues, wrap the loop around the pedicle again and start planning a new approach with loop coagulation, a heat probe, argon plasma, or some other method. You can also infiltrate 1:10,000 adrenaline at the base of the pedicle or obliterate it with an endoloop and/or an endoclip (17), but never use a sclerosing agent (42).

Post polypectomy syndrome is managed with intestinal rest, broad spectrum antibiotics, monitoring of acute phase reactants, and imaging with standing chest x-rays and/or CT scans to assess the integrity of the intestinal wall (18).

When a perforation of less than 15 mm in diameter is detected during polypectomy, an attempt to close it can be made with endoclips or endoloops. The success rate has been 50% (16, 36). Once the perforation is closed, the patient can be managed in the same way a patient with post polypectomy syndrome would be managed with a strict surveillance clinical status and acute phase reactants. In case detection is delayed, or the perforation cannot be sealed endoscopically, the patient should undergo surgery (19).

RECOMENDATIONS FOR RESECTION ACCORDING TO THE PARTICULAR CHARACTERISTICS OF POLYPS

Broad-based polyp (Is / II a, b, c, tumors with lateral extensions)

If the base of the polyp is greater than 15 mm in diameter, especially if it is in the right colon, it should not be resected in a single session. Instead the punch (piecemeal) technique should be used in multiple sessions (5). Depending on the criteria of the individual endoscopist, the piece to be resected may be tinted prior to resection. According to reports in the literature the punch technique remove a polyp in 3 sessions in 83% of the cases (11). When beginning to use this technique, two principles that should be followed to facilitate resection (44): 1) when engaging the mucosa of

the polyp, always place the end of the loop's cover between the immediate vicinity of the healthy mucosa and the adenoma. Then resect this portion first so that next, one arm of the loop can be repositioned on the resected edge while the other arm of the loop engages a new portion of the mucosa adjacent to the polyp. 2) Air should be drawn before closing the loop since this causes the reduction of the intraluminal diameter which thins and compacts the base of the polyp making it easier to resect. During this process the loop's tip should be constantly monitored. This should be complemented by raising the loop and the mucosa that is trapped in the form of a tent together. Then gradually close the loop. This will cause a purplish color which indicates ischemia. Then start gradually cutting with coagulation (always use pure coagulation without cutting or mixing). Next, gradually close the loop again. Repeat this process in a cycle of ischemia and cutting with repetitive forward-back movements. This is associated with two goals. The first is to assess whether the loop is taking only the mucosa and submucosa. This can be corroborated by moving the loop. If the mucosa and submucosa move with the loop, but the wall remains stationary, only the mucosa and submucosa have been cut, but if movement occurs in block, it is most likely that the muscle layer is involved. In such a case the loop should be released and a new attempt should be made. The second reason is that moving the loop dissipates energy in the segment and avoids contact of the loop with the walls and therefore prevents transmural burns.

Pedunculated polyps

The approach to pedunculated polyps depends on the thickness of the pedicle. For practical purposes the pedicles have been divided into groups according to their thickness:

- Pedicle less than 10 mm in diameter: As in resection of any polyp, correct positioning is necessary for the approach. This can be done either from the front or proximally. From the front the physician advances the loop in order to proceed by wrapping it around the pedicle. For a proximal approach the physician advances the endoscope past the polyp and then returns with the open loop and wraps it around the pedicle on the return for extraction. The loop should be wrapped around the middle third of the pedicle. Then the physician should being to close the loop until ischemia (reddish purple) sets in at which point the pedicle should be cut with controlled coagulation.
- Pedicle between 10-15 mm in diameter: The initial steps are the same as above but two additional actions must be considered: infiltration assisted polypectomy and having hemostatic material prepared. Infiltration assisted polypectomy is infiltration of the stem of the

pedicle with 1:10,000 adrenaline prior to resection (14). In any case, resection should be attempted "in toto," except for polyps in the cecum (Figure 6).
- Pedicle over 15 mm in diameter: In addition to the above procedures we suggest placing a prophylactic endoclip or endoloop prior to the procedure or following the procedure since bleeding occurs after the polypectomy in up to 13% of resections of these pedicles when the stem has not been infiltrated prior to the procedure, in 3% of cases when the stem has been infiltrated, and in 1.8% of cases when an endoloop is placed prophylactically (12).
- Pedunculated polyps with heads greater than 30 mm in diameter: Hogan and Hogan have described an inventive technique for reducing the size of polyps with giant heads. The technique uses an injection of 4.8 cc of 1:10,000 epinephrine within the head at two to four different sites. After the head is bleached, two to four cc of the mixture are injected into two or more sites on the stem resulting in a reduction to 80% of the original volume within five minutes (13). Argon plasma coagulation with current ranges between 30 W (cecum) to 60 W (left colon and rectum) and flows between 1 and 2 L/minute can then be used to eliminate residual tissue. Infiltration assisted polypectomy and punch type endoscopic mucosal dissection are used in these cases.

Flat polyps (IIb) stamp-like polyps (14)

Resection of these lesions is easier if the open loop is attached to the wall and then wrapped around the polyp which is then aspirated. Submucosal infiltration is not recommended.

Approach according to the number of polyps (5)
- Multiple polyps:
  - Send each polyp removed to the pathology laboratory in a separate container.
  - Perform polypectomy on entry approach if polyps are small.
  - Perform polypectomy on return approach if polyps are large.
  - If there are more than 10 polyps resect them on separate occasions (> 1 colonoscopies).

Approach according to location (20,43)
- Right Colon and Cecum:
  - Do not use hot biopsy, aspirate air before removing polyp.
- Sessile polyp in diverticular area of the sigmoid colon or in any narrow segment within the reach of an endoscope:
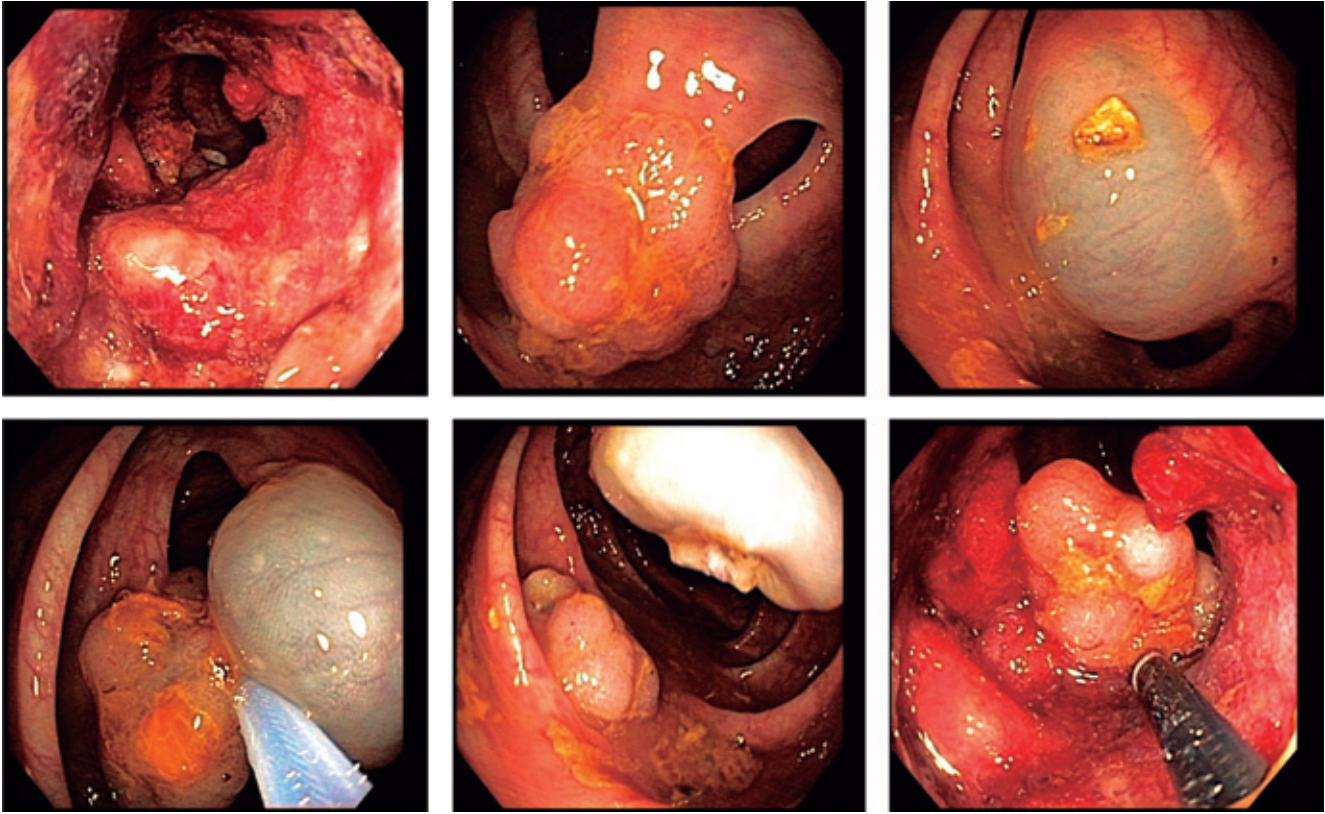
Figure 6. Patient with 70% stenosis from adenocarcinoma of the sigmoid colon which was diagnosed by proctosigmoidoscopy. A colonoscopy prior to surgery showed a synchronous pedunculated polyp of 20mm in diameter (stem 15 mm in diameter) in the ascending colon. Infiltration with hypertonic solution (SSL 3% + 50% + DAD epinephrine 1:10,000) was performed without residual bleeding. The polyp was removed with tripod forceps through the tumor.

- Use an upper endoscope because it is thinner and has a neck which is flexible closer to the tip which allows more acute angles. Use a mini loop.
- Polyp located on, between or behind folds (5,20):
  - Advance the endoscope proximally to the lesion and inject abundant saline solution (10-40cc) into the edge of the submucosa until the welt prolapses. The lesion will be visible for removal with the loop and performance of endoscopic submucosal dissection.
  - Place a transparent plastic capsule in the endoscope tip in order to push the folds. This facilitates opening and flattening the folds which makes the lesion visible to the eye.
  - Bend the endoscope backward (retroflexion technique) and approach the lesion frontally. You must take into account the fact that retroflexion alters spatial relationships as well as the quadrant in which the instrument emerges.
- Villous adenomas and polyps located distally or in the mid-rectum:

- These polyps can be resected in more easily, safely and effectively through a transanal approach (21) (figure 7).
- Polyp located in a difficult position:
  - Locate the polyp at 5 o'clock. Reposition the patient and apply abdominal compression with the assistant holding the endoscope.

HELPFUL TIPS

When a polyp has been found, when should biopsies samples be taken rather than attempting resection?

When the polyp is suspected of being invasive or a high-grade dysplasia in accordance with the morphological characteristics listed earlier in this article. Morphological characteristics do not provide a one hundred percent accurate prediction of malignancy since up to 15% of the resected polyps which had been diagnosed as benign turn out to be carcinomas (38). When malignancy is suspected, it is preferable to take biopsies and tint them, and then

approach the lesion according to the histological findings (18) (Figure 8).

When should polypectomy be deferred? (41):

If you plan an endoscopic mucosal dissection or endoscopic submucosal dissection or resection of a large polyp which has already been diagnosed, and if the patient is taking aspirin or clopidogrel, these medications should be suspended one week before the procedure, if possible (5,42).

For anticoagulated Patients restarting of coumadin should be deferred until 48 to 72 hours after the procedure. In any case delayed post polypectomy bleeding may occur up to 14 days after the procedure. The patient should be warned of this possibility (42).

- Poor preparation.
- Pacemaker/Defibrillator.

The approach to a polyp should always be planned together with the assistant and maneuvers should be synchronized. In addition some basic principles for polyp resection should be followed (4,8,32):

- Have a properly equipped room.
- Positioning the polyp at 5 o'clock. Use submucosal infiltration.
- Place tip of the cover of the loop at the planned resection site.
- Vacuum/change air
- Monitor the tip of the loop and close until ischemia appears
- Coagulate before cutting (maximum 10 seconds to ensure a dry site)
- Signs of coagulation (smoke, white stem, appearance of a "snow capped mountain")
- Abdominal pain: **ALERT!** (This occurs when colonic muscle becomes caught in the loop which requires immediate release of the mucosa and correction of the approach.)
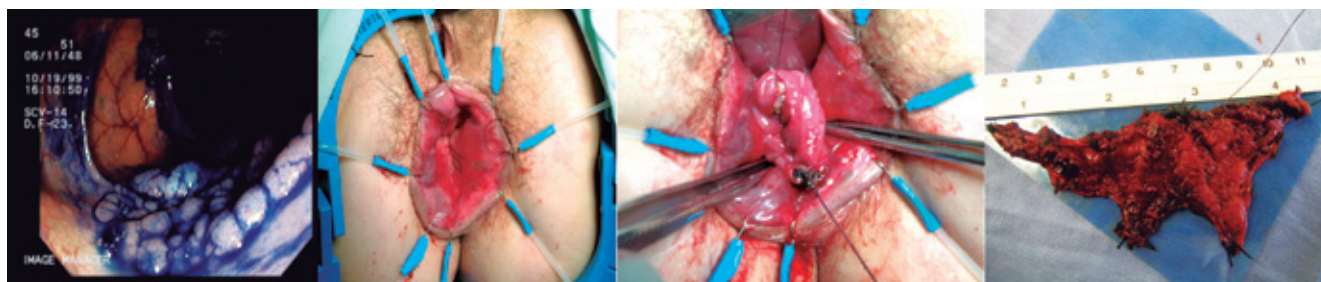- Always check hemostasis. If there are doubts about histology tint the lesion.

Figure 7. Villous adenoma in the middle third of the rectum (about 2⁰ over the Houston valve). Transanal resection with Lone Starr ® separator. Initial stitching with thick sutures. Fixation of the specimen for pathology.
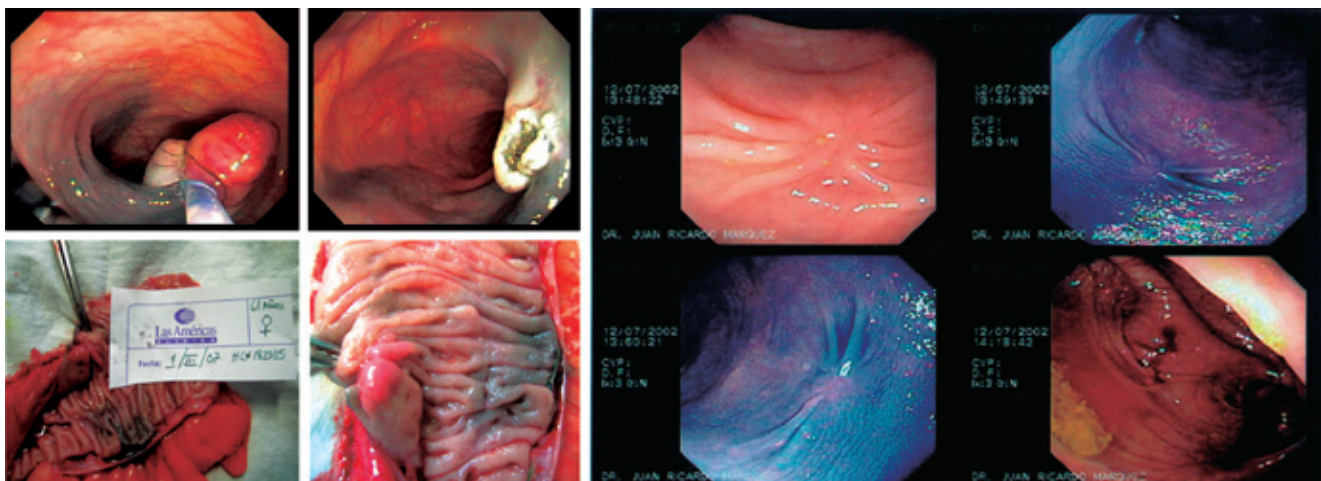

Figure 8. Pathology report of resected sigmoid polyp with a stem compromised by high-grade dysplasia. Biopsies were taken repeatedly and tinted with India ink. The histological report confirmed the diagnosis. The patient underwent sigmoidectomy. The final report was T1N0M0 adenocarcinoma.

- Use an argon plasma laser to resect remaining tissue since up to 15% of the neoplastic tissue can remain and relapse rates range from 28% to 50% (31,43).
- Remove the resected tissue (Although this is impossible in 16% of cases).
- Re-examine the colon endoscopy and check its agreement with histological tests from 6 months to 1 year after procedure.

CONCLUSIONS

The difficult and complex polypectomies require expertise by the endoscopist, sufficient time, appropriate accessories and trained support staff.

90% of difficult polyps can be removed, and surgery can be avoided from 58% to 90% of the times (17, 22). Endoscopic resection is safe, cost effective and executable.

A high level of expertise (more than 500 colonoscopies per year) is essential for the removal of polyps with a 76% success rate. By comparison non-expert practitioners have only a 40% success rate. Part of the expertise required is the ability to understand whether a lesion has a high risk of complications and whether the lesion is too large to be approached safely. In these cases it is reasonable to abandon the attempt, mark the lesion, and then approach it surgically (23). All of this should be done to fulfill the basic principle of a doctor: primum non nocere (First, do no harm).

REFERENCES

1. Winawer SJ, Zauber AG, Fletcher RH, et al. Guidelines for colonoscopy surveillance after polypectomy: a consensus update by the Muti-Society Task Force on Colorectal Cancer and the American Cancer Society. Gastroenterology 2006; 130: 1872-1885.
2. MutoT, Kamija J, Sawada T, et al. Small "flat" adenoma of the large bowel with special reference to its clinicopathologic features. Dis Colon Rectum 1985; 28: 847-854.
3. Winawer SJ, Zauber AG, Ho MN, et al. Prevention of colorectal cancer by colonoscopicpolypectomy: the National Polyp Study Workgroup. N Eng J Med 1993; 329: 1977-1981.
4. Fyock CJ, Draganov PV. Colonoscopicpolypectomy and associated techniques. World J Gastroenterol 2010; 16: 3630-37.
5. Monkemuller K, Neumann H, Malfertheiner P, et al. Advanced polypectomy: state of the art. Clin Gastroenterol Hepatol 2009; 7: 641-52.
6. Lieberman DA, Weiss DG. One time screening for colorectal cáncer with combined fecal occult-blood testing and examination of the distal colon. N Engl J Med 2001; 345: 555-60.
7. McAfee JH, Katon RM. Tiny snares prove safe and effective for removal of diminute colorectal polyps. Gastrointest Endosc 1994; 40: 301-3.
8. Martínez C, Márquez JR, Escobar J, et al. Polipectomía endoscópica. En Cirugía endoscópica "Fundamentos para una práctica adecuada". Sociedad Colombiana de Cirugía, agosto de 2000.
9. Mitooka H, Fujimori T, Ohno S, et al. Chromoscopy of the colon using indigo carmine dye with electrolyte lavage solution. Gastrointest Endosc 1992; 38: 373-374.
10. Buchner AM, Shahid MW, Heckman MG, et al. High-definition colonoscopy detects colorectal polyps at a higher rate than standard white-light colonoscopy. Clin Gastroenterol Hepatol 2010; 8: 364-370.
11. Iishi H, Tatsuta M, Iseki K, et al. Endoscopic piecemeal resection with submucosal saline injection of large sessile colorectal polyps. Gastrointest Endosc 2000; 51: 697-700.
12. Di Giorgo P, De Luca L, Calcagno G, et al. Detachable snare versus epinephrine injection in the prevention of postpolypectomy bleeding: a randomised controlled study. Endoscopy 2004; 36: 860-863.
13. Hogan RB, Hogan RB 3rd. Epinephrine volume reduction of giant colon polyps facilitates endoscopic assessment and remocal. Gastrointest Endosc 2007; 66: 1018-1022
14. Waye JD. Techniques for polypectomy and the problem polyp. Tech Gastrointest Endosc 2003; 5(4): 160-165.
15. Puli SR, Kakugawa Y, Gotoda T, et al. Meta-analysis and systematic review of colorectal endoscopic mucosal resection. World J Gastroenterol 2009; 15: 4273-4277.
16. Tanaka S, Oka S, Kaneko I, et al. Endoscopic submucosal dissection for colorectal neoplasia: possibility of standardization. Gastrointest Endosc 2007; 66: 100-107.
17. Swan MP, Bourke MJ, Alexander S, et al. Large refractory colonic polyps: is it time to change our practice? A prospective study of the clinical and economic impact of a tertiary referral colonic mucosal resection and polypectomyservice .Gastrointest Endosc 2009; 70: 1128-1136.
18. Gallegos-Orozco JF, Gurudu SR. Complex colon polypectomy. Gastroenterology & Hepatology 2010: 6: 375-382.
19. Toliver KA, Rex DK. Colonoscopic polypectomy. Gastroenterol Clin N Am 2008; 37: 229-251.
20. Friedland S, Soethikno R. Optimizing resection of difficult colon polyps. Gastrointest Endosc 2006; 63(1): 148-149.
21. Whitlow Ch, et al. Management of rectal adenomas. Surgical Oncology Clinics of NA, 1996; 5: 723-734.
22. Voloyianis T, Snyder MJ, Bailey RR, et al. Management of the difficult colon polyp referred for resection: resect or rescope? Dis Colon Rectum 2008; 51: 292-295.
23. Brooker JC, Saunders BP, Shagh SJ, et al. Endoscopic resection of large sessile colonic polyps by specialist and non-specialist endoscopists. Br J Surg 2002; 89: 1020-1024.
24. Zuckerman MJ, Hirota WK, Adler DG, et al. ASGE guideline: The management of low-molecular-weight heparin and nonaspirin antiplatelet agents for endoscopic procedures. Gastrointest Endosc 2005; 61: 189-194.

25. Kudo S. Tamura S, Nakayima T, et al. Diagnosis of colorectal timorous lesions by magnifying endoscopy. GastrointestEndosc 1996; 44: 8-14.

26. Lapalus MG, Helbert T, Napoleon B, et al. Does chromoendoscopy with structure enhancement improve the colonoscopic adenoma detection rate? Endoscopy 2006; 38: 444-448.

27. Bianco MA, Rotondano G, Marmo R. et al. Predictive value of magnification chromoendoscopy for diagnosing invasiveneoplasia in nonplypoid colorectal lesions and stratifying patients for endoscopic resection or surgery. Endoscopy 2006; 38: 470-476.

28. Hurlstone DP, Cross SS, Drew K, et al. An evaluation of colorectal endoscopic mucosal resection using high-magnification chromoscopic colonoscopy: a prospective study of 1000 colonoscopies. Endoscopy 2004; 36: 491-498.

29. Kaltenbach T, Friedland S, Soetikno R. A rondomised tandem colonoscopy trial of narrow band imaging versus white light examination to compare neoplasia miss rates. Gut 2008; 57: 1406-1412.

30. Monkemuller K, Neumann H, Fry L, et al. Polypectomy techniques for difficult colon polyps. Dig Dis 2008; 26: 342-346.

31. Vanaguna A, Jacob P, Vakil N. Adequacy of "hot biopsy" for the treatment of diminute polyps: a prospective randomized trial. Am J Gastroenterol 1989; 84: 383-385.

32. Waye JD. It ain't over 'til it's over: retrieval of polyps after colonoscopicpolypectomy. Gastrointest Endosc 2005; 62: 257-259.

33. Dominitz JA, Eisen GM, Baron TH, et al. Complications of colonoscopy: ASGE standard of practice report. Gastrointest Endosc 2003; 57: 441-445.

34. Schlemper RJ, Riddell RH, Kato Y, et al. The Vienna classification of gastrointestinal neoplasia. Gut 2000; 47: 251-255.

35. Varadarajulu S, Tmahane A, Slaughter RL. Evaluation of dextrose 50% as a medium for injection-assisted polypectomy. Endoscopy 2006; 38: 907-912.

36. Fujishiro M, Yahagi N, Nakamura M, et al. Endoscopic submucosal dissection for rectal epithelial neoplasia. Endoscopy 2006; 38: 493-497.

37. Matsushita M, Takakuwa M, Matsubayashi Y. Effective endoscopic tattooing technique. Gastrointest Endosc 2004; 60: 165-166.

38. Waye JD. Colorectal cancer screening, In Clinical Gastroenterology. Anderson JC, Kahi CJ (eds.). Springer Science+Business Media 2011. p. 151-176.

39. Farrar WD, Sawhney MS, Nelson DB, et al. Colorectal cancers found after a complete colonoscopy. Clin Gastroenterol Hepatol 2006; 4: 1259-1264.

40. Waye JD. Advanced polypectomy. Gastrointest Endosc Clin N Am 2005; 15: 733-756.

41. Rubin PH, Waye JD. Colonoscopic polypectomy. En Clinical Gastroenterology: Diagnostic and Therapeutic Procedures in Gastroenterology, Wu GY, Sridhar S (eds.). Springer Science+Business Media 2011. p. 291-305.

42. Baillie J. Postpolypectomy bleeding. Am J Gastroenterol 2007; 102: 1151-1153.

43. Waye JD. Colonoscopic polypectomy. Diagnostic and Therapeutic Endoscopy 2000; 6: 111-124.

44. Waye JD. Colonoscopic polypectomy. Tech Gastrointestinal Endosc 2000; 2(1): 9-17.