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Mesenteric Tear Can Be Caused by Abdominal Counter-Pressure Applied During Colonoscopy

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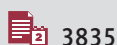
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Patient: Female, 72-year-old
Final Diagnosis: Mesenteric hematoma
Symptoms: Abdominal pain • bloating • nausea • vomiting
Medication: —
Clinical Procedure: Screening colonoscopy • followed by open laparoscopy with the evacuation of a hematoma
Specialty: Gastroenterology and Hepatology • Surgery

Objective: Diagnostic/therapeutic accidents**Background:** We report the case of a patient undergoing a colonoscopy during which pressure applied on the abdomen by a nurse assisting in the procedure caused an extraluminal mesenteric tear. Mesenteric tears can be life-threatening and need to be managed appropriately. This is the first case reported in the literature describing abdominal counter-pressure applied in the endoscopic procedure room as the cause of traumatic bowel injury.**Case Report:** A 72-year-old woman presented for a screening colonoscopy. Advancement of the colonoscope became so difficult that the procedure was temporarily aborted. To reduce looping of the colonoscope, the nurse assistant applied a forceful two-handed counter-pressure maneuver upon the abdomen to help the endoscopist advance the colonoscope to the cecum. After the procedure, the patient complained of abdominal pain and nausea. A CT scan of the abdomen showed a hematoma abutting the anterior abdominal wall. Unfortunately, laparoscopic surgery was hastily recommended over conservative medical management. Approximately 500 mL of old blood was evacuated. The patient survived postoperative complications, including pneumonia, respiratory failure, and sepsis.**Conclusions:** Mesenteric tears are a rare but potentially life-threatening complication of colonoscopy. Post-colonoscopy patients with severe nausea, abdominal pain and/or distention, who fail to demonstrate free air in the abdomen, should have a CT scan with i.v. contrast to assess their condition. Hemodynamically stable patients should be managed with serial vitals and bedside observations, laboratory tests, imaging studies, fluid replenishment, and medication, to avoid unnecessary high-risk surgery. Abdominal counter-pressure applied safely during colonoscopy can reduce the risk of injury inherent in the procedure.**Keywords:** Colon • Colonoscopy • Hematoma • Intestinal Perforation • Mesentery • Operating Room TechniciansFull-text PDF: <https://www.amjcaserep.com/abstract/index/idArt/928889>

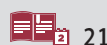
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Background

Colonoscopy is one of the most frequently performed invasive medical procedures. It is recommended by the U.S. Preventive Services Task Force to begin at age 50 and continuing until age 75 [1]. Colonoscopy is essential in diagnosing a variety of conditions, but is most commonly used in the prevention and detection of colorectal cancer, which is the third most common cancer in men and women in the United States [2]. Common complications of colonoscopy include perforation of the colon when 1) too much force is applied, 2) a polyp is removed, or 3) a biopsy is taken, as such procedures tend to weaken the colonic wall structure at that specific point of tissue removal [3]. Intra-colonic bleeding following colonoscopy can occur if the integrity of blood vessels is disturbed during tissue removal, or if the colon wall is scraped or abraded due to the use of a push-through technique without adequate visualization. Extra-colonic bleeding following colonoscopy is rare, and complications include splenic injury, mesenteric tears, hepatic injury, and retroperitoneal hemorrhage [4].

During a colonoscopy procedure, externally applied counter-pressure is used by an assistant to counteract mounting internal abdominal pressures created by the sideways movement of the colonoscope shaft. The endoscopy assistant applies pressure with one or 2 hands upon the surface of the abdomen. When artfully and carefully applied, this counter-pressure can help to safely guide the colonoscope in a forward direction.

Unfortunately, complications do occur, and the primary purpose of this case report is to demonstrate an uncommon complication of colonoscopy, the mesenteric tear, and to learn how to manage it appropriately. Proper medical management of mesenteric tears following colonoscopy must include a determination of which patients can be treated conservatively with bed rest, i.v. antibiotics, and observation; and which patients require surgery.

A likely cause of a mesenteric tear during colonoscopy can be the forceful manhandling of patients (aka “cowboy assisting”) by nurses and technicians assisting in the endoscopy room. This occurs when experienced endoscopy room assistants place their full weight onto a patient’s abdomen to keep the colonoscope from twisting and looping during a colonoscopy procedure. While complications from “cowboy assisting” are rare, the forceful manhandling of patients is an all-too-common event in the endoscopy room, and it often is even unnoticed by the colonoscopist in charge, as the patient’s abdomen is turned away from him or her, and his or her attention is focused on the video monitors mounted above and to the side.

Two commonly used proverbs or aphorisms apply here. “The road to hell is paved with good intentions”, is the first [5]. With

good intentions, experienced assistants apply forceful manual pressure in cases in which the endoscopist is having difficulty advancing the colonoscope (due to looping), under the mistaken belief that the only known complication of this kind of “cowboy assisting” might be some soft tissue bruising. The second, “the ends justify the means”, is germane as well. The assistants believe that the goal of advancing the colonoscope all the way to the cecum justifies the means of forceful pressure.

The secondary purpose of this case report is to demonstrate and describe the proper techniques of assisting in colonoscopy. Proper colonoscopy assisting techniques are only briefly described in most of the medical literature about colonoscopy, so additional discussion points about “*Safe Assisting During Colonoscopy*” are crucial.

As discussed above, this is the first case reported in the literature which cites unsafe assisting during colonoscopy as the cause of traumatic bowel and mesenteric injuries (TBMI). The assistance provided by nurses and technicians in this article is described as recklessly applied abdominal counter-pressure during the colonoscopy as the cause of a TBMI, and in this case, a mesenteric tear. Mesenteric tears can be life-threatening and need to be recognized and managed appropriately and quickly.

Case Report

A 72-year-old woman, BMI 17.9 (kg/m²), presented for a screening colonoscopy. She had a personal history of colonic adenomatous polyps with bleeding diverticula 5 years ago. From the beginning of the procedure and throughout, the endoscopist was careful not to apply excessive forward pressure to avoid a perforation in a patient with extensive diverticula. The endoscopist used a “push forward and pull back” [6] maneuver while rotating the patient from her side to her back to her side, to reduce looping. Midway through the procedure, the colonoscope became difficult to advance without looping or undue pressure. The nurse assisting in the colonoscopy applied external pressure techniques on the abdomen to help the endoscopist successfully advance the colonoscope to the cecum, which is the end-point of the colonoscopy exam. The nurse, using hands and sometimes an elbow, leaned into the patient, sustaining pressure with clenched hands and with all his weight (Figure 1), a technique that was easily noticed by everyone in the room because the nurse was about a foot taller and twice the weight of the patient. However, unbeknownst to the practitioner, the procedure was completed with injury to the patient caused by the nurse’s excessive use of force. This is known because of the type of injury sustained (a.k.a. The Seatbelt Syndrome), where violence applied by an external force to an entrapped hollow viscus (the colon) at a fixed point (the seatbelt), results in mesenteric tears [7]. However, instead



Figure 1. Nurse, hands clenched, leaning into the patient with all his weight.

of abdominal forces against a relatively fixed restraining seat belt, in this case abdominal forces were applied against an entrapped hollow viscus, the colon. Abdominal counter-pressure applied against a stiffened colonoscope can tear a colon away from its mesentery in the same way that a crowbar can be used to tear a door off its hinges. In this case, the colon was entrapped, held in place by a stiffened colonoscope, while external forces were applied against it by the nurse assisting in the procedure, thus causing the mesentery to tear.

In the recovery room after the procedure, the patient complained of abdominal pain of 2 on a 10-point scale, along with some nausea and vomiting. Her pain and nausea diminished upon ambulation. An X-ray did not reveal free air under the diaphragm (indicative of a perforation), and she was discharged to home. About 50 hours later, she was admitted to the hospital with complaints of gradual onset of a non-radiating left lower-quadrant abdominal pain associated with vomiting and diarrhea. A CT scan of the abdomen and pelvis with Isovue-300 i.v. contrast showed a small amount of free fluid in the pelvis, with a large heterogeneous area suspected by the radiologist to be a hematoma in the left mid-abdomen, measuring 112 mm craniocaudally×94 mm in transverse dimension. The following day, a diagnostic laparoscopy was performed. There was an injury of one of the posterior leaflets of the mesentery, an intramesenteric hematoma behind the distal transverse colon, and free blood in the peritoneal cavity. Approximately 500 mL of old blood was evacuated. A peritoneal lavage was performed, and a suction-bulb drain was placed into the peritoneum. Postoperative complications included pneumonia, respiratory failure, and sepsis. She was discharged from the hospital 8 days after surgery in satisfactory condition.

Discussion

Extra-colonic Bleeding Following Colonoscopy

Colonoscopy allows the physician to look inside the intestine, from the lowest part of the rectum, through the colon, to the lower end of the ileum. The procedure is used to diagnose the causes of unexplained changes in bowel habits (constipation or watery diarrhea), gastrointestinal bleeding (occult or obscure), rectal bleeding, abdominal pain with loss of weight or appetite, and for the surveillance of inflammatory bowel disease, colon polyps, and colorectal cancer. Extra-colonic bleeding following colonoscopy is rare, with only 5 cases of mesenteric tears identified in the literature. Causes that have been identified in the literature include splenic injury, mesenteric tears, hepatic injury, and retroperitoneal hemorrhage. There is little published literature specifically on isolated peri-colonic hematomas following colonoscopy [4]. Traumatic bowel and mesenteric injuries (TBMI) in blunt trauma occur because of 3 basic mechanisms: shearing injuries caused by deceleration, crush injuries from direct impacts, and burst (blowout) injuries from sudden increases in intraluminal pressure [8].

It is important to note that this case report is *not* about a diagnostic or iatrogenic colon perforation caused by excessive looping of the colonoscope. It is about a shearing injury against the anatomical attachments of the colon where the colon is attached to the mesenteric membrane. Understanding the key differences between perforations of the colon and perforations of the colon mesentery is key to understanding this case, and both types of injuries shall be explained here.

Perforations of the Colon Wall and Looping

Colonic perforation occurs in 0.03-0.8% of colonoscopies and is the most feared complication of the colonoscopy procedure, with a mortality rate as high as 25%. It can result from mechanical forces against the bowel wall, barotrauma, or as a direct result of therapeutic procedures [9]. Reports have shown that mortality rises with the number of associated injuries [10]. Perforation of the colon most always results in a finding of free air in the abdomen. It may occur as either an intraperitoneal or extraperitoneal perforation or in combination. Most colonic perforations are intraperitoneal, causing air and intracolonic contents to leak into the peritoneal space. Rarely, colonic perforation can be extraperitoneal, leading to the passage of air into the retroperitoneal space, causing pneumoretroperitoneum [9].

Perforations of the colon can be: 1) traumatic, 2) diagnostic, 3) therapeutic, or 4) iatrogenic, a combination of the first 3 caused by the diagnosis, manner, or treatment by a physician. A perforated traumatic bowel is a result of a burst injury from

a sudden increase in intraluminal pressure, or as a direct result of therapeutic procedures. Iatrogenic colonoscopic perforations can result from diagnostic and therapeutic procedures. Therapeutic perforations can be induced by any intervention involving dilation or electrocoagulation, including treatment of arteriovenous malformations and, most commonly, polypectomy. Diagnostic perforation is the result of mechanical disruption of the colonic wall induced directly by the tip of the endoscope or by considerable stretching of the bowel [9], especially when loops in the endoscope are formed (“looping”) or when the endoscope is advanced blindly and by feel (the “slide-by” technique), as the endoscope is pushed gently forward against a resistance that the endoscopist can feel, and into a colonic lumen that cannot be seen [6].

Looping of the colonoscope is a common cause of delayed or incomplete colonoscopies. When forward progression of the colonoscope becomes difficult, and advancement of the colonoscope moves the colon wall sideways into an S-curve, endoscopic physicians and technicians also call this phenomenon “looping”. The typical non-biopsy/polypectomy injury to the colon is caused by excessive looping of the colonoscope, or by direct trauma caused by pushing the endoscope through the colon wall. Both are the cause of intraluminal pressure, and injury to the colon is usually a result of increased intraluminal pressure, with blowout of the colon wall [8].

Interestingly, looping occurs in up to 90% of all colonoscopies; it is a primary cause of patient pain and increased procedure time and it increases the risk of bowel perforation and splenic injury. Ancillary maneuvers such as abdominal pressure and patient position change are often employed to correct looping, yet these maneuvers are applied variably, require extra personnel, are incompletely successful, and can increase procedure time and cost. Manual application of abdominal pressure (generally by a technician or nurse) is the most frequently used ancillary maneuver during colonoscopies, yet this is largely an unscientific and unregimented practice [11]. The inability to reduce the loops can be the result of pain and discomfort that the patient feels during the procedure, and if the doctor or assistant pushes too fast, too hard, and too far, the risk of perforation and bleeding is extremely high.

Along with physician scoping techniques (eg, pull-back push-forward [6]) the best way to address looping is to apply counter-pressure to the patient’s lower abdomen to “splint the colon” (ie, hold it in place). Almost universally, the responsibility for providing this counter-pressure lies with endoscopy nurses and technicians supporting the procedure. Furthermore, if manual pressure fails to prevent looping, the patient must be rolled onto his or her back. Best practices for applying manual pressure have enhanced the safety and efficacy of these methods. However, sometimes there is no safe way for these

techniques to be performed by staff. As a result, musculoskeletal injuries are common among endoscopy nurses and staff. Patients are at risk as well; a recent study examining causes of post-colonoscopy pain found that 2 of the strongest predictors of post-procedure pain were: 1) if manual abdominal compression was used or 2) if the patient was repositioned. Unfortunately, the current counter-pressure approach to addressing looping puts providers and patients at risk [12].

The injury to the patient described in this case was not caused by intraluminal blowout or pressure. There was never pneumoperitoneum or free air in the abdominal cavity. Therefore, the injury was caused or sustained by an extraluminal shearing force as described by M. I. Carvajal in his paper titled Bowel and Mesenteric Trauma [8].

Colon Mesentery Avulsions

Although excessive colon looping in this case was not the direct cause of the patient’s injury (because there was no intraluminal blowout), the nurse’s response to the looping which occurred was to apply a two-handed force upon the abdomen, which caused the mesentery to tear. The application of a counter-pressure against the colonoscope over the abdomen caused an avulsion, (ie, the action of pulling or tearing away to cause an injury [13]), a shearing force which tore the colonic serosa away from its attachment to the mesentery, thereby causing an intramesenteric perforation and hematoma to occur.

Avulsions and tears of the colon mesentery occur at points of fixation of otherwise mobile viscera and mesenteries, whereas explosive visceral perforations are generally at a point where the structure overlies immobile bony framework [7,14]. It is known that seatbelt trauma from motor vehicle accidents is the most common mechanism of mesenteric injury [15]. Small mesenteric vessels are torn by direct force, but mesenteric avulsion and hematoma formation with subsequent ischemia are associated with a torsion (turning with force) injury [7,14].

Much like pushing a rolling pin over dough and flattening it thinner with each stroke until the rolling pin hits the work surface and the dough separates, the colon wall and serosa can also be stretched and flattened to a point of separation by applying too much abdominal counter-pressure or force upon a twisted colon that is held tightly in place by a rigid colonoscope. In this case, compression with tearing between 2 opposing surfaces, between the abdominal mesentery and serosa of the colon, likely describes how the mesentery tore during the colonoscopy procedure.

Mesenteric tears occur far more often in colonoscopy than is documented in the literature. As minor mesenteric tears resolve spontaneously, usually without hospitalization, and with minimal pain, one can only guess how common they are. While

not related to a colonoscopy, a literature review provides information on the case of a 63-year-old man who reported that his abdominal pain was a result of a blunt abdominal injury caused by being hit by his 3-year-old grandson's head during play. This appears as a minor event. However, intraoperative findings revealed the presence of up to 1 liter of bloody ascites and a stable mesenteric hematoma [15]. Therefore, we can confirm that mesenteric tears occur in sporting and play activities of daily life, but we do not have statistics on how often they occur because of the colonoscopy procedure.

Diagnosis of Mesenteric Injuries After Colonoscopy

The diagnosis of mesenteric injuries tends to be delayed, as mesenteric injury from blunt abdominal trauma is uncommon and can be difficult to diagnose [7,15]. Examinations might detect a rigid abdomen, generalized tenderness (guarding or rebound), and bowel sounds ranging from quiet to absent. Symptoms include gradual and localized lower-abdominal pain, anorexia, nausea, and vomiting [16]. Symptomatic abdominal distention with tenderness indicates a possible complication of colonoscopy. Upright chest radiography or abdominal echography are approved for diagnosis but show low sensitivity and specificity [17]. The role of imaging is to confirm free intraperitoneal gas, determine the underlying cause of the injury if possible, and to identify the site of perforation. Imaging is therefore extremely helpful before surgical intervention [16].

Pneumoperitoneum in the abdominal cavity is usually detected on X-ray, but small amounts of free peritoneal air may be missed and are often detected on computerized tomography (CT) [18,19]. Whereas, an investigation for free air in the peritoneal or retroperitoneal space should begin with an upright X-ray of the abdomen, a CT scan with i.v. contrast is the criterion standard for investigational imaging to detect free gas and fluid within the peritoneal cavity [16], and should be ordered whenever a perforated colon or mesenteric tear is suspected and the upright abdominal X-ray is negative.

Retrospective Analysis and Literature Review

Peri-colonic hematoma is a rare but potentially life-threatening complication of colonoscopy [4]. Early detection and surgical intervention, when necessary, are critical in improving the outcome of treatment. Diagnostic peritoneal lavage or trauma sonography should be used to assess patients who are hemodynamically unstable. On the other hand, hemodynamically stable patients may benefit from abdominal CT scanning, which helps localize free fluids, pneumoperitoneum, or mesenteric hematomas. It also helps evaluate solid organ injuries. If the mesenteric laceration is minimal and only a localized hematoma is present, the patient can be managed conservatively. However, the finding of a moderate to large volume of

intraperitoneal fluid without solid organ injury should prompt surgical assessment for bowel and mesenteric injury [15].

A selected number of patients can be treated conservatively with bed rest, i.v. antibiotics, and close observation. In the event of a perforation, surgical options include primary repair of the perforated bowel segment or segmental resection. Surgical intervention is more likely to be successful if the perforation is diagnosed earlier rather than 24 h after perforation [9]. Hence, early recognition and treatment of the injury and determining whether it is a colon perforation or a mesenteric hematoma, are imperative. All patients with abdominal pain following colonoscopy should be treated with a high index of suspicion. Baseline investigations including observations, and a biochemical screen, and full blood count should be undertaken. A normal erect chest X-ray image should not prevent further imaging with CT if there is any clinical suspicion of an intra-abdominal complication. CT scanning should be the investigation of choice in these circumstances. In cases of extra-colonic bleeding, CT scanning will facilitate the diagnosis, identify active hemorrhage, and assist in determining whether conservative management is appropriate. Once a diagnosis of extra-colonic hematoma has been established, conservative management with intravenous fluids and blood transfusions may be sufficient. In such patients there should be a period of close observation and follow-up to ensure the condition is resolving. Persistent hemodynamic instability in the setting of an extra-colonic hematoma would necessitate radiological intervention with possible embolization of the bleeding source or surgical intervention, most likely requiring a laparotomy [4].

According to this literature review, the patient in this case did not present as a surgical candidate. Even though there was a hematoma and free blood in the peritoneal cavity, there was no active bleeding and no evidence of hemodynamic instability or solid organ injury. Therefore, the course of action should have been non-surgical medical management [4].

Safe Assisting During Colonoscopy to Reduce the Incidence of Looping, Perforations, and Tears

Along with good physician scoping techniques (ie, pull-back push-forward) and rotating the patient from side-to-back and back-to-side, the best way to reduce looping of the colon is by having a technical assistant apply artful and careful counter-pressure against the patient's abdomen. Applied counter-pressure is a calculated maneuver to splint the abdominal wall in place, to keep the colon in its natural anatomical position, and to prevent the colon from shifting into an S-curve as the colonoscope moves forward. Carefully applied counter-pressure guides the colonoscope through a tunnel formed by and created by the technician's hands to prevent the colonoscope from changing the natural anatomical shape of the colon.



Figure 2. CORRECT: Flat-handed technique. Demonstrated by Brian Gillis, D.O.



Figure 4. WRONG: Jabbing. Focused pressure on a single area with both hands, which is likely to cause injury.



Figure 3. CORRECT: Flat hands with carefully applied counter-pressure to a wide area.



Figure 5. WRONG: Jabbing, with focused pressure on a single area.

Looping is the most common cause of patient pain during colonoscopy, often causing patients to awaken from sedation. If too much force is put into the loop by the endoscopist, a laceration or blowout rupture of the colon wall might occur. The assistant should apply gentle but firm counter-pressure to guide the colonoscope through the colon and to reduce looping wherever an S-shaped curve is suspected to have formed. The assistant should give most of his or her attention to the sigmoid colon located in the left lower and mid-left side of the abdomen, as this is where most looping occurs. Most complete perforations were found in the sigmoid colon. This may be explained by its redundancy, which makes it susceptible to closed-loop formation [10].

Forceful pressure should not be applied to the abdomen that a reasonable person might expect to cause bruising of the skin or internal contusions. “With possibly the exception of patients with large girth or adipose tissue, these pressures

do not need to be exceptionally forceful” [20]. External forces should be applied over a several-centimeter-wide area to avoid pinpoint injuries (Figures 2, 3). There should never be pinpoint forceful pressure applied to the abdomen with knuckles and elbows (Figures 4, 5).

Cocky attitudes need to be managed inside the endoscopy room and the endoscopist should advise his or her team to respect the anatomy of sedated patients who are unlikely to complain. A “no-cowboy attitude” policy should be established for endoscopy room staff exhibiting “qualities (such as recklessness, aggressiveness, or independence) popularly associated with cowboys” [21].

Manual application of abdominal counter-pressure, if applied incorrectly, can cause a perforation or tear in the colon mesentery, which is the subject of this case report. In the endoscopy room, there are too many instances of an overconfident nurse or endoscopy technician applying excessive counter-pressure

with the mistaken belief that it is in the patient's best interest, because there is "no documentation in the current literature regarding injuries" [20]. It is important to note that until the case documented here, it was not known that abdominal counter-pressure applied during a colonoscopy had ever injured a patient.

Techniques for Assisting in Colonoscopy: A Visual Guide

Figures 2-5 show techniques for safe assisting in colonoscopy. There is a correct way and a wrong way to assist.

Conclusions

Mesenteric tears are a rare but potentially life-threatening complication of colonoscopy. Manual abdominal counter-pressure applied safely during colonoscopy can reduce the risk of injury during the procedure. However, when done incorrectly, manual abdominal counter-pressure can also perforate or tear the colon mesentery. Post-colonoscopy patients with severe nausea, abdominal pain, and/or distention, who fail to demonstrate free air in the abdomen, should have a CT scan with i.v. contrast to assess their condition. Hemodynamically stable patients should be managed with serial vitals and bedside observations, laboratory tests, imaging studies, fluid replenishment, and medication to avoid unnecessary high-risk surgery.

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Department and Institution In Which The Work Was Done

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Conflict of Interest

None.