

Segmental colectomy for bleeding diverticular disease guided by the PEEP test

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Abstract

Many patients with massive lower gastrointestinal (GI) haemorrhage from diverticulosis are subjected to total colectomy when preoperative localisation is unavailable. We dissected colectomy specimens and noted that there was limited retrograde reflux in most of these cases. Therefore, we sought to assess the value of a positive endoluminal erythrocyte presence (PEEP) test (presence of fresh blood in the caecum) to direct segmental colectomies in 14 patients who required emergency operations for massive lower GI haemorrhage. Overall, 13 (93%) patients who had segmental colectomy guided by the PEEP test had successful control of bleeding. There was no mortality and a 14% postoperative morbidity after segmental resections guided by the PEEP test. One patient had persistent bleeding and required a completion colectomy on the third postoperative day. We propose that the PEEP test be added to the surgical armamentarium to guide segmental resection in the absence of localisation by conventional means. However, we advocate blind total colectomy if the PEEP test is equivocal and early completion colectomy if there is significant re-bleeding.

Keywords

Colectomy, bleeding, gastrointestinal, emergency, segmental, total

Introduction

Total colectomy is a widely accepted emergency treatment for unrelenting massive lower gastrointestinal (GI) haemorrhage secondary to diverticulosis.¹⁻⁴ A blind total colectomy is highly effective in arresting unrelenting haemorrhage.⁵⁻⁷ However, its utility is balanced by the high incidence of postoperative morbidity, in the range of 52-74%^{5,6} and mortality in the range of 27-50%.^{5,7}

On the other hand, a subtotal colectomy is preferable because it is accompanied by a lower incidence of morbidity and mortality.^{1,4,5} The subtotal colectomy, however, should be directed by identifying the site of active haemorrhage preoperatively by colonoscopy, conventional selective angiography, computed tomography (CT) angiography or radionuclide scanning. Unfortunately, these investigations are not readily available in low- and middle-income countries; even in high-income countries haemodynamically unstable patients, unresponsive to resuscitative measures, need to be subjected to emergency surgery without prior localisation of the bleeding site.^{2,3}

To avoid the postoperative morbidity associated with a blind total colectomy for massive diverticular haemorrhage, Naraynsingh et al.⁸ proposed the PEEP test, where the surgeon evaluated the caecum by peeping through an incision at its contents, as a means to localise the source of bleeding intraoperatively, thereby allowing directed segmental colectomy. Having dissected total colectomy specimens from patients with massive diverticular haemorrhage, they noted that there was limited retrograde reflux of blood in an anti-peristaltic direction (Figures 1 and 2). This is likely because intra-luminal blood—a potent cathartic—is moved ab-orally by accelerated peristalsis.

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Figure 1. A dissected total colectomy specimen excised from a patient with massive diverticular bleeding originating at the left colon. In this specimen, the left colon contains fresh blood within its lumen. On the other hand, the caecum (asterisk) only contains normal GI content because luminal blood, a potent cathartic, is propelled ab-orally by accelerated peristalsis, with minimal anti-peristaltic reflux. This patient would have a negative PEEP test if performed.

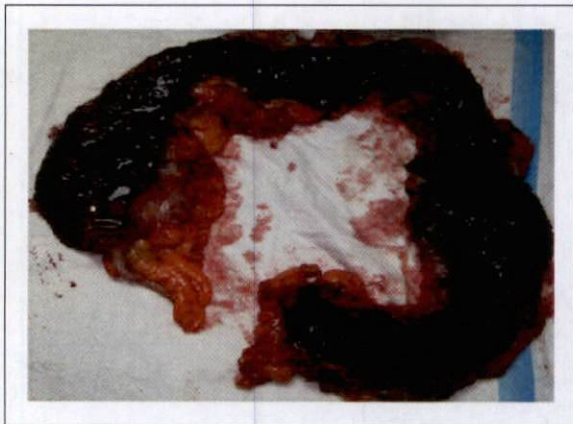


Figure 2. A dissected total colectomy specimen excised from a patient with massive diverticular bleeding originating at the right colon. In this specimen, there is fresh blood in the caecum (asterisk) and the blood has passed distally to fill the left colon since luminal blood is a potent cathartic. This patient would have a positive PEEP test if performed.

Therefore, fresh blood should not be present in the caecum if the source of diverticular bleeding was in the left colon. Similarly, fresh blood in the caecum would suggest a source of bleeding in the right colon. The PEEP test, therefore, involved controlled entry into the caecum as the first step of an emergency laparotomy in patients who required emergency surgery for bleeding diverticular disease.⁸ In the presence of fresh blood at the caecum, a right hemicolectomy was performed; in the absence of blood in the caecum, a left

hemicolectomy was advocated; and in indeterminate cases a total colectomy was advocated.⁸ We now report our experience with the PEEP test in patients with massive diverticular bleeding.

Methods

This prospective study was carried out in a tertiary hospital in Trinidad & Tobago. Ethical approval from the institutional review board at this facility was secured to collect and analyse data for this study.

All patients who required emergency colon resection for unlocalised, massive lower GI haemorrhage secondary to diverticulosis were potential candidates for this study. The decision to proceed to operation was wholly determined by the attending clinicians and was based on clinical parameters alone, regardless of study protocols. Patients were only included in this study if they granted informed consent to participate.

All patients were counselled by an independent investigator about the details of the PEEP test and the proposed management algorithm. They were also counselled on the potential need for a completion total colectomy in the event of persistent or recurrent bleeding. This was explained to the patient and relatives in great detail, including a risk of re-bleeding with segmental resections compared to total colectomy. Patients who did not wish to give written consent to participate were excluded from the study population.

A standardised method was used to perform the PEEP test: the anterior wall of the caecum was lifted, without prior mobilisation, using Babcock forceps. A full thickness vertical incision about 2 cm in length was created at the anterior caecal wall using diathermy, taking care to ensure that there was no bleeding from the caecotomy site. The caecal contents were examined in good lighting, with the aid of coaxial headlights and Langenbeck retractors.

If fresh blood was observed within the caecum (positive PEEP test), suggesting that the source of haemorrhage was in the right colon, a right hemicolectomy was performed. In the absence of fresh blood within the caecum (negative PEEP test), indicating a source other than the right colon, a left hemicolectomy was performed. If there was any uncertainty about the source of bleeding from an equivocal PEEP test, a total colectomy was performed. An algorithm to utilise the PEEP test is outlined in Figure 3.

We recorded the following data: result of PEEP test; nature of operation performed; results of pathologic evaluation of the colectomy specimen; presence of re-bleeding; the need for completion operations; and postoperative morbidity and mortality. The data recorded were entered into a Microsoft Excel[®] worksheet and analysed using SPSS version 19.0.

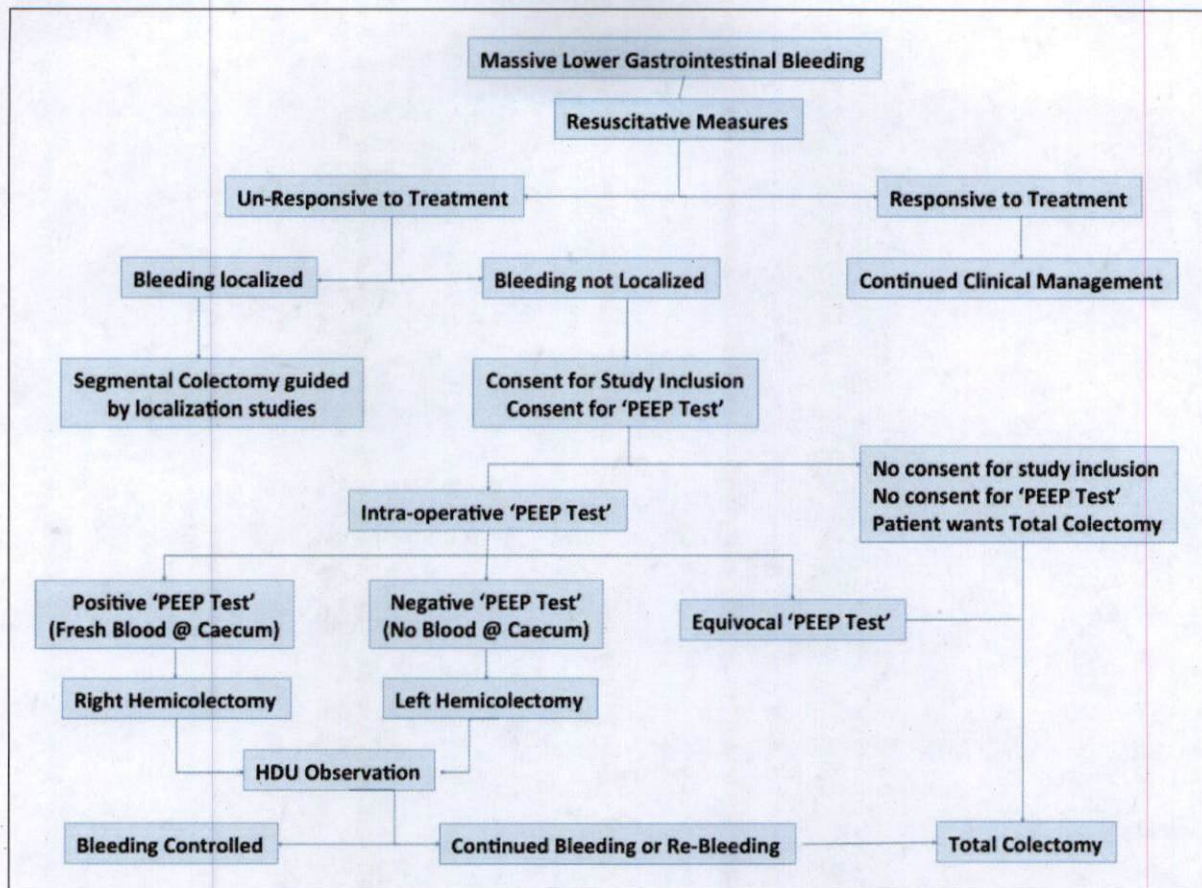


Figure 3. A proposed algorithm to utilise the PEEP test in patients who require emergency surgery for massive lower GI bleeding without prior localisation of bleeding site. This algorithm advocates segmental resection as guided by the PEEP test but the patients should be routinely observed in the high dependency unit for 48 h to identify continued or recurrent bleeding. If necessary, a completion total colectomy should be performed early.

Results

Over the study period, 16 patients were offered emergency colon resection for unlocalised, massive lower GI haemorrhage secondary to diverticulosis. Two patients were excluded because written informed consent was not secured: one chose total colectomy as she wanted the lowest risk of re-bleeding; during the informed consent process in the second case, the investigator concluded that the patient did not fully understand the procedure and had unrealistic expectations. These two patients, therefore, were not included in this study.

There were 14 patients analysed in this study. The PEEP test was positive in ten cases (Figure 4) and these patients were treated with a right hemicolectomy. The PEEP test was negative in four cases and these patients were treated with a left hemicolectomy (Figure 5). There were no cases in which the surgeon recorded an equivocal PEEP test.

Of the ten patients with a positive PEEP test who were treated with right hemicolectomy, one required reoperation for persistent 'stuttering' bleed. This patient

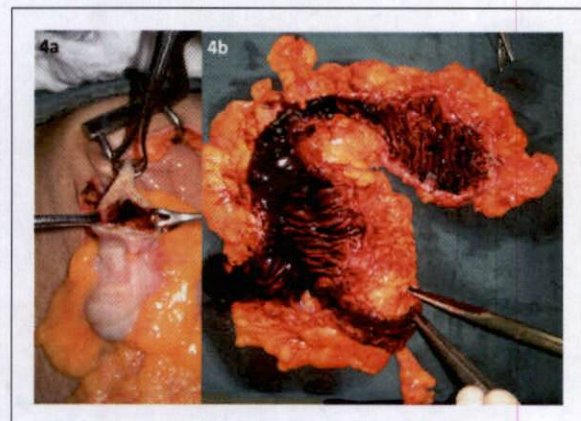


Figure 4. (a) Intraoperative photograph illustrating the PEEP test being performed. The caecum has been lifted using atraumatic Babcock's forceps and was opened using electrocautery to minimise bleeding. Examination of luminal contents revealed the presence of fresh blood – a positive PEEP test. (b) The right hemicolectomy specimen in the same patient reveals significant load of fresh blood in the lumen of the right colon from a confirmed right-sided diverticular source of bleeding.

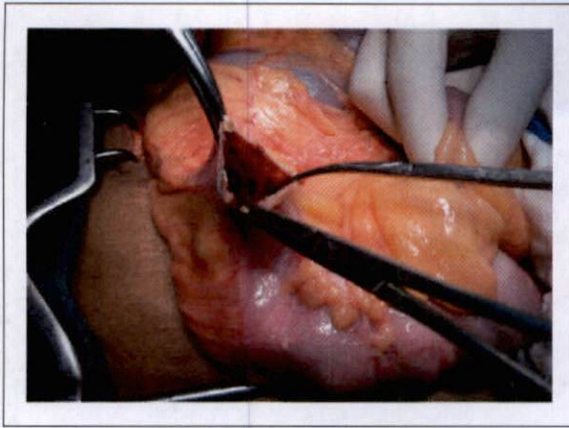


Figure 5. Intraoperative photograph illustrating the PEEP test being performed. Examination of luminal contents revealed the presence of GI contents without fresh blood – a negative PEEP test.

was taken back to the operating room for a completion total colectomy on the third postoperative day. The other nine patients had control of their bleeding. Similarly, none of the four patients with a negative PEEP test required further interventions for persistent bleeding after a left hemicolectomy.

Therefore, in this study a positive PEEP test had 100% sensitivity and 80% specificity to identify the right colon as the source for diverticular bleeding. A negative PEEP test had 80% sensitivity and 100% specificity to correctly detect a source of bleeding in the left colon. Overall, 13/14 patients who had segmental colectomy guided by the PEEP test had successful control of their bleeding. Therefore, the PEEP test had 93% positive predictive value to guide segmental colectomy in order to successfully control bleeding in patients with diverticular disease.

In this study, there was no recorded mortality. There were complications in two (14%) cases, with both requiring prolonged ICU stay for cardiac and renal complications.

Discussion

Approximately 5–15% of patients with colonic diverticulosis will develop lower GI bleeding.⁹ Almost 90% of these patients can be managed conservatively,¹⁰ aided by non-surgical techniques such as therapeutic colonoscopy,⁹ selective angiography with catheter-directed vasopressin infusion and/or trans-catheter super-selective embolisation.^{11,12}

Although there has been great success reported with non-operative modalities, 10–25% of these patients¹⁰ will require emergency surgery for haemodynamic instability. In these cases, many authorities recommended blind total colectomy to arrest haemorrhage.^{2,3} The high postoperative mortality accompanying a blind

total colectomy, in the range of 27–50%,^{5,7} was justified by the fact that it was an emergency operation to preserve life.

However, opponents pointed out that there was significantly lower postoperative mortality (22% versus 32%) when segmental colectomy was performed.^{4,5} This is likely due to the limited operating time, reduced physiologic disturbance and lower blood loss with a less extensive procedure in these already unstable patients, who may have coagulopathy from massive haemorrhage. There is also a lower incidence of postoperative complications, such as persistent diarrhoea, and better quality of life when a segmental colectomy is performed, especially in the cohort of patients who develop diverticulosis coli.

Therefore, most modern therapeutic algorithms advocate a directed segmental colectomy after aggressive diagnostic evaluation if emergency surgery is required.^{4,5,13} The available modalities to localise bleeding and guide segmental resections include colonoscopy,⁹ selective catheter-directed mesenteric angiography,^{11,12,14} CT Angiography^{15,16} and radio nucleotide scintigraphy using labelled red cells.¹⁷ Directed segmental colectomy after localisation of bleeding source using one of these techniques has been shown to yield better outcomes with reduced morbidity and mortality compared with blind total colectomy.^{1,4-7,10,13,14}

Unfortunately, these investigations are not readily available in low- and middle-income countries; even in high-income countries, hemodynamically unstable patients, unresponsive to resuscitative measures, need to be subjected to emergency surgery without prior localisation of the bleeding site.^{2,3} Commonly faced with this dilemma in our setting, many patients were subjected to blind total colectomy despite the risks.

In massive colonic bleeding due to diverticulosis and angiodysplasia, the bleeding site is usually a minute vessel about 2 mm² while the total colonic surface is 240,000–300,000 mm². Thus, a total colectomy sacrifices an enormous area of colon to solve bleeding from a tiny source.

We acknowledge that the PEEP test cannot detect the exact source of bleeding in patients with massive lower GI haemorrhage. Nevertheless, this study has demonstrated that the PEEP test can sufficiently localise bleeding to an area of the colon in order to correctly guide segmental resection in 93% of cases. A test with 93% positive predictive value that may allow a directed segmental resection must be considered, especially in this high-risk, elderly population.

There is a probability for re-operation in the event of continued bleeding. However, the failure rate associated with the PEEP test was only 7% in this study. To further mitigate this risk, we advocate total colectomy if the PEEP test yields equivocal results for any

reason. We have also instituted a protocol for close monitoring in the high dependency unit and early completion total colectomy in the event of re-bleeding.

We acknowledge that a second operation in rapid succession may lead to increased cumulative morbidity and mortality compared to a single-stage blind total colectomy, but this study does not allow us to comment on this as the numbers are small. These early results should prompt further evaluation of the PEEP test in a larger randomised blinded trial.

Conclusion

In patients with massive lower GI haemorrhage who require emergency surgery without prior localisation of a bleeding source by conventional modalities, we recommend the PEEP test whose acronym could refer to "positive endoluminal erythrocyte presence". It can sufficiently localise the area of bleeding in the colon to guide a segmental resection and avoid a blind total colectomy with 93% positive predictive value.

There is a 7% failure rate associated with the PEEP test and these patients may require early completion total colectomy. Therefore, informed consent should be modified to include a discussion on this possibility. Also, we advocate total colectomy if the PEEP test is equivocal and early completion colectomy if there is significant re-bleeding.

Declaration of conflicting interests

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