

Pneumothorax: a rare complication of colonoscopy.

A systematic review of literature



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Daniele Crocetti, Enrico Fiori, Umberto Costi, Mariarita Tarallo, Antonietta De Gori, Giuseppe Cavallaro, Giorgio De Toma

Department of Surgery "Pietro Valdoni", "Sapienza" University, Rome, Italy

Pneumothorax: a rare complication of colonoscopy. A systematic review of literature

AIM: The purpose of this study is to determine the anatomical aspects, mechanisms, risk factors and appropriate management of development of pneumothorax during a routine colonoscopy.

MATERIAL OF STUDY: The review has been carried out according to PRISMA statement. The literature search included PubMed and Scopus database. The search string was "pneumothorax AND colonoscopy".

RESULTS: A total of 36 papers met the inclusion criteria out of 57 non duplicate citations. Papers describing the clinical course of 36 patients with pneumothorax after colonoscopy plus one case (our personal report), achieving a total of 37 patients available for analysis have been investigated. The review revealed a female predominance. 16 procedures were just diagnostic without biopsies, whereas in 21 cases procedures were performed with interventional maneuvers. The most common clinical feature of extraperitoneal colonic perforation was dyspnea in 31 patients (84%). Treatment included unilateral or bilateral chest drain, chest drain and laparotomy, only laparotomy or laparoscopic approach, endoscopic treatment and conservative management was also reported.

DISCUSSION: Rarely, colonic perforation during colonoscopy can occur into the extraperitoneal space, thus leading to the passage and diffusion of air along the fascial planes and large vessels, possibly causing pneumoretroperitoneum, pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous emphysema. The combination of intraperitoneal and extraperitoneal perforation has also been reported.

CONCLUSION: Pneumothorax and tension pneumothorax following a colonoscopy is an extremely rare but severe and often lifethreatening complication. If the patient develops dyspnea and pneumoderma during or after this procedure, a chest radiogram or thoracoabdominal CT should be taken for diagnostic purposes. Urgent treatment, starting with chest tube insertion(s) and laparotomy or laparoscopy could be lifesaving.

KEY WORDS: Colonic perforation, Colonoscopy, Pneumothorax

Introduction

Colonoscopy is worldwide used for diagnosis and treatment of most colorectal diseases. As the number of colonoscopies has increased over the years, the frequency of complications has increased too^{1,2}. Bowel perforation is the most common complication, often requiring

urgent surgery. The incidence of perforation after diagnostic colonoscopy has been reported to be 0.03% to 0.65%, while it raises up to 0.07% - 2.1% after interventional manoeuvres³. Perforations of the colon usually causes pneumoperitoneum and subsequent peritonitis. Rarely, colonic perforation can occur into the extraperitoneal space, thus leading to the passage and diffusion of air along the fascial planes and large vessels, possibly causing pneumoretroperitoneum, pneumomediastinum, pneumopericardium, pneumothorax, and subcutaneous emphysema^{3,4}. The combination of intraperitoneal and extraperitoneal perforation has also been reported. The purpose of this study is to determine the anatomical aspects, mechanisms, risk factors and appropriate management of development of pneumothorax during a routine colonoscopy³.

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Correspondence to: Daniele Crocetti, MD, Department of Surgery "Pietro Valdoni", "Sapienza" University of Rome, Policlinico "Umberto I°" Viale del Policlinico 155, 0 0161 Rome, Italy (e-mail: danielecrocetti@hotmail.it)

Material and Method

The review has been carried out according to PRISMA statement⁵. The literature search included PubMed and Scopus database. Hand searching of reference lists of relevant studies and previous review articles was also performed. No language restrictions were applied. The search string was “*pneumothorax AND colonoscopy*”. Advanced search options including synonyms, partial word and combinations were used. Articles were included if they had enough information regarding symptoms, demographics characteristics, and type of procedure performed (screening, diagnostic or therapeutic colonoscopy). In case of duplicate publications, the latest and most complete one was included in this review.

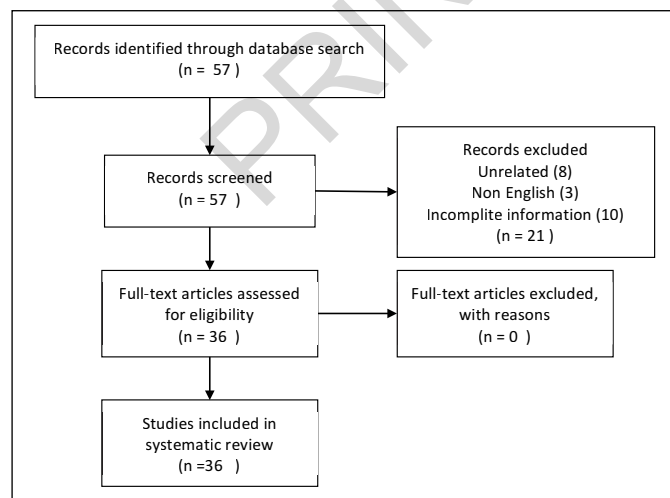
DATA EXTRACTION

Two independent reviewers (DC and ADG) extracted data from each study using a predefined database form, which resulted in high inter-observer agreement. Informations included name of the authors, title of the study, journal in which the study was published, country and year of the study, treatment regimen, performed procedure (screening, diagnostic or therapeutic colonoscopy), clinical signs and symptoms and procedure performed after colonoscopy. After completing data extraction from included papers, the reviewers discussed results of collected data and, if discrepancies were present, a consensus was reached by mutual agreement on the accuracy of data.

Results

A total of 36 papers met the inclusion criteria out of 57 non duplicate citations. Papers describing the clinical

Prisma - Flow diagram



course of 36 patients with pneumothorax after colonoscopy plus one case (our personal report), achieving a total of 37 patients available for analysis have been investigated (Table I).

OUR CASE

a 52 year-old woman underwent diagnostic colonoscopy for chronic anemia. During the procedure, an accidental bowel wall injury was created. So, urgent thoracic and abdominal computed tomography (CT) scan was performed due to acute abdominal pain and dyspnea, revealing pneumoperitoneum of the right abdomen, associated with right pneumothorax. Urgent laparotomy was then performed, and during exploration of the abdomen a 0.5-cm sigmoid perforation was identified and treated by direct suture. At the level of the right hemi-diaphragm we found a 3 cm diaphragmatic fenestration, so a direct suture was performed to close it and a right chest tube was inserted to solve the pneumothorax. The postoperative course was uneventful, and the patient was discharged on postoperative day 9.

DEMOGRAPHICS

The review revealed a female predominance (Female: Male= 26:11). Mean age at presentation was 64 (range= 10-95) years. No specific information regarding weight, body mass index and biochemical tests were available.

COLONOSCOPY

16 procedures were just diagnostic without biopsies, whereas in 21 cases procedures were performed with interventional maneuvers (biopsies [n=5], rectal polypectomy [n=2], sigmoid polypectomy [n=5], caecal polypectomy [n=3], transverse polypectomy [n=1] multiple polypectomy [n=1], balloon dilatation [n=1], therapeutic colonoscopy for evacuation of impacted stools [n=1], therapeutic colonoscopy for sigmoid volvulus [n=1], placement a colonic stent [n=1]).

CLINICAL PRESENTATION

The most common clinical feature of extraperitoneal colonic perforation was dyspnea in 31 patients (84%), followed by subcutaneous emphysema of the neck, face, or upper chest in 19 patients (51%). Abdominal pain was present in 16 patients (43%). 2 patients (5%) were asymptomatic. Pneumothorax was right sided in 16 cases, left sided in 10 cases and bilateral in 11 cases (Table I). In 15 patients, pneumothorax was associated with other extraperitoneal accumulation of air such as pneumomediastinum and pneumoretroperitoneum (Table I).

TABLE I - Literature Systematic Review

Study	Year	Age	Sex	Primary Procedure	Side of pneumothorax	Other sites	Intervention	Intraoperative Findings
Our Case (44)	2017	45	F	Diagnostic	Right	-	Chest tube, laparotomy	Sigmoid perforation
Tsumura (6)	2017	83	M	Colonic stent	Bilateral	SE	Bilateral chest tube	ND
Hekimoğlu (7)	2017	46	F	Biopsies	Bilateral	SE, PM	Bilateral chest tube, ileostomy	ND
Vadhvana (8)	2017	84	F	Diagnostic	Right	-	Conservative treatment	ND
Vojcek (9)	2017	10	F	Diagnostic	Left	SE, PM	Chest tube, Laparotomy	Transverse colon
Lee (10)	2017	64	F	Diagnostic	Left	SE, PM	Endoscopy	ND
Lee (11)	2017	55	M	Rectal polypectomy	Right	SE	Endoscopy	Rectum
Gupta (3)	2017	50	F	Diagnostic	Right	-	Chest tube, Laparotomy	ND
Tseng (12)	2016	95	M	Sigmoid volvulus	Bilateral	-	Bilateral chest tube	ND
Prakash (13)	2016	66	F	Diagnostic	Right	SE	Chest tube, laparotomy	ND
Choi (1)	2016	75	F	Caecal polypectomy	Left	SE, PM	Laparoscopy	ND
Yang (14)	2016	51	M	Rectal polypectomy	Left	SE, PM	Chest tube	ND
Dehal (2)	2014	55	M	Biopsies	Left	PRP	Chest tube, laparotomy	No perforation
Polat (15)	2014	46	F	Diagnostic	Right	-	Laparotomy	ND
Pourmand (16)	2013	84	F	Diagnostic	Right	PM	Chest tube	ND
Sheikh (17)	2013	56	F	Diagnostic	Right	SE, PM	Chest tube	ND
Duri (18)	2013	65	F	Multiple polypectomy	Bilateral	SE	Chest tube	ND
Bonner (19)	2013	50	F	Sigmoid polypectomy	Right	-	Chest tube	ND
Gorantla (20)	2012	50	F	Caecal polypectomy	Right	-	Chest tube	ND
Kipple (21)	2010	78	M	Sigmoid polypectomy	Bilateral	SE	Chest tube, laparotomy	Sigmoid perforation
Thimmapuram (22)	2010	49	F	Biopsies	Bilateral	SE, PM, PRP	Chest tube	ND
Chan (23)	2010	77	F	Balloon dilatation	Bilateral	SE	Chest tube	ND
Ignjatović (24)	2009	54	M	Sigmoid polypectomy	Left	SE	Chest tube, laparotomy	Sigmoid perforation
Öztürk (25)	2009	77	M	Diagnostic	Bilateral	SE	Laparotomy	ND
Marwan (26)	2007	89	F	Diagnostic	Right	SE, PM	Conservative	ND
Lovisetto (27)	2007	75	F	Diagnostic	Left	PM	Chest tube, laparoscopy	Sigmoid perforation
Zeno (28)	2006	64	F	Therapeutic colonoscopy	Right	-	Chest tube, laparotomy	Sigmoid perforation
Ball (29)	2006	77	F	Diagnostic	Bilateral	PM	Chest tube, laparotomy	Ileocolic anastomosis perforation
Hearnshaw (30)	2004	80	F	Sigmoid polypectomy	Right	-	Chest tube, laparotomy	No perforation
Parmar (31)	2003	76	F	Diagnostic	Right	-	Chest tube, laparotomy	ND
Sangwan (32)	2003	50	M	Diagnostic	Left	-	Conservative treatment	ND
Webb (33)	1998	72	F	Diagnostic	Bilateral	SE, PM	Chest tube	ND
Ho (34)	1996	68	M	Caecal polypectomy	Right	-	Chest tube, laparotomy	Caecum perforation
Tam (35)	1996	65	F	Sigmoid polypectomy	Left	SE, PM	Chest tube	ND
Schmidt (36)	1986	59	F	Biopsies	Left	SE, PM	Conservative treatment	ND
Thomas (37)	1979	47	F	Biopsies	Bilateral	-	Chest tube, laparotomy	Caecum perforation
Meyers (38)	1975	68	M	Transverse polypectomy	Right	PM	Chest tube, laparotomy	Sigmoid perforation

SE: Subcutaneous Emphysema, PM: Pneumo-Mediastinum, PRP: Pneumo-Retro-Peritoneum

TREATMENT

Unilateral or bilateral chest drain was placed in 12 patients, while chest drain and laparotomy was performed in 16 patients, only laparotomy or laparoscopic approach was performed in 3 cases, endoscopy was used in 2 patients and conservative management was successful on 4 occasions.

Discussion

Colonoscopy has become a standard tool for colorectal cancer screening and diagnosis of other diseases, and clinicians have gained increased experience in performing it; therefore, the incidence of colonoscopic perforation during colonoscopy shows a decreasing trend³⁹ Mechanisms resulting in colonic perforations may include direct mechanical trauma, thermal injury from electrocautery and pneumatic barotrauma from excessive air insufflation¹. In the majority of cases, the perforation occurs intraperitoneally, and only few cases reporting extraperitoneal colonic perforation with pneumothorax or extraperitoneal accumulation of air^{40,41}.

The anatomical basis of this phenomenon can be explained by the continuity between the visceral space of neck, thorax and abdomen via a fascial compartment. Maunder et al.⁴² described the route of extraperitoneal gas. The soft-tissue compartment of neck, thorax, and abdomen contains 4 regions: the subcutaneous tissue, prevertebral tissue, visceral space, and previsceral space. The visceral space goes from the neck through the mediastinum to the retroperitoneum, with communication between these areas. Air leaked into one of these spaces may pass into others along fascial planes and large vessels, eventually reaching the neck and pericardial, mediastinal, and pleural space. Pneumothorax can occur when rupture of the mediastinal parietal pleura occurs, or when the pneumoperitoneum extends to the intrapleural space through diaphragmatic fenestrations, such as our case²⁸. Retroperitoneal air results from either direct retroperitoneal colonic perforation or from dissection through the colonic wall (pneumatosis coli) and subsequent air entry along the mesentery to the retro-peritoneum.

The most common presenting symptom after colonoscopic bowel perforation is abdominal pain. The symptoms of perforation may not be immediately apparent (small and localized perforations often covered by the adhesion of pericolic fat, omentum, or adjacent viscera)¹. Moreover, if the perforation occurs on the extraperitoneal aspect of the colon, symptoms may be unusual and confounding. When the retroperitoneal perforation is associated with pneumothorax, dyspnea is the most common symptom. This was present in 31 patients (84%) out of 37, followed by subcutaneous emphysema of the neck, face, or upper chest seen in 19 patients (51%). Abdominal pain was present in 16 patients (43%). In only 5% of patients,

the retroperitoneal perforation associated with pneumothorax remained asymptomatic.

There was no relevant difference between the side of pneumothorax (right sided in 16 cases, left sided in 10 cases and bilateral in 11 cases). Interventional manoeuvres during colonoscopy represent a risk factor for colonic perforation³⁹ but cannot be considered as an adjunctive risk factor for the development of pneumothorax after colonoscopy, in fact only 57% (21 out of 37) of patients in this systematic review, having pneumothorax after colonoscopy, were submitted to interventional procedures.

Management of colonoscopic perforation associated with pneumothorax is controversial due to the lack of clinical evidence. The controversy begins in the decision between operative and non-operative treatment. The decision on whether operative or non-operative treatment should be used will depend on the type of injury, the quality of bowel preparation, the underlying colonic pathology, the time of diagnosis relative to the time of perforation, and most importantly, the clinical status of the patient².

Conservative management, chest tube alone, surgical intervention or endoscopy procedure have been proposed. 16 patients (43%) have been treated by chest drain associated with laparotomy. Unilateral or bilateral chest tube alone has been placed in 12 patients (32,4%). Only laparotomy or laparoscopic approach was performed in 3 cases (8,1%), endoscopy was used in 2 (5,4%) patients and conservative management was successful in 4 (10,8%).

The management can range from simple clinical monitoring of the patient, to placement of a chest drain, depending on the severity of the pneumothorax, and associated, in cases of severe respiratory failure, with orotracheal intubation. Owing to the bowel preparation, faecal contamination after colonoscopic bowel perforation is uncommon, and conservative treatment has been successfully applied in most cases. Direct closure by suture on the bowel perforation site is often appropriate, even if, in complicated cases, large bowel resections have been described, even with diverting stoma creation^{1-3, 6-38, 43}. Two cases of endoscopic procedure to repair intestinal perforation through the placement of clips are reported in this review^{10,11}. This treatment, made possible by the progress of operative endoscopy, appear appropriate to repair small and localized perforations following colonoscopy procedure.

Conclusion

Pneumothorax and tension pneumothorax following a colonoscopy is an extremely rare but severe and often lifethreatening complication. Pneumothorax accompanied by pneumomediastinum, pneumoperitoneum, pneumoretroperitoneum, and pneumoderma is a very rare

complication of rectosigmoidoscopy. If the patient develops dyspnea and pneumothorax during or after this procedure, a chest radiogram or thoracoabdominal CT should be taken for diagnostic purposes. Urgent treatment, starting with chest tube insertion(s) and laparotomy or laparoscopy could be lifesaving.

Riassunto

Lo scopo di questo studio è di determinare gli aspetti anatomici, i meccanismi fisiopatologici, i fattori di rischio e l'appropriata gestione di una rara complicanza che può presentarsi a seguito di una colonscopia, lo pneumotorace. Abbiamo eseguito una Review sistematica della letteratura utilizzando la stringa di ricerca "pneumothorax AND colonoscopy" sul database di Scopus e PubMed. Dalla ricerca eseguita risultavano 57 articoli ma solo 36 incontravano i criteri di inclusione stabiliti. (PRISMA statement) Questi 36 articoli selezionati descrivevano il decorso clinico di 36 pazienti che hanno sviluppato un pneumotorace a seguito di una colonscopia. Abbiamo aggiunto a questi, un nostro caso clinico raggiungiamo un totale di 37 pazienti disponibili per l'analisi dei dati clinici (Table I).

I risultati del nostro studio dimostrano una predominanza femminile (M/F: 26/11). Le colonscopie eseguite si suddividono in 16 procedure diagnostiche e 21 procedure operative, senza una differenza statistica significativa tra le due. Il sintomo clinico più frequente di perforazione colica con pneumotorace secondario è la dispnea presente in 31 pazienti (84%). Il trattamento di questa complicanza varia dal semplice posizionamento di un drenaggio pleurico, unilaterale o bilaterale, alla laparotomia urgente. Tale differenza dipende dalla sede della perforazione intestinale e dalla sua grandezza e dalle condizioni clinico-anamnestiche del malato. In letteratura è riportato anche un trattamento conservativo, la perforazione colica in corso di colonscopia è infatti di solito piccola e non associata a peritonite generalizzata. Negli ultimi anni sono riportati trattamenti endoscopici di chiusura della perforazione mediante il posizionamento di clips.

Le cause di questa rara complicanza sono due: la perforazione colica in corso di colonscopia viene generata nello spazio retroperitoneale, questo può determinare il passaggio di aria lungo i piani fasciali dei grandi vasi causando pneumoretroperitoneo, pneumomediastino, pneumopericardio, pneumotorace ed enfisema sottocutaneo. La seconda eventualità per la quale si può generare un pneumotorace a seguito di perforazione colica in corso di colonscopia, come a noi capitato nel nostro caso clinico, è che l'aria dello pneumoperitoneo filtra all'interno della cavità pleurica attraverso una lesione di continuo, non iatrogena, del diaframma.

La comparsa di uno pneumotorace e di uno pneumotorace iperteso a seguito di una colonscopia è un'eve-

nienza estremamente rara ma estremamente seria che può portare il paziente alla morte. Se il paziente sviluppa dispnea o enfisema sottocutaneo durante o dopo una colonscopia bisogna eseguire una lastra del torace o una tomografia del torace urgente. L'introduzione di un tubo di drenaggio pleurico in urgenza con una eventuale esplorazione chirurgica dell'addome, laparoscopica o laparotomica, possono salvare la vita del paziente.

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Commento e Commentary

Prof. MARCELLO MIGLIORE
Otdinario di Chirurgia Toracica
Università di Catania

Crocetti D et al. report an interesting systematic review on pneumothorax as a rare complication of colonoscopy. Authors collected 36 patients adding a personal case. Although metaanalysis has not been performed because the small number of patients, the systematic review is outstanding and the authors followed the PRISMA method which is well known internationally¹. The case report is very interesting as during the procedure the authors found an unusual fenestration in the right hemidiaphragm which was clearly responsible for the escape of the air from the abdomen to the thorax. The reported finding is very rare and the authors have to be congratulated for having reported to the scientific community. Symptoms have been typical with dyspnea and chest pain which could mimic a myocardial infarction². CT of abdomen and chest have been correctly performed to diagnose simultaneous intrathoracic pathologies such as bullae or lung metastasis as cause of the pneumothorax^{3,4}. In case of simultaneous intrathoracic pathology it could have been possible to treat via uniportal VATS during the insertion of the chest drain to avoid the development of hypertensive pneumothorax^{5,6}. The timing of intervention for pneumothorax after colonoscopy could be a difficult decision as the surgeons have to decide between urgent treatment or wait and see. Although the authors decided to operate immediately via open laparotomy, in some centers exploration of the abdomen could have been performed via minimally invasive technique; but it is wise to consider that the general condition of the patient and the experience of the surgeon on-call are important factors that could influence decision making⁷. It is imperative that the chest drain must be inserted before abdominal surgery to avoid the possible development of hypertensive pneumothorax during general anesthesia.

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Crocetti D et all. hanno presentato una interessante revisione sistematica che riguarda lo pneumotorace come complicanza molto rara della colonoscopia. Sono casi rari e gli autori hanno collezionato ben 36 pazienti dalla letteratura aggiungendo un caso personale per un totale di 37 pazienti; ragguardevole è la revisione sistematica che è stata meticolosa ed ha seguito il metodo PRISMA riconosciuto in campo internazionale¹. Il caso clinico riportato dagli autori è molto appassionante in quanto durante l'intervento chirurgico oltre che la perforazione colica hanno rinvenuto una fenestrazione di 3 cm nell'emidiaframma destro che è stata chiaramente responsabile del passaggio dell'aria dall'addome al torace. Ritengo questa una evenienza molto rara ed è stato giusto proporla alla comunità scientifica. La sintomatologia è stata tipica con dispnea e dolore toracico che ricordiamo potrebbe simulare un infarto del miocardio². Concordo anche con l'utilizzo della TAC torace che, anche se non ha permesso di evidenziare la breccia sul diaframma, avrebbe sicuramente permesso di rilevare eventuali concomitanti bolle polmonari o patologie endotoraciche che avrebbero potuto causare lo pneumotorace^{3,4}. In questo caso chiaramente sarebbe stato possibile durante l'inserimento del drenaggio toracico eseguire una diagnosi operatoria ed eventualmente trattare mediante chirurgia toracica uniportale le patologie concomitanti polmonari^{5,6}. Il trattamento in questi casi può creare vari dilemmi al chirurgo che deve decidere se attendere oppure procedere all'intervento in urgenza. Da questo punto di vista mi trovo d'accordo con gli autori che hanno eseguito un intervento tempestivo sia in addome che in torace. Probabilmente in alcuni centri si sarebbe eseguita una laparoscopia esplorativa prima di effettuare la laparotomia, ma spesso le condizioni cliniche del paziente e l'esperienza di ogni singolo operatore condizionano la scelta dell'approccio chirurgico in urgenza⁷. In ogni caso è d'obbligo inserire il tubo di drenaggio toracico immediatamente dopo la diagnosi e quindi prima dell'intervento chirurgico all'addome per evitare la possibilità di uno pneumotorace ipertensivo.

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