**Abstract:** Introduction: Iatrogenic splenic injury is a recognized complication in abdominal surgery. The aim of this paper is to understand the medico-legal issues of iatrogenic splenic injuries. We performed a literature review on PubMed and Scopus using iatrogenic splenic or spleen injury and iatrogenic splenic rupture as keywords. Iatrogenic splenic injury cases were identified. Most cases were related to colonoscopy, but we also identified cases related to upper gastrointestinal procedures, colonic surgery, ERCP, left nephrectomy and/or adrenalectomy, percutaneous nephrolithotomy, vascular operations involving the abdominal aorta, gynecological operation, left lung biopsy, chest drain, very rarely spinal surgery and even cardiopulmonary resuscitation. There are several surgical procedures that can lead to a splenic injury. However, from a medico-legal point of view, it is important to assess whether the cause can be attributed to a technical error of the operator rather than being an unpredictable and unpreventable complication. It is important for the medico-legal expert to have great knowledge on iatrogenic splenic injuries because it is important to evaluate every step of the first procedure performed, how a splenic injury is produced, and whether the correct treatment for the splenic injury was administered in a judgment.

**Keywords:** Spleen laceration; Spleen rupture; Splenectomy; Iatrogenic splenic injury; Professional liability; Colonoscopy

**1 Introduction**

Iatrogenic splenic injury is a recognized complication in abdominal surgery that results in an increased risk of morbidity and mortality, increased operation time, and a longer hospitalization [1,2]. Numerous risk factors are associated with iatrogenic splenic injury, such as previous surgery, adhesions, underlying pathology, morbid obesity, advanced age and location of primary incision (exposure of the left upper quadrant) [3]. It is also important to know how this type of injury is produced to evaluate medical professional liability. Therefore, in many cases, a splenectomy is required after an injury and can cause permanent impairment. The aim of this review is to evaluate cases of iatrogenic injury of the spleen and analyze the related medico-legal cases.

**2 Methods**

A review of the literature on iatrogenic splenic injuries was conducted. The research was performed using PubMed and Scopus with the following keywords:

- iatrogenic AND spleen OR splenic AND injuries OR injury
- iatrogenic AND splenic OR spleen AND rupture

Furthermore, scientific articles were identified using the reference lists of eligible studies or articles citing the eligible studies.

To include papers in our review, we decided to employ the subsequent criteria:

1. papers written in English;
3 Results

We identified 55 papers reporting 88 cases according our criteria. Colonoscopy was the procedure most related to spleen injury, but cases related to upper gastrointestinal procedures, colonic surgery, ERCP, left nephrectomy and/or adrenalectomy, percutaneous nephrolithotomy, vascular operations involving abdominal aorta, gynecological operation, left lung biopsy, chest drain, very rarely spinal surgery and even cardiopulmonary resuscitation were also described. The management of splenic injury included splenectomy (n.=57) and conservative treatment (n.=30). The cases are summarized in Table 1.

4 Discussion

The spleen is situated in the left upper quadrant running along the 9th rib, and it is surrounded by a peritoneal capsule [59]. The spleen’s function is not fully understood; however, it is important in circulatory filtration, immune responses, hemopoiesis, iron reutilization, and blood and immune cell reservoir function [59]. The spleen represents the largest accumulation of lymphoid tissue in the body [59]. Cassar et al., defined iatrogenic splenic injury as any unintentional damage caused to the spleen by the surgeon or the assistant(s) during a surgical procedure [1]. The true incidence of iatrogenic splenic injuries is difficult to assess due to variability in reporting and documentation [1, 60]. In the literature, iatrogenic splenic injuries have been reported after various surgical procedures, such as upper gastrointestinal procedures, colonic surgery, colonoscopy, ERCP, left nephrectomy and/or adrenalectomy, percutaneous nephrolithotomy, vascular operations involving abdominal aorta, gynecological operation, left lung biopsy, chest drain and very rarely spinal surgery [4-59, 61-64]. These injuries are also described in cases of cardiopulmonary resuscitation [31, 65-67]. As noted in table 1, the procedure most related to iatrogenic splenic injury is colonoscopy; however, splenic injury is not a frequent complication of colonoscopy [34]. The risk factors for splenic injury during colonoscopy are categorized as patient and operator dependent. Patient associated risk factors include splenomegaly, adhesions between spleen and colon from prior surgery, neoplasm, and inflammation, such as diverticular disease, pancreatitis, inflammatory bowel disease, endometriosis, and infection (malaria, typhoid fever, Epstein-Barr virus-induced mononucleosis, anticoagulation) [68]. Operator-dependent risk factors include supine position, inexperienced operator, biopsy polypectomy, excess tractions, direct injury, and multiple previous colonoscopies [68]. In addition, various maneuvers during colonoscopy, such as hooking the splenic flexure to straighten left colon, applying external pressure on the left hypochondrium, slide by advancement and alpha maneuver, are risk factors for splenic injury [19, 68]. The significance of splenic injury and subsequent splenectomy during colon surgery has been well documented [69]. Merchea et al. performed a study on 13,897 colectomies and reported a total of 71 splenic injuries (0.42%), of which 44 (76%) required a splenectomy [60]. Masoomi et al., analyzed data from 975,825 individuals who underwent colorectal resection during the period of 2006 to 2008 and found that the rate of splenic injury was 0.96%, of which 84.75 were treated with splenectomy [2]. These iatrogenic injuries account for approximately 20% of all spleen procedures performed in the US [70]. According to Masoomi et al., the most common procedure associated with splenic injury is transverse colectomy [2]. During colectomy, the majority of splenic injuries are capsular tears due to traction [60]. An important risk factor is previous abdominal operations, which contribute to the presence of adhesions in the splenic region [60]. Finally, it must be highlighted that colonic surgery performed laparoscopically is less associated with splenic injury compared with laparothmic procedures [2, 71, 72]. Cases of splenic injury have also been described in upper gastrointestinal surgery [56]. Splenic injury is also a rare complication of ERCP [12,38,50]. The mechanism by which the injury is produced remains unclear, but it postulated that bowing of the endoscope in the long position with torsion on the greater curvature of the stomach plays a key role [12, 16]. In particular, this maneuver may cause splenic capsular tears or vascular avulsion by traction on the short gastric vessels [22,38]. In addition, increased manipulation resulting from difficulty accessing the ducts and a prolonged procedure resulting from activities, such as obtaining biopsies or brushings, are also potentially associated with increased risk of injury [16]. Furthermore, positioning a chest drain can produce splenic injury. This complication is typically related to a malpositioning of the intercostal chest drain [73] or percutaneous procedures, such as lung biopsy or nephrolithotomy. Kong et al. evaluated visceral injuries produced by misplaced intercostal chest drains and found that 6 out of 58 patients experienced a splenic injury (3 isolated splenic
Table 1: Cases selected from the literature

| Author                | Publication Year | Patient (age; sex) | Procedure                                                                 | Spleen Injury                                  | Treatment          |
|-----------------------|------------------|--------------------|---------------------------------------------------------------------------|------------------------------------------------|-------------------|
| Zappa et al. [4]      | 2016             | 73 M               | colonoscopy                                                               | grade III subcapsular hematoma                 | splenectomy       |
| Lahat et al. [5]      | 2016             | 61 F               | colonoscopy                                                               | splenic injury grade III                       | splenectomy       |
| Lahat et al. [5]      | 2016             | 68 F               | colonoscopy                                                               | splenic injury grade II                        | conservative      |
| Lahat et al. [5]      | 2016             | 85 M               | colonoscopy                                                               | splenic injury grade III                       | splenectomy       |
| Lahat et al. [5]      | 2016             | 54 F               | colonoscopy                                                               | splenic injury grade III                       | splenectomy       |
| Lahat et al. [5]      | 2016             | 65 F               | colonoscopy                                                               | splenic injury grade III                       | splenectomy       |
| Lahat et al. [5]      | 2016             | 61 F               | colonoscopy                                                               | splenic injury grade II                        | conservative      |
| Bogner et al. [6]     | 2015             | 38 M               | thoracoscopic corpectomy and replacement of the vertebral body            | rupture                                        | splenectomy       |
| Giri et al. [7]       | 2015             | 67 M               | open left nephrectomy                                                     | 2 cm long, 1 cm deep splenic tear              | conservative      |
| Giri et al. [7]       | 2015             | 58 M               | open left nephrectomy                                                     | 3 cm long, 1 cm deep splenic tear              | conservative      |
| Giri et al. [7]       | 2015             | 54 M               | open left nephrectomy                                                     | 3 cm long, 1 cm deep splenic tear              | splenectomy       |
| Giri et al. [7]       | 2015             | 64 F               | open left nephrectomy                                                     | 2 cm long, 2 cm deep splenic tear              | conservative      |
| Ridd et al. [8]       | 2015             | 69 F               | colonoscopy                                                               | large hematoma surrounding the spleen with capsular avulsion | splenectomy |
| Mulkerin et al. [9]   | 2015             | 64 M               | colonoscopy                                                               | large subcapsular hematoma                     | splenectomy       |
| Voore [10]            | 2015             | 52 F               | colonoscopy                                                               | hematoma                                      | splenectomy       |
| Angeli et al. [11]    | 2015             | 63 F               | colonoscopy                                                               | Laceration and decapsulation of the upper pole | splenectomy       |
|                      |                  |                    |                                                                           | subcapsular hematoma                           |                   |
| Grammatopoulos et al. | 2014             | 64 M               | ERCP                                                                      | rupture at the hilum                           | splenectomy       |
| Sevinc et al. [13]    | 2014             | 57 M               | colonoscopy                                                               | rupture                                       | splenectomy       |
| Brennan et al. [14]   | 2014             | 75 F               | colonoscopy                                                               | lower pole splenic laceration                 | conservative      |
| Gremida et al. [15]   | 2014             | 74 M               | colonoscopy and polypectomy                                               | sub-capsular splenic hematoma                  | splenectomy       |
| Weaver et al. [16]    | 2013             | 66 M               | ERCP                                                                      | rupture                                       | splenectomy       |
| Chow et al. [17]      | 2013             | 84 F               | colonoscopy                                                               | grade III or IV splenic laceration            | conservative      |
| Malik et al. [18]     | 2013             | 61 M               | colonoscopy                                                               | Grade III splenic lesion                      | splenectomy       |
| Malik et al. [18]     | 2013             | 46 F               | colonoscopy                                                               | Grade III splenic lesion                      | splenectomy       |
| Zandonà et al. [19]   | 2012             | 80 M               | colonoscopy follow-up and biopsies for colorectal neoplastic disease     | rupture of the splenic capsule                | splenectomy       |
| Asnis et al. [20]     | 2012             | 28 M               | elective splenectomy for massive enlarged spleen                         | following incision, huge abdominal bleeding    | splenectomy       |
|                      |                  |                    |                                                                           | due to splenic rupture                         |                   |
| Elessawy et al. [21]  | 2012             | 40 F               | laparoscopic excision of uterine myoma                                    | superficial tear of the capsule                | splenectomy       |
| Gaffney et al. [22]   | 2012             | 48 M               | ERCP                                                                      | Laceration with subcapsular hematoma           | conservative      |
| Authors                        | Year | Age | Procedure/Action                        | Findings                                      | Management          |
|-------------------------------|------|-----|-----------------------------------------|-----------------------------------------------|---------------------|
| Henneman et al. [23]          | 2012 | 44 F | laparoscopic Roux-en-Y gastric bypass    | subcapsular splenic hemorrhage                | conservative        |
| Garancini et al. [24]         | 2011 | 77 M | colonoscopy                             | complete laceration of splenic capsule        | splenectomy         |
| Darragh et al. [25]           | 2011 | 58 F | chest drain for a thick walled empyema in the left lung screening colonoscopy with polypectomy | chest drain traversing the spleen with associated hemorrhage | splenic laceration  |
| Pothula et al. [26]           | 2010 | 64 M | T12 corpectomy and fusion using a thoracoscopic approach laparoscopic left nephrectomy | rupture                                      | splenectomy         |
| Binning et al. [27]           | 2010 | 60 M | colonoscopy                             | rupture                                      | splenectomy         |
| Arruabarrena et al. [28]      | 2010 | 61 F | colonoscopy                             | rupture                                      | splenectomy         |
| Murariu et al. [29]           | 2010 | 55 M | colonoscopy                             | rupture                                      | splenectomy         |
| Desai et al. [30]             | 2010 | 62 M | percutaneous nephrolithotomy            | Nephrostomy tube through the spleen           | conservative        |
| Wind et al. [31]              | 2009 | 49 M | mechanical cardiopulmonary resuscitation | rupture found at the autopsy                 | none                |
| Kiosoglous et al. [32]        | 2009 | 47 F | colonoscopy                             | splenic tear                                 | splenectomy         |
| de Vries et al. [33]          | 2009 | 81 M | colonoscopy                             | large hematoma in the spleen                 | splenic embolization splenectomy |
| de Vries et al. [33]          | 2009 | 66 M | colonoscopy                             | hemorrhage                                   | splenectomy         |
| Kamath et al. [34]            | 2009 | 70 M | colonoscopy                             | splenic tear                                 | splenectomy         |
| Kamath et al. [34]            | 2009 | 56 M | colonoscopy                             | splenic laceration                           | splenectomy         |
| Kamath et al. [34]            | 2009 | 46 F | colonoscopy                             | splenic injury with hemoperitoneum            | splenectomy         |
| Kamath et al. [34]            | 2009 | 40 F | colonoscopy                             | splenic injury with hemoperitoneum            | splenectomy         |
| Kamath et al. [34]            | 2009 | 45 F | colonoscopy                             | splenic injury                               | splenectomy         |
| Kamath et al. [34]            | 2009 | 64 F | colonoscopy                             | splenic injury                               | splenectomy         |
| Kamath et al. [34]            | 2009 | 59 F | colonoscopy                             | splenic injury                               | splenectomy         |
| Kelly [35]                    | 2009 | 73 M | chest drain for a left-sided empyema thoracis | bleeding point in the spleen with surrounding hematoma | conservative        |
| Skipworth et al. [36]         | 2009 | 71 F | colonoscopy                             | shattered spleen                             | splenectomy         |
| Petersen et al. [37]          | 2008 | 65 M | colonoscopy                             | laceration                                   | splenectomy         |
| Petersen et al.[37]           | 2008 | 70 F | colonoscopy                             | laceration                                   | splenectomy         |
| Petersen et al. [37]          | 2008 | 38 M | sigmoidoscopy                           | hilar laceration                             | splenectomy         |
| Petersen et al. [37]          | 2008 | 72 F | colonoscopy                             | laceration                                   | splenectomy         |
| Petersen et al. [37]          | 2008 | 66 F | colonoscopy                             | capsule avulsion                             | splenectomy         |
| Petersen et al. [37]          | 2008 | 80 F | colonoscopy                             | capsule avulsion                             | splenectomy         |
| Petersen et al. [37]          | 2008 | 68 F | colonoscopy                             | capsule avulsion and tear in the lower pole  | splenectomy         |
| Petersen et al. [37]          | 2008 | 67 F | colonoscopy                             | capsule avulsion and tear                     | splenectomy         |
| Cho et al. [38]               | 2008 | 63 F | ERCP                                    | Laceration                                   | splenectomy         |
| Khan et al. [39]              | 2008 | 48 M | left lung biopsy                        | ruptured subcapsular splenic hematoma        | unavailable         |
Table 1 continued: Cases selected from the literature

| Authors          | Year | Age | Gender | Procedure | Description                                                                                           | Treatment  |
|------------------|------|-----|--------|-----------|--------------------------------------------------------------------------------------------------------|------------|
| Gayer et al.     | 2008 | 81  | F      | Left hemicolecction and omentectomy | one infarct containing tiny air bubbles                                                              | Conservative |
| Gayer et al.     | 2008 | 66  | F      | Total colectomy                      | a subcapsular collection                                                                               | Conservative |
| Gayer et al.     | 2008 | 81  | F      | Left hemicolecction                   | two infarcts                                                                                           | Conservative |
| Gayer et al.     | 2008 | 70  | M      | Anterior resection and subsequent repair of an anastomotic leak | a subcapsular collection                                                                               | Conservative |
| Gayer et al.     | 2008 | 67  | M      | Abdominoperineal resection of colon and colostomy | one infarct                                                                                           | Conservative |
| Heyworth et al.  | 2008 | 44  | F      | Thoracolumbar spinal fusion           | Intracapsular hematoma with extracapsular extension                                                   | Splenectomy |
| Di Lecce et al.  | 2007 | 82  | M      | Colonoscopy                          | Rupture                                                                                               | Splenectomy |
| Sin et al.       | 2007 | 52  | M      | Anterior L1-L2 corpectomy and fusion of osteomyekutus of the lumbar spine | Laceration                                                                                           | Splenectomy |
| Carey et al.     | 2006 | 52  | M      | Percutaneous nephrostolithotomy | Transsplenic percutaneous renal access                                                                | Conservative |
| Prowda et al.    | 2005 | 48  | F      | Colonoscopy                          | Subcapsular and perisplenic hematoma                                                                | Conservative |
| Goitein et al.   | 2004 | 39  | F      | Colonoscopy                          | Subcapsular and perisplenic hematoma                                                                | Conservative |
| Rinzivillo et al.| 2003 | 71  | M      | Colonoscopy                          | Capsular tear                                                                                         | Splenectomy |
| Kingsley et al.  | 2001 | 54  | F      | ERCP                                  | Approximate 6-cm tear towards the diaphragmatic face                                                  | Splenectomy |
| Chang et al.     | 2000 | 31  | F      | Laparoscopic salpingoplasty to correct bilateral hydrosalpinges and reform the fimbriated tubal ends | A small tear (3 cm long and 1 cm deep) with active bleeding in the inferior splenic tail | Conservative |
| Tse et al.       | 1999 | 67  | F      | Percutaneous renal surgery           | Capsular lesion                                                                                        | Splenectomy |
| Santiago et al.  | 1998 | 20  | F      | Percutaneous renal surgery           | Splenic hematoma                                                                                      | Conservative |
| Ahmed et al.     | 1996 | 72  | F      | Colonoscopy                          | Rupture                                                                                               | Splenectomy |
| Levine et al.    | 1987 | 62  | F      | Colonoscopy                          | Subcapsular and perisplenic hematomas and splenic laceration                                          | Splenectomy |
| Sagar et al.     | 1987 | 74  | M      | Benign esophageal stricture negotiated with a fine guide wire and dilated using a Celestin dilatator | Splenic hematoma                                                                                      | Conservative |
| Castelli         | 1986 | 71  | F      | Colonoscopy                          | Rupture                                                                                               | Splenectomy |
| Mearns et al.    | 1973 | 50  | F      | Pleural biopsy                        | Subcapsular hematoma with rupture near the upper pole and 1 to 4 cm track passing into the pulp       | Splenectomy |
injuries and 3 combined splenic and diaphragmatic injuries) [73]. Splenic injuries during left nephrectomy are also reported in literature. In 1996, Cooper et al. reported that 4.3% of left nephrectomies resulted in splenectomy [74]. In more recent papers, the rate was between 4.2% and 5.13% [7, 75]. In the case of thoracoscopic spinal surgery, the spleen can be vulnerable to iatrogenic injury due to its proximity to the thoracolumbar junction [6]. According to the American Association for the Surgery of Trauma (AAST), splenic injuries are classified as grade I) subcapsular hematoma <10% of surface area, capsular laceration <1 cm depth; grade II) subcapsular hematoma 10-50% of surface area; intraparenchymal hematoma <5 cm in diameter, laceration 1-3 cm depth not involving trabecular vessels; grade III) subcapsular hematoma >50% of surface area or expanding, intraparenchymal hematoma >5 cm or expanding, laceration >3 cm depth or involving trabecular vessels, ruptured subcapsular or parenchymal hematoma; grade IV) laceration involving segmental or hilar vessels with major devascularization (>25% of spleen); grade V) shattered spleen, hilar vascular injury with devascularized spleen [76]. The management of an iatrogenic splenic injury can be conservative or a splenectomy can be performed. The decision to attempt splenic salvage depends on the severity of the injury, the patient’s hemodynamic stability, and the surgeon’s experience [3]. The techniques used in conservative treatment include splenorrhaphy, topical hemostasis, suture repair, mesh repair and segmental resection [3]. Conservative management during laparoscopy can occasionally be arduous; therefore, recent advancements in surgical hemostatic agents have provided beneficial therapeutic alternatives [77]. In addition, radiofrequency fulguration has been used to achieve hemostasis to the spleen [78]. When it is not possible to salvage the spleen, a splenectomy must be performed. Splenectomy can be performed using either an open or laparoscopic method [79]. In many cases, as reported in table 1, a splenectomy is required. As described by Falsetto et al., splenectomy has its own early complications, such as 1) acute gastric dilatation, collapse of the left lung base and thromboembolic events; 2) blood loss requiring transfusions at an increased rate compared with patients who did not have a splenectomy; 3) infections [80]. After the surgical procedure, it should be noted that splenectomized patients are more susceptible to infections [postsplenectomy overwhelming infection (OPSI)] [81]. Finally, there are several surgical procedures that can lead to a splenic lesion; however, from a medico-legal point of view, it is important to assess whether the cause can be attributed to a technical error of the operator rather than an unpredictable and unpreventable complication of a particular surgical procedure. These considerations are important in the management of litigation for an iatrogenic splenic injury. To reduce claims, it is very important to correctly inform the patient of the risk of a splenic injury during a procedure and to describe every maneuver in the operation report.

### 5 Conclusions

Colonoscopy is the procedure most often associated with these injuries. However, these injuries may be observed in cases of upper gastrointestinal procedures, colonic surgery, ERCP, left nephrectomy and/or adrenalectomy, percutaneous nephrolithotomy, vascular operations involving the abdominal aorta, gynecological operation, left lung biopsy, chest drain, very rarely spinal surgery and even cardiopulmonary resuscitation. From a medico-legal point of view, iatrogenic splenic injury can represent a source of litigation. In the assessment of the possible liability of the physician, it is critical to evaluate the eligibility for the first intervention, the clinical status and patient characteristics before the intervention, and the technical execution of the procedure. Finally, in cases where a splenic injury has been determined, the indication for splenectomy or conservative treatment must be assessed because the treatment itself can determine some functional consequences for the life of the subject in addition to the risks and complications related with the splenectomy intervention itself.
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**References**

[1] Cassar K., Munro A., Iatrogenic splenic injury, J. R. Coll. Surg. Edinb., 2002, 47, 731-741

[2] Masoomi H., Caramichel J.C, Mills S., Ketana N., Dolich M.O., Stamos M.J., Predictive factors of splenic injury in colorectal surgery, Arch. Surg., 2012, 147, 324-329

[3] Merchant A., Bhanot P., Evans S.R.T., Management of intraoperative splenic injury, Operative Techniques in General Surgery, 2008, 4-10

[4] Zappa M. A., Aiolfi A., Antonini I., Musolino C.D., Porta A., Splenic rupture following colonoscopy: case report and literature review, Int. J. Surg. Case Rep., 2016, 21, 118-120

[5] Lahat E., Nepler A., Batumsky M., Shapiro R., Zmora O., Gutman M., Diagnosis and management of splenic injury following colonoscopy: algorithm and case series, Tech. Coloproctol., 2016, 20, 163-169

[6] Bogner R., H. Resch, Mayer M., Lederer S., Ortmaier R., Rupture of the spleen following thoracoscopic spine surgery in a patient with chronic pancreatitis, Eur. Spine J., 2015, 24, S569-S572

[7] Giri S.K., Abdelrahmam M., Flood H.D., Experience with endoscopic retrograde cholangiopancreography, Am. Surg., 2014, 80, e230-e231

[8] Chow M.D., Shih R. D., Acute Colonoscopy-Induced Splenic Rupture Presenting to the Emergency Department, Case Reports in Emergency Medicine, 2013, 3

[9] Malik H., Popovic D., Van Rooyen H., Post colonoscopy splenic injuries: case series and recommendations, J. Med. Cases, 2013, 11, 758-761

[10] Zandonà C., Turrina S., Pasin N., De Leo D., Medico-Legal consideration in a case of splenic injury that occurred during colonoscopy, J. Forensic Leg. Med., 2012, 19, 229-233

[11] Asnis J., Neustin S.M., General anesthesia complicated by perioperative iatrogenic splenic rupture, Middle East J. Anaesthesiol., 2012, 21, 619-622.

[12] Elessawy M., Schollmeyer T., Rajabi A., Wedel T., Mettler L., Jonat W., et al., Intraoperative splenic injury as a complication of the laparoscopic excision of uterine myoma, Asian Pacific Journal of Reproduction, 2012, 1, 320-322

[13] Gaffney R.R., Jain V., Moyer M.T., Splenic injury and ERCP: a possible risk for patients with advanced chronic pancreatitis, Case Rep. Gastroenterol., 2012, 6, 162-165

[14] Henneman D., Lagarde S., Geubbels N., Turrent S., Jansch S., Van Wagenveld B., Complications after laparoscopic Roux-en-Y gastric bypass: a diagnostic challenge. Report of three cases and review of the literature, G. Chir., 2012, 33, 209-217

[15] Garancini M., Maternini M., Romano F., Uggeri F., Dinelli M., Uggeri F., Are there risk factors for splenic rupture during colonoscopy? Case report and literature review, Gastroint. Dig. Syst., 2011, 1-6

[16] Harrag L., Clements W.D.B., An unusual iatrogenic splenic injury managed conservatively, Injury Extra, 2011, 42, 58-59

[17] Pothula A., Lampert J., Mazeh H., Eisenberg D., Shen H.Y., Splenic rupture as a complication of colonoscopy: report of a case, Surg. Today, 2010, 40, 68-71

[18] Binning M.J., Bishop F., Schmidt M.H., Splenic rupture related to thoracoscopic spine surgery, Spine (Phil Pa 1976), 2010, 35, e654-e656

[19] Arruabarrena A., Azagra J.S., Wilmart J.F., Bachner I., Manzoni D., Goergen M., Unusual complication after laparoscopic left nephrectomy for renal tumour: a case report, Videosurgery and other miniinvasive techniques, 2010, 5, 60-64

[20] Muraniu D., Takekawa S., Furumoto N., Splenic Rupture: A Case of Massive Hemoperitoneum Following Therapeutic Colonoscopy, Hawaii Med. J., 2010, 69, 140-141

[21] Desai A.C., Jain S., Benway B.M., Grubb R.L. III, Picus D., Splenic injury during percutaneous nephrolithotomy: a case report with novel management technique, Journal of Endourology, 2010, 24, s41-s45

[22] Wind J., Bekkers S.C.A.M., Van Hooren L.J.H., Complications after laparoscopic Roux-en-Y gastric bypass: a diagnostic challenge. Report of three cases and review of the literature, G. Chir., 2012, 33, 209-217

[23] Jonat W., et al., Intraoperative splenic injury as a complication of colonoscopy, J. Forensic Leg. Med., 2012, 19, 229-233

[24] De Vries J., Ronnen H.R., Oomen A.P., Linksken R.K., Splenic rupture following colonoscopy, a rare complication, J. Forensic Leg. Med., 2012, 19, 229-233

[25] Kamath A.S., Iqbal C.W., Sarr M.G., Cullinane D.C., Uggeri F., A rare iatrogenic splenic rupture following colonoscopy: a case report and literature review, Acta Radiologica Shorts Reports, 2014, 27, 117.1

[26] Skipworth J.R., Raptis D.A., Rawal J.S., Olde Damink S., Shankar A., Malago M., et al., Splenic injury following colonoscopy - an

[27] Cassar K., Munro A., Iatrogenic splenic injury, J. R. Coll. Surg. Edinb., 2002, 47, 731-741

[28] Masoomi H., Caramichel J.C, Mills S., Ketana N., Dolich M.O., Stamos M.J., Predictive factors of splenic injury in colorectal surgery, Arch. Surg., 2012, 147, 324-329

[29] Merchant A., Bhanot P., Evans S.R.T., Management of intraoperative splenic injury, Operative Techniques in General Surgery, 2008, 4-10

[30] Zappa M. A., Aiolfi A., Antonini I., Musolino C.D., Porta A., Splenic rupture following colonoscopy: case report and literature review, Int. J. Surg. Case Rep., 2016, 21, 118-120

[31] Lahat E., Nepler A., Batumsky M., Shapiro R., Zmora O., Gutman M., Diagnosis and management of splenic injury following colonoscopy: algorithm and case series, Tech. Coloproctol., 2016, 20, 163-169

[32] Bogner R., H. Resch, Mayer M., Lederer S., Ortmaier R., Rupture of the spleen following thoracoscopic spine surgery in a patient with chronic pancreatitis, Eur. Spine J., 2015, 24, S569-S572

[33] Giri S.K., Abdelrahmam M., Flood H.D., Experience with sliding-clip splenorrhaphy for splenic injury during radical nephrectomy, Can. Urol. Assoc. J., 2015, 9, e476-e479

[34] Ridd C.J., Campbell J., Garner J.P., Emergency splenectomy for traumatic splenic injury following colonoscopy, Trauma, 2015, 17, 79-80

[35] Mulkerin W., Mitarai T., Gharrabaghian L., Perera P., Splenic rupture diagnosed with bedside ultrasound in a patient with shock in the emergency department following colonoscopy, West. J. Emerg. Med., 2015, 16, 758-759

[36] Voore N., Unusual complication of colonoscopy, BMJ Case Rep., 2015, 1

[37] Angeli M.C., Fernandez O.A., Molina Y.A., Sampredo J.Q., Splenic injury after colonoscopy: two case reports and literature review, J. Gastric Disord., Ther., 2015, 1, 2015, 1-3

[38] Grammatopoulos A., Moschou M., Rigopoulou E., Katsoras G., Splenic injury complicating ERCP, Annals of Gastroenterology, 2014, 27, 1-2

[39] Sevinc B., Okus A., Ay S., Eryilmaz M. A., Karahan O., Splenic rupture after colonoscopy, Eur. J. Gen. Med., 2014, 11, 203 – 205

[40] Brennan I.M., Faintuch S., Sacks B., Superselective splenic artery embolization for the management of splenic laceration following colonoscopy, Acta Radiologica Shorts Reports, 2014, 4, 1-5

[41] Gremsida A.K., Chan M.Q., Hachem C.Y., Colonoscopy-Induced Splenic Injury: An Unusual Complication Warranting Urgent Attention, Journal of Medical Cases, 2014, 5, 541-544

[42] Weaver J.L., Jones W., Miller K.R., Life-threatening splenic rupture after endoscopic retrograde cholangiopancreatography, Am. Surg., 2014, 80, e230-e231

[43] Chow M.D., Shih R. D., Acute Colonoscopy-Induced Splenic Rupture Presenting to the Emergency Department, Case Reports in Emergency Medicine, 2013, 3
underdiagnosed, but soon to increase, phenomenon? Ann. R. Coll. Surg. Engl., 2009, 91, 6-11

[37] Petersen C.R., Adamsen S., Gocht-Jensen P., Amesen R.B., Hart-Hansen O., Splenic injury after colonoscopy, Endoscopy, 2008, 40, 76-79

[38] Cho C.L., Yuen K.K.Y., Yuen C.H., Chong L.C., Chu R.W.S., Splenic Laceration after endoscopic retrograde cholangiopancreatography, Hong Kong Med. J., 2008, 14, 145-147

[39] Khan S., Yousuf M.I., Bisharat M., Wali J., Iatrogenic splenic injury in percutaneous procedures, Ulster Med. J., 2008, 77, 131-132

[40] Gayer G., Galperin-Aizenberg M., Iatrogenic splenic injury in postoperative patients: a series of case reports, Emerg. Radiol., 2008, 15, 109-113

[41] Heyworth B.E., Schwab J.H., Boachie-Adjei O.B., Case reports: splenic rupture after anterior thoracolumbar spinal fusion through a thoracoabdominal approach, Clin. Orthop. Relat. Res., 2008, 466, 2271-2275

[42] Duarte C.G., Splenic rupture after colonoscopy, Am. J. Emerg. Med., 2008, 26, 117.e1-117.e3

[43] Lalor P.F., Mann B.D., Splenic rupture after colonoscopy, JSLS, 2007, 11, 151-156

[44] Di Leccce F., Viganò P., Pilati S., Mantovani N., Togliani T., Pulica J., Splenic rupture after colonoscopy: A case report and review of the literature. Chir. Ital., 2007, 59, 755-757

[45] Sin A., Smith D., Nanda A., Iatrogenic splenic injury during anterior thoracolumbar spinal surgery case report, J. Neurosurg. Spine, 2007, 7, 227-229

[46] Carey R.J., Siddiq F.M., Guerra J., Bird V.G., Conservative management of a splenic injury related to percutaneous nephrostolithotomy, JSLS, 2006, 10, 504-506

[47] Prowda J.C., Garrett Trevisan S., Lev-Toaff A.S., Splenic Injury After Colonoscopy: Conservative Management Using CT, Am. J. Roentgenol., 2005, 185, 708-710

[48] Goitein D., Goitein O., Pikarski A., Splenic rupture after colonoscopy, IMAJ, 2004, 6, 61-62

[49] Rinzivillo C., Minutolo V., Gagliano G., Minutolo G., Morello A., Scilletta B., et al., Splenic Trauma following colonoscopy, G. Chir., 2003, 24, 309-311

[50] Kingsley D.D., Schermer C.R., Jamal M.M., Rare complications of endoscopic retrograde cholangiopancreatography: two case reports, JSLS, 2001, 5, 171-173

[51] Chang M.Y., Shiau C.S., Chang C.L., Hou H.C., Chiang C.H., Hsieh T.T., et al., Spleen laceration, a rare complication of endoscopic retrograde cholangiopancreatography, Hong Kong Med. J., 2000, 159, 2071-2073

[52] Tse C.C.W., Chung K.M., Hwang J.S.T., Splenic injury following colonoscopy, HKMJ, 1999, 5, 202-203

[53] Santiago L., Bellman G.C., Murphy J., Tan L., Small bowel and splenic injury during percutaneous renal surgery, J. Urol., 1998, 159, 2071-2073

[54] Ahmed A., Eller P.M., Schifflman F.J., Splenic rupture: an unusual complication of colonoscopy, Am. J. Gastroenterol., 1997, 92, 120-1204

[55] Levine E., Wetzel L.H., Splenic trauma during colonoscopy, Am. J. Roentgenol., 1987, 149, 939-940

[56] Sagar P.M., Macfie J., Iatrogenic splenic trauma – a rare complication following esophageal dilation, Gastrointest. Endosc., 1987, 33, 333-334

[57] Castelli M., Splenic rupture: an unusual late complication of colonoscopy, CMAJ, 1986, 134, 916-917

[58] Mearns A.J., Iatrogenic Rupture of the spleen, Br. Med. J., 1973, 1, 395-396

[59] Lloyd D.M., Strickland A.D., Surgery of the spleen, Surgery, 2008, 10, 229-233

[60] Merchea A., Dozois E.J., Wang J.K., Larson D.W., Anatomic Mechanisms for splenic injury during colorectal surgery, Clinical Anatomy, 2012, 25, 212-217

[61] Eaton M.A., Valentine J., Jackson M.R., Modrall G., Clagett P., Incidental splenic injury during abdominal vascular surgery: a case controlled analysis, J. Am. Coll. Surg., 2000, 190, 54-64

[62] Urschel J.D., Complications of antireflux surgery. Am. J. Surg., 1993, 166, 68-70

[63] Nicklin J.L., Copeland L.J., O’Toole R.V., Lewandowski G.S., Vaccarello L., Havenar L.P., Splenectomy as part of cytoreductive surgery for ovarian carcinoma, Gynecol. Oncol., 1995, 58, 244-247

[64] Morris M., Gershenson D.M., Burke T.W., Wharton J.T., Copeland L.J., Rutledge F.N., Splenectomy in gynecologic oncology: indications, complications, and technique, Gynecol. Oncol., 1991, 43, 118-122

[65] Hashimoto Y., Moriya F., Furumiya J., Forensic aspects of complications resulting from cardiopulmonary resuscitation, Leg. Med. (Tokyo), 2007, 9, 94-99

[66] Helleuvel H., Sainio M., Nevalainen R., Huhtala H., Ollkka K.T., Tenhenun J., et al., Deeper chest compression - more complications for cardiac arrest patients?, Resuscitation, 2013, 84, 760-765

[67] Buschmann C.T., Tsokos M., Frequent and rare complications of resuscitation attempts, Intensive Care Med., 2009, 35, 497-404

[68] Fong H.J., Minchin D., Splenic Injury in colonoscopy: a review, Int. J. Surg., 2009, 7, 424-427

[69] Kastenmeier A., Ludwig K.A., Splenic Injury during colon surgery: a matter of technique?, Arch. Surg., 2012, 147, 329-330

[70] Stey A.M., Ko C.Y., Hall B.L., Louie R., Lawson E.H., Gibbons M.M., et al., Are procedures codes in claims data a reliable indicator of intraoperative splenic injury compared with clinical registry data?, J. Am. Coll. Surg., 2014, 219, 237-244

[71] Malek M.M., Greenstein A.J., Chin E.H., Nguyen S.Q., Sandler A.L., Wong R.K., et al., Comparison of iatrogenic splenectomy during open and laparoscopic colon resection, Surg. Laparosc. Endosc. Percutan. Tech., 2007, 17, 385-387

[72] Isik O., Aytac E., Ashburn J., Ozuner G., Remzi F., Costedio M., et al., Does laparoscopy reduce splenic injuries during colorectal resections? An assessment from the ACS-NSQIP database, Surg. Endos., 2015, 29, 1039-1044

[73] Kong V.Y., Clarke D.L., The spectrum of visceral injuries secondary to misplaced intercostal chest drains: experience from a high volume trauma service in South Africa, Injury Int. J. Care Injured, 2014, 45, 1435-1439

[74] Cooper C.S., Cohen M.B., Donovan J.F., Splenectomy complicating left nephrectomy, J. Urol., 1996, 155, 30-36

[75] Tan K., Lewis G.R., Chahal R., Browning A.J., Sundaram S.K., Weston P.M., et al., Iatrogenic splenectomy during left nephrectomy: a single-institution experience of eight years, J. Neurosurg. Spine, 2007, 7, 227-229

[76] AAST, Spleen injury scale (1994 revision). http://www.aast.org/library/traumatools/injuryscoringscales.aspx#spleen
[77] Humphreys M.R., Castle E.P., Andrews P.E., Gettman M.T., Ereth M.H., Microporous polysaccharide hemospheres for management of laparoscopic trocar injury to the spleen, Am. J. Surg., 2009, 195, 99-103

[78] Jarry J., Bodin R., Claverie D., Evrard S., Radiofrequency fulguration of the spleen under laparoscopy to stop iatrogenic hemorrhage, Surg. Endosc., 2012, 26, 1163-1164

[79] Strickland A.D., Lloyd D.M., The spleen and indications for splenectomy, Surgery, 2007, 25, 98-101

[80] Falsetto A., Della Corte M., De Pascale V., Surfaro G., Cennamo A., Iatrogenic splenic injuries, Ann. Ital. Chir., 2005, 76, 175-181

[81] Okabayashi T., Hanazaki K., Overwhelming postsplenectomy infection syndrome in adults – A clinically preventable disease, World J. Gastroenterol., 2008, 14, 176-179