

# Splenic injury associated with colonoscopy in hospitalized patients: Incidence, risk factors, management, and outcome



## Authors

Herbert Koop<sup>1</sup>, Christoph Skupnik<sup>2</sup>, Torsten Schnoor<sup>3</sup>, Dirk Horenkamp-Sonntag<sup>2</sup>

## Institutions

- 1 Formerly Dept of Medicine and Gastroenterology, Helios Klinikum Berlin-Buch, Berlin, Germany
- 2 Techniker Krankenkasse, Hamburg, Germany
- 3 Referat Medizinrecht, Medizinischer Dienst Mecklenburg-Vorpommern, Stralsund, Germany

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## Corresponding author

Prof. Herbert Koop, Tölzer Str. 20, 14199 Berlin, Germany  
[prof.koop@t-online.de](mailto:prof.koop@t-online.de)

## ABSTRACT

**Background and study aims** The frequency of splenic injuries due to colonoscopy is largely unknown. Therefore, the aim of this study was to give estimate the risk for hospitalized patients.

**Patients and methods** Using the administrative database from a health insurance company with more than 10 million insured subjects, patients undergoing inpatient colonoscopy associated with a splenic injury within 2 weeks were retrieved from the administrative records based upon OPS (comparable to International Classification of Procedures in Medicine) and ICD-10 codes. In each case identified (n = 141), the individual course of the hospital stay was reconstructed and analyzed by two experienced physicians. Patients with overt other causes of splenic injuries (e.g. abdominal surgery, trauma etc.) were not further evaluated.

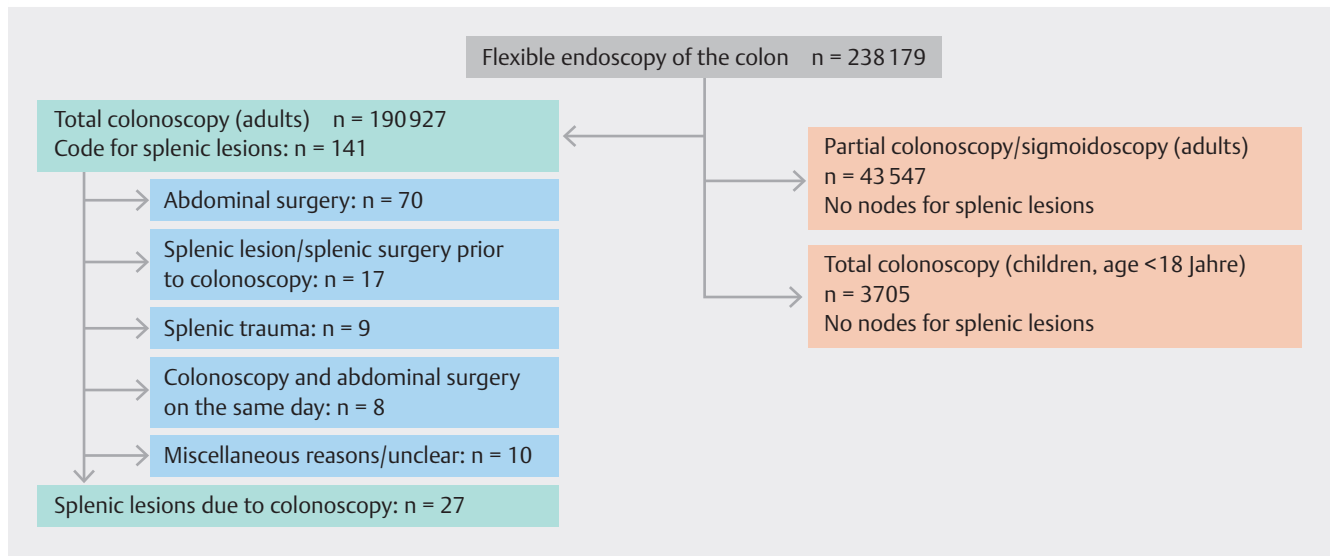
**Results** Among 190,927 total colonoscopies over a 5-year period, 27 splenic lesions were most likely solely due to colonoscopy. This accounts for 14.1 splenic injuries per 100,000 colonoscopies or one lesion in 7,071 patients. Afflicted patients were older and more likely to be female than male (risk in females: 1 in 5,324 colonoscopies). Surgical interventions were carried out in 17 cases, predominantly splenectomy (n = 15) whereas 10 events were managed conservatively. Transfusions and requirement for intensive care unit treatment were strong predictors of need for surgery. Most lesions (74%) were diagnosed within 48 hours after colonoscopy. Death occurred in two patients, but less likely directly due to the splenic injury.

**Conclusions** Administrative data analysis suggests that splenic injuries due to colonoscopy are more frequent than previously estimated. Endoscopists should be aware of this rare life-threatening adverse event.

## Introduction

Since its first description by Wherry and Zehner in 1974 [1], injury to the spleen associated with and probably caused by a colonoscopy has been reported in numerous case reports and

small series. Until 2016, a total of 172 cases had been reported in the literature [2]. However, the magnitude of this adverse event (AE) is largely speculative because individual case reports do not permit even a rough estimate of incidence. There have been attempts to calculate incidence of splenic injuries due to



► **Fig. 1** Selection process in patients with flexible endoscopy of the colon (for further details, see the study protocol).

the endoscopic procedure using registries, which have produced divergent results. The reported incidences range widely from one splenic alteration in 4,000 up to 87,000 colonoscopies, but in many instances, the underlying total population of colonoscopies was not well defined [3] or was based on extraction of case reports [4]; moreover, some analyses were restricted to selected populations such as outpatients [5, 6], those beyond age 66 [7], and patients aged at least 80 years [8]. Cortés et al [9] presented the largest study, based upon more than 2.2 million colonoscopies, with an incidence of one splenic injury per 9,400 colonoscopies. However, only lesions occurring within 2 days after the endoscopy were included, whereas concurrent abdominal surgery within this observation period as a possible cause of the splenic injury was ignored in their analysis.

Thus, the aim of the present study was to give a realistic estimate of splenic alterations associated with inpatient colonoscopy of different extents in real-world medicine using a large health insurance data base and, furthermore, to identify risk factors and treatment options during follow-up.

## Patients and methods

### Study cohort

Using a health insurance database of approximately 10.5 million insured patients [9], all patients who had undergone endoscopy of the colon (excluding endoscopy limited to rectum and anus) both as inpatients within the study period from January 2016 to December 2020 (► **Fig. 1**) were retrieved by specific OPS codes (German operation and procedure codes [OPS] equivalent to International Classification of Procedures in Medicine [ICPM] codes). To capture both complete and incomplete colonoscopies, colonoscopy was defined using billing codes for insertion of a flexible colonoscope to at least the sigmoid colon (Supplementary Table 1). To ensure that no intraop-

erative colonoscopies were captured, we excluded cases in which surgical polypectomy codes (resections during laparotomy/laparoscopy) were billed. Thereafter, patients with an ICD-10 diagnosis of a splenic injury parallel to the colonoscopy were identified (International Classification of Diseases [ICD] codes–10th revision, German version): the specific ICD code for a splenic injury S 360x, medically documented within the scope of patient billing, was used for operationalization in the study (Supplementary Table 2) as previously described [10].

In patients with a colonoscopy and concomitant splenic injury identified by the aforementioned selection process, the presumed cause of the splenic lesion was further evaluated by an experienced gastroenterologist (H.K.). In this first evaluation step, additional OPS and ICD codes during the hospital stay in each individual patient were carefully studied. This included analysis of the sequence of medical interventions because OPS codes are day-specific. This approach was necessary for reconstruction of each individual clinical course to give a clear picture of what had been happening to the patient during follow-up. Using this evaluation process, other causes of splenic alterations could be established, e.g. splenic surgery preceding the colonoscopy, splenic interventions occurring during abdominal surgery (concomitant OPS codes on the same day), splenic injuries in the context of trauma with additional traumatic injuries (ICD codes) or for other indications in the database (► **Fig. 1**). In case of a colonoscopy and abdominal surgery (overwhelmingly for colorectal cancer) being performed on the same day, the splenic lesion was attributed to the (more probable) operative procedure rather than colonoscopy. If a firm cause for splenic lesions could not be retrieved from the panel of codes in the first evaluation step, an additional evaluation was carried out by an experienced surgeon with additional profound knowledge of coding principles (T.S.). Patients with splenic lesions most unlikely due to a colonoscopy but with other overt causes were then excluded from further evaluation. In those patients

in whom the splenic injury occurred in the context of colonoscopy without any additional evidence for another cause, the splenic injury was regarded as a direct AE of the endoscopic procedure.

### Factors examined

In all patient groups, data on age and sex were collected. Subsequently, the interval between colonoscopy and the time of diagnostic procedures performed to clarify the suspected complication was recorded because it was impossible to rely on symptoms based upon the nature of the study. The date of diagnostic and therapeutic procedures is exactly documented in claims data by day-specific OPS codes during the course of the hospital stay. If the diagnosis of splenic injury was most probably made solely by ultrasound (which does not generate an OPS code), the interval could not be determined. Thus, it was possible to track precisely further interventions occurring during follow-up. Furthermore, additional necessities during the treatment, such as the frequency of transfusions, requirement for intensive care unit (ICU) therapy, and surgical procedures were identified by specific OPS codes.

### Statistical analysis

All statistical analyses were made using the *t*-test (age) and the  $\chi^2$ -test (gender) using the open source PSPP software from gnu.org.

## Results

During the study period, 238,179 endoscopic investigations of the colon ranging from sigmoidoscopy to ileoscopy were carried out in the cohort. It turned out that splenic injuries were not detected in 43,547 patients undergoing partial colonoscopy (extending beyond the splenic flexure) or sigmoidoscopy (► Fig. 1). Therefore, these patients were excluded from further analysis. Furthermore, complete colonoscopies were performed in 3,705 children in whom splenic injuries were not detected. Therefore, this cohort was also not subsequently evaluated.

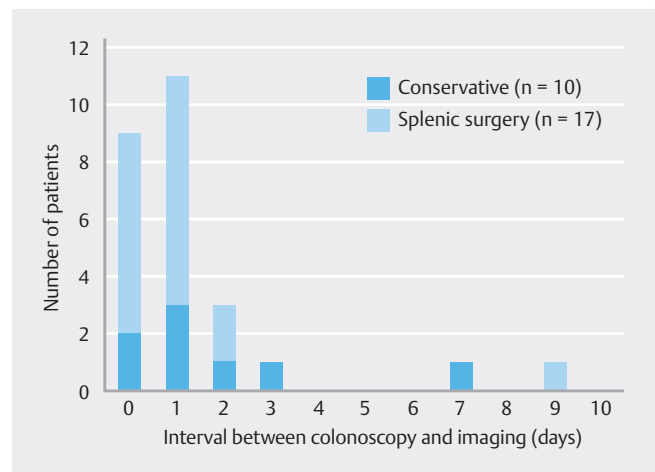
In the remaining cohort of 190,927 total colonoscopies in adults, a total of 141 splenic injuries in close timely connection to a colonoscopy were documented (► Fig. 1). Further analysis showed that most splenic injuries occurred during surgical procedures, predominantly colorectal surgery performed during the same hospital stay as colonoscopy but also in the context of other surgical procedures on the gastrointestinal tract (e.g. gastric and pancreatic surgery). Additional causes such as trauma also contributed to splenic injuries. This finally resulted in 27 colonoscopies that were most likely causally associated with spleen injuries. In eight of 27 patients, endoscopic interventions (e.g. polypectomy) had been performed. The diagnosis of the splenic injury was made in 25 patients by computed tomography (CT), in one case by magnetic resonance imaging, and presumably in one case by ultrasound.

The demographic data from patients with presumed colonoscopy-induced splenic lesions are shown in ► Table 1 in comparison with the total cohort of hospitalized patients with a

► **Table 1** Demographic data from adult patients with complete colonoscopy.

	Patients with complete colonoscopy	Patients with colonoscopy-induced splenic injury
Total (n)	190,927	27
Male (n)	100,408 (52.6%)	10 (37%)
Female (n)	90,519 (47.4%)	17 (63%)*
Age male (years, mean)	65.4	69.1
Age female (years, mean)	62.6	66.1

\**P* < 0.05 vs. male patients.



► **Fig. 2** Time course for detection of splenic injuries after colonoscopy by radiological imaging. In one patient, the interval could not be established (see results section).

complete colonoscopy. Patients with splenic lesions were numerically older, and females were significantly more affected (► Table 1). Based upon the data obtained in the study, the estimated frequency of splenic lesions associated with a complete colonoscopy accounts for 14.1 cases per 100,000 colonoscopies or one splenic injury in 7,071 colonoscopies. According to these data, the estimated risk for a female patient to experience a splenic injury during colonoscopy (1 in 5,324 colonoscopies) was two times greater than for males (1 in 10,041).

The time course of diagnostic imaging for splenic injury (or surgery in 1 case) served as a marker for suspicious clinical symptoms (► Fig. 2): In the vast majority of patients with splenic injuries imaging techniques were initiated within 48 hours after the endoscopic procedure. In only two of 27 patients, CTs were performed 7 and 10 days after the colonoscopy. In one case, the interval between colonoscopy and diagnosis of the splenic lesions could not be determined, probably due to the diagnosis made by ultrasound (which does not generate an

► **Table 2** Frequency of intensive care unit (ICU) treatment and transfusion requirement.

	Patients requiring surgical therapy (n = 17)	Patients with conservative treatment (n = 10)
ICU treatment	16 (94 %)	3 (33 %)
Transfusions	13 (76 %)	0

OPS code) and subsequent conservative treatment (which also does not generate an OPS code). Surgical procedures were carried out in 17 patients (63%): 15 patients underwent splenectomy (in 2 cases after an unsuccessful spleen-preserving surgical approach), whereas in two patients, the spleen could be preserved with different procedures (fibrin glue, net implantation, stitching). Both ICU treatment and transfusion requirement (► **Table 2**) were strong predictors for necessity of surgical therapy. Ten patients were managed conservatively.

There were two deaths during the hospital stay in the study group: one death occurred 32 days after colonoscopy and conservative treatment of a subcapsular splenic hematoma in an 83-year old patient with severe comorbidities, whereas an 82-year old female suffering from an extensively advanced cancer of unknown origin (CUP) died 3 weeks after splenectomy.

## Discussion

There have been several attempts to calculate the frequency of splenic lesions due to colonoscopy; however, the true incidence and outcome could not be reliably determined because these calculations were based upon case reports or small series without proven characterization of the study cohort of total colonoscopies performed [11]. One previous study—although with another focus—reported on incidence of splenic injuries exclusively in outpatients using an approach similar to this study [5]; however, no further data were presented, e.g., on the time course, necessity of surgery, and outcome. Another study [9] in hospitalized patients, using a design similar to this study, evaluated splenic lesions within only 48 hours of colonoscopy but the study design reveals conceptual problems (abdominal surgery during the observation period as a major cause of splenic lesions not excluded) and the data presented are inconsistent (e.g. calculations). Furthermore, the splenectomy rate of 10% was unexpectedly low (> 50% surgical therapy in most reports [2, 4, 12] and this study).

The strength of this study is the large number of patients (approximately 200,000 hospitalized patients undergoing a colonoscopy) and the availability of additional data on the follow-up. Furthermore, each case was analyzed by a panel of experts, thus ensuring high quality of data evaluation which is clearly visible from ► **Fig. 1**. Because the number of subjects inscribed in the health insurance program accounts for almost 13% of the German population, results can be largely regarded as representative of German inpatients undergoing colonoscopy. Furthermore, due to the nature of the study, the results re-

flect real-world data without any interference from selection bias.

However, the study also has limitations. The analysis was based on a registry consisting of administrative data; codes for diagnostic and therapeutic procedures and diagnoses primarily used for reimbursement had to be translated back into the clinical course without access to clinical reports. Because two experienced physicians were involved in analysis of each individual case, correct interpretation was probably achieved in the vast majority of patients. Nevertheless, the quality of the coding remains an essential factor.

Limited endoscopy just reaching the sigmoid or transverse colon rarely seems to cause splenic injuries, if at all. However, because the number of patients in this group only accounts for approximately 43,000 patients, the incidence may be underestimated, though the risk is still probably very low. The number of children was too small to draw any conclusion about risk of splenic injuries during colonoscopy.

Frequency of splenic injuries in total colonoscopy determined in the present study (1 case in about 7,100 colonoscopies) is similar to reports involving inpatients. Singla et al [4] reported an incidence of one in 6,000 cases based upon a calculation of case reports, whereas Olaiya et al [8] reported a rate of one in 4,545 colonoscopies performed in octogarians. Cortés found an incidence of one in 9,400 colonoscopies [9]. Compared with inpatients, however, splenic injuries seem to be less common in outpatient colonoscopy, with an estimate of one in 22,000 cases [5], one in 50,000 [6], and one in 13,000 patients, the latter restricted to patients older than age 65 years [7]. Older age may be a risk factor, but due to the small number of patients with splenic injuries, the difference was not significant. It may be argued that concomitant diseases may be the driving factor contributing to increased risk of splenic injuries in older age. Which age-related conditions render the spleen more vulnerable requires additional studies. Nevertheless, the higher incidence of splenic injuries from colonoscopy in inpatients may result particularly from multimorbid patients who are very likely to undergo endoscopy predominantly under hospital conditions.

This study confirms numerous previous results that females are more prone to this AE than males [4, 11, 12, 13, 14, 15]: The risk of experiencing a splenic injury during colonoscopy was almost 2-fold greater for women than for men. The reason for the female preponderance still deserves a plausible explanation because it seems less probable that discussed risk factors, such as stretching the splenicocolic ligament [16] or external compression [17], play a major gender-related role. Anesthesia does not increase risk [5, 8]. Previous abdominal surgery has also been proposed to increase risk [18], but convincing evidence is still lacking. The latter hypothesis could not be evaluated in the present study because there was no access to health care data outside the study period. On the other hand, interventions such as polypectomy do not seem to increase risk of splenic lesions.

There is evidence that most patients with a splenic injury develop symptoms within approximately 48 hours [12]. Because symptom onset could not be identified in the present investigation due to the nature of the study, timing of diagnostic proce-

dures (almost exclusively by CT scan) was chosen for calculation of the interval between colonoscopy and diagnosis of splenic injury (although symptoms may have commenced earlier). Accordingly, in about 89%, the diagnosis was made within 48 hours, which is in line with previous studies. In very few cases, splenic injuries may, however, become symptomatic with some delay (> 5 days), confirming previous similar observations [19, 20].

Two-thirds of patients underwent surgery, with splenectomy being the predominant procedure, which is similar to published case series [13]. Spleen-preserving surgery was successful in only a few patients with minor injuries. Transfusion requirements and necessity of ICU treatment were strong predictors for splenectomy.

Nevertheless, in about one-third of patients with a splenic injury, a watch-and-wait strategy was successful for avoiding surgery, and this applies predominantly to cases with minor alterations of the spleen, such as a subcapsular hematoma. It cannot be overlooked that very few patients with such limited splenic injury were treated conservatively without generating OPS codes in the analysis because it applied to one patient.

There were two deaths, which would account for an a priori mortality of 5%. This correlates with previous calculations [4, 8]. However, the fatalities occurred in patients suffering from advanced metastatic disease or from severe concomitant diseases, and death occurred with substantial delay after colonoscopy; thus, a causal relationship between the colonoscopy-associated splenic injury and death is questionable. Meanwhile, the data support the hypothesis that a lethal outcome is probably predominantly restricted to multimorbid patients. Consequently, such patients need particular attention in follow-up after colonoscopy.

## Conclusions

In summary, splenic injuries due to colonoscopy – at least in inpatients – are definitively more frequent than previously reported; thus most hospital-based endoscopists will be confronted with this AE at least once during their career. Moreover, every gastroenterologist should be aware of and rule out this complication in patients with left upper abdominal pain and the Kehr's sign (left shoulder pain) after colonoscopy, as eminent physicians told us decades ago [21, 22].

## Conflict of Interest

The authors declare that they have no conflict of interest.

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