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Preservation of the superior rectal artery

Influence on postoperative morbidity in sigmoid resection for diverticular disease

Introduction

Anastomotic leak rate in sigmoidectomy varies between 5% and 15% [1–3]. Ischemia of the anastomotic region counts to the most meaningful factors, leading to anastomotic leakage. Therefore, the preservation of the anatomical blood supply of the rectum was investigated concerning its impact on anastomotic healing by several authors, commonly focusing on the inferior mesenteric artery (IMA, [4, 5]). Valdoni et al. first described the technique of sigmoidectomy with preservation of the IMA in 1972 [6]. The objective of the present analysis was to figure out, whether preservation of the superior rectal artery (SRA) contributes to a decrease in anastomotic leakage rate in sigmoidectomy for diverticular disease.

Materials and methods

Data collection was conducted according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement [7].

Inclusion criteria

Randomized and nonrandomized studies, reporting on the influence of preser-

vation or dissection of the superior rectal artery on anastomotic leak rate in sigmoidectomy for diverticular disease were included.

Exclusion criteria

Studies, giving no information on defined endpoints as well as studies dealing with alternate pathologies such as inflammatory bowel disease or colorectal cancer were excluded.

Outcomes

Primary outcome: anastomotic leak rate; secondary outcome: overall postoperative morbidity.

Search strategy

A systematic database search for all studies, comparing preservation or dissection of the superior rectal artery in sigmoidectomy for diverticular disease was conducted in PubMed and in the Cochrane library. A combination of the following search terms was used: sigmoidectomy,

diverticulitis, diverticular disease, superior rectal artery, vascular preservation, pedicle preservation, artery preservation. The “similar articles” function of PubMed was used, in order to extend potential hits. Moreover, references of relevant and eligible studies were screened for additional reports according to the objectives of the review.

Study selection

Two authors (SM and AA) independently assessed titles and/or abstracts of all identified reports and excluded those considered irrelevant. Afterwards, full-text papers were screened on their accordance to inclusion criteria. One author (SM) extracted data from the included studies and a second (AA) checked extracted data. Disagreements were discussed.

Data items

The following parameters were extracted from included studies: number of patients/intervention, year, study design, inclusion/exclusion criteria, indication

Table 1 Newcastle–Ottawa Scale for assessing methodological quality of nonrandomized studies

Author	Year	Selection				Comparability		Outcome assessment		
		1	2	3	4	5	6	7	8	Score (max 9 Stars)
Lehmann [5]	2011	*	*	–	*	*	*	*	–	6
Borchert [11]	2015	*	*	–	*	*	*	*	–	6
Sohn [12]	2017	*	*	–	*	*	*	*	–	6

The German version of this article can be found under <https://doi.org/10.1007/s00053-017-0212-x>.

Registration: The review is registered with the PROSPERO Database (<http://www.crd.york.ac.uk/prospero>). Registration Number: CRD42017077781

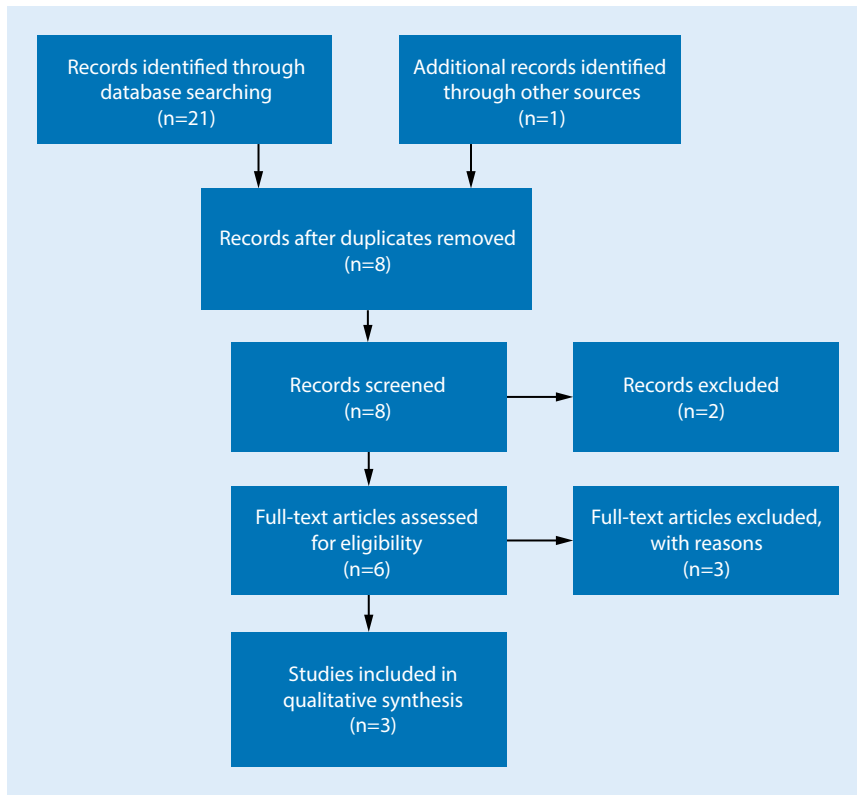


Fig. 1 ▲ Flow diagram for the different phases of the systematic review

Table 2 Studies excluded from the qualitative analysis			
Author	Year	Design	Reason for exclusion
Cirocchi [4]	2012	RV	Systematic review
Valdoni [6]	1972	RS	Variable: inferior mesenteric artery
Bergamaschi [13]	2003	RS	No control group, indication for surgery: rectal prolapse
Wakahara [14]	2015	RS	Indication for surgery: colorectal cancer
Trencheva [15]	2013	PONR	No differentiation of pathologies and results (CA, IBD, diverticular disease)

RV review, RS retrospective study, PONR prospective, nonrandomized observational study, CA carcinoma, IBD inflammatory bowel disease

Table 3 Current studies								
Author	Year	Design	N	Anastomotic leak rate (%)		p	Limitations	
				VR	VP			
Lehmann et al. [5]	2011	RS	44	48	3.7	6.5	0.610	No randomization
Borchert et al. [11]	2015	PONR	113	100	8	1	0.038	No randomization
Sohn et al. [12]	2017	RS	102	157	7	1.9	0.053	No randomization

RS retrospective study, PONR prospective nonrandomized observational study, VP vascular preservation, VR vascular resection

for the operation, surgical technique, definition of anastomotic leakage.

Assessment of study quality and risk of bias

The Newcastle–Ottawa Scale (NOS) was used to estimate the risk of bias of non-randomized studies ([8, 9]; ■ Table 1). NOS is a simple instrument, recommended within the Cochrane handbook for systematic reviews [10]. Construct validity and interrater reliability of NOS are well established. Quality assessment was based on three domains: patient selection, comparability of case and control group and assessment of outcomes. A maximum of one star could be allocated for each item in the categories “Selection” and “Exposure/Outcome”. “Comparability” could be labeled with two stars. Maximum score is nine stars.

Results

Using the described search strategy, 21 studies were selected from an overall number of 381 hits (■ Fig. 1). In all, 14 studies were excluded as duplicates after a review of title and abstract. The remaining eight studies were included into the detailed analysis. Therein, five more studies were excluded after full-text screening (■ Table 2). Thus, three studies were included into the qualitative analysis (■ Table 3). Two of them are retrospectively conducted and one has a prospective, but nonrandomized design. Overall, no randomized study could be identified. A total of 564 patients were investigated. Therein, SRA was preserved in 305 cases and sacrificed in 259.

Primary outcome

Exclusively, Borchert et al. demonstrate a significant reduction of anastomotic leak rate after a preservation of the SRA ([11]; ■ Table 3). The same, but without significant difference, was stated by Sohn et al. in 2017 [12]. This study is a multi-centric analysis, reporting on the highest number of patients with SRA preservation yet. Data were collected in three surgical centers. Overall, 267 patients

were included; a preservation of the SRA was performed in 157 cases. The analysis demonstrated a tendential reduction of anastomotic leak rate (SRA preservation: 1.9%, SRA dissection: 7%, $p = 0.053$). In contrast to these results, Lehmann et al. found a nonsignificant increase of anastomotic leaks after a preservation of the SRA. Data of 92 patients were retrospectively analyzed; in 48 cases, SRA was preserved (SRA preservation: 6.5%, SRA dissection: 3.7%, $p = 0.610$, [5]).

Secondary outcome

In the series of Lehmann et al., solely two cases of a temporarily retrograde ejaculation occurred. Both cases are associated with an arterial dissection [5]. Borchert et al. found a significant increase of wound dehiscence in case of a SRA dissection. Apart from that, no other differences arose, comparing postoperative complications [11]. Postoperative complications are equal in both groups within the analysis of Sohn et al.

Inclusion and exclusion criteria of all analyzed studies are depicted in [Table 4](#), technical aspects in [Table 5](#), and definitions of anastomotic leakage in [Table 6](#). Quality assessment of included studies according to the Newcastle–Ottawa scale was homogenous. All studies were rated with a maximum of six of possible nine stars. Deductions were found due to identical reasons in all studies. The parameter “Selection of controls” (Selection, No. 3) requires a control group out of the general population. Since controls are all hospitalized and had operations, requirements were not fulfilled. Within the category “comparability”, all studies were rated with one of two possible stars because a matched pair analysis is demanded for maximum appraisal. No included investigation could meet this requirement. A lacking statistic difference concerning the baseline characteristics does not qualify sufficiently. The parameter “non-response rate” in the category “assessment of outcome” (Assessment of outcome, No. 3) was achieved in no study.

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Preservation of the superior rectal artery. Influence on postoperative morbidity in sigmoid resection for diverticular disease

Abstract

Purpose. To evaluate the impact of the preservation of the superior rectal artery (SRA) in sigmoidectomy for diverticular disease on anastomotic leak rate and postoperative morbidity.

Materials and methods. A systematic literature search was conducted in MEDLINE/PubMed and Cochrane Library, according to the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) for the search items “sigmoidectomy”, “diverticulitis”, “diverticular disease”, “superior rectal artery”, “arterial preservation”. Inclusion criteria are: sigmoid colectomy for diverticular disease, comparison of a preservation and ligation of the SRA.

Results. Overall, inclusion criteria were fulfilled by three studies. Therein, a total

of 564 patients were analyzed. SRA was preserved in 305 patients and sacrificed in 259. One study demonstrated a significant reduction of the anastomotic leak rate in the arterial preservation group. One study showed a nonsignificant reduction of anastomotic leakages. In a third study, preservation of the SRA was associated with a no significant increase of leakages.
Conclusion. Preservation of the SRA seems to be associated with a positive influence on postoperative morbidity after sigmoidectomy for diverticular disease.

Keywords

Sigmoidectomy · Diverticulitis · Diverticular disease · Superior rectal artery · Arterial preservation

Erhalt der A. rectalis superior. Einfluss auf die postoperative Morbidität nach Resektion des Colon sigmoideum bei divertikelassoziierter Operationsindikation

Zusammenfassung

Ziel. Der Einfluss des Erhalts der A. rectalis superior (ARS) auf die Anastomoseninsuffizienzrate und postoperative Morbidität nach Sigmaresektion bei divertikelassozierten Operationsindikationen wurde überprüft.

Material und Methoden. Zur Identifikation entsprechender Studien erfolgte auf Grundlage des Preferred-Reporting-Items-for-Systematic-Reviews-and-Meta-analyses (PRISMA)-Statements eine systematische Literaturrecherche in den Datenbanken MEDLINE/PubMed und Cochrane Library nach den Stichwörtern „sigmoidectomy“, „diverticulitis“, „diverticular disease“, „superior rectal artery“, „arterial preservation“. Einschlusskriterien waren: Sigmaresektion bei divertikelassoziierter Operationsindikation, Vergleich von Erhalt und Durchtrennung der ARS.

Ergebnisse. Insgesamt wurden die Einschlusskriterien von 3 Studien erfüllt. Bei einer

Gesamtzahl von 564 analysierten Patienten erfolgte in 305 Fällen ein Erhalt und in 259 eine Durchtrennung der ARS. Eine signifikante Reduktion der Anastomoseninsuffizienzrate in der Gruppe mit Arterienerhalt wurde in einer Studie demonstriert. Eine Arbeit zeigte eine nichtsignifikante Reduktion der Insuffizienzrate. In einer weiteren Studie war der Arterienerhalt mit einer nichtsignifikanten Zunahme von Insuffizienzen assoziiert.
Schlussfolgerung. Der Erhalt der ARS scheint einen vorteilhaften Einfluss auf die postoperative Morbidität nach Sigmaresektion bei divertikelassozierten Operationsindikationen zu haben.

Schlüsselwörter

Sigmaresektion · Divertikulitis · Divertikelkrankheit · A. rectalis superior · Arterienerhalt

Table 4 Inclusion criteria	
Author	Inclusion criteria
Lehmann et al. [5]	<i>Pathology:</i> sigmoid diverticulitis <i>Surgical technique:</i> all patients with a resection of the sigmoid colon with formation of a colorectal anastomosis without additional enterostomy <i>Assessment on handling with the superior rectal artery:</i> decision on vascular preservation or dissection by the treating surgeon
Borchert et al. [11]	<i>Pathology:</i> diverticular disease <i>Surgical technique:</i> all patients with sigmoidectomy without additional enterostomy <i>Assessment on handling with the superior rectal artery:</i> decision on vascular preservation or dissection by the treating surgeon
Sohn et al. [12]	<i>Pathology:</i> diverticular disease/diverticulitis <i>Surgical technique:</i> all patients with laparoscopic sigmoidectomy without additional enterostomy <i>Assessment on handling with the superior rectal artery:</i> decision on vascular preservation or dissection by the treating surgeon

Table 5 Operative characteristics							
Author	Approach (%)			Anastomotic technique (%)		Setting (%)	
–	–	VP + VR		VP + VR	VP + VR		
Lehmann et al. [5]	Lap	41		Stapler	91	Emergency	13
	Open	54		Handsewn	7	Elective	87
	Conv	5		–	–	–	–
Borchert et al. [11]	–	VP	VR	p	–	–	
	Lap	10	13.3	0.518	No information		Emergency+elective, no assignment to VP or VR
	Open	76	77				
Conv	14	9.7					
Sohn et al. [12]	Lap	91.1	97.1	0.07	Stapler	100	Emergency+elective, no assignment to VP or VR
	Conv	8.9	2.9		Handsewn	0	

Lap laparoscopic, *Conv* conversion (laparoscopic → open), *VP* vascular preservation, *VR* vascular resection

Table 6 Definition anastomotic leak	
Author	Definition anastomotic leak
Lehmann et al. [5]	No explicit definition (clinical identification (reoperation) or radiological)
Borchert et al. [11]	No explicit definition (clinical identification (reoperation) or radiological)
Sohn et al. [12]	Explicit definition: (1) clinically as manifestation with fever, septicemia and abdominal pain/peritonitis and/or extravasation of bowel content and/or gas through drainage or wound, confirmed by radiographic analysis or digital rectal examination or endoscopy, (2) evidence of local peritonitis and/or leakage of bowel content and/or gas from the anastomosis into the abdomen or pelvis within reoperation. Radiologic signs of anastomotic leakage were surrounding gas and/or fluid collection as well as extraluminal detection of contrast agent after enema. Patients requiring antibiotics or percutaneous drainage for postoperative pelvic abscess or phlegmon were included in the anastomotic leak group

Discussion

To investigate the influence of preservation of the SRA on anastomotic leak rate and postoperative morbidity after sigmoidectomy for diverticular disease, a systematic review of the current specific literature was conducted. Overall, availability of data is weak. Three studies were included into the qualitative analysis. Extracted results are inhomogeneous (Table 3). One investigation showed a significant reduction of anastomotic leak rate in case of a vascular preservation, a second study demonstrated a tendential reduction of leaks, and a third was in line with a nonsignificant increase of anastomotic leakages. Altogether, a preservation of the SRA seems to have a positive effect on anastomotic healing. No investigation showed a significant negative influence. In 2012, Cirocchi et al. published the first systematic review and meta-analysis on the preservation of the inferior mesenteric artery, according to requirements of the PRISMA statement. After the selection process, four studies were included into the qualitative analysis, therein only one randomized [4]. Meta-analysis failed to demonstrate a significant influence of preservation of the SRA on anastomotic leak rates. However, within an individual consideration of the different studies, leak rate of the only randomized trial could be shown to be significantly lower after SRA preservation ($p = 0.03$, [16]). The authors discussed different definitions of anastomotic leaks and the low number of included studies as potential reasons for inhomogeneous results. In 2013, Trencheva et al. published results of a prospectively conducted, nonrandomized observational study [15]. The objective of this investigation was to identify predictors for the development of anastomotic leakages after colon and rectum resections. A total of 616 patients were included. No selection of the underlying disease was performed. A subgroup analysis showed that there was no significant influence between preservation ($n = 57$) and dissection ($n = 246$, $p = 0.219$) of the SRA on anastomotic leak rate. Bergamaschi et al. reported a 0% leak rate in a consecutive series of 30 patients after re-

section rectopexy with SRA preservation [13]. However, the study was retrospectively conducted and neither controlled nor randomized and thereby of low quality.

Apart from anastomotic leak rate, Sohn et al. found a significant reduction of the procedural length, which needs to be emphasized for patient and economic reasons. Short- and long-term follow-up, investigating postoperative functional aspects is lacking in all studies. Due to the risk of a potential damage of the hypogastric nerves, this aspect is of principal interest. The decreased risk of a nerve damage, resulting from tubular dissection of the mesocolon in case of arterial preservation could relevantly influence long-term function and thereby associated quality of life. Concluding, to date, evidence on the influence of SRA preservation or dissection on anastomotic leak rate in sigmoidectomy for diverticular disease is insufficient. Studies from Borchert and Sohn showed a positive influence. Since preservation of the superior rectal artery improves aboral blood supply of the anastomosis, and appropriate perfusion is crucial for anastomotic healing, SRA preservation generally should be intended. Additional reasons are the decreased risk of nerve damage with consecutively improved functional outcomes and shorter length of surgery. Due to a lack of randomization, a risk of bias is inherent. Moreover, definitions of anastomotic leakage were inconsistent. For these reasons, the level of evidence of included studies is limited. For appropriate assessment of the influence of a SRA-preserving technique, randomized studies must be performed.

Conclusion

Preservation of the SRA seems to have a positive effect on anastomotic leak rate. Therefore, vascular preservation is generally recommended in sigmoidectomy for diverticular disease. Due to the low number of available studies and the absolute lack of randomized trials, to date the level of evidence is relatively low.

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Compliance with ethical guidelines

Conflict of interest. M. Sohn and A. Agha declare that they have no competing interests.

This article does not contain any studies with human participants or animals performed by any of the authors. The ethical guidelines of the studies discussed in this article are provided in each study.

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