



Chronic Mesenteric Ischemia: Long Term Results after Open Surgical Revascularization

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Abstract

Objectives: Open Surgical Revascularization (OR) as well as Endovascular Revascularization (ER) is widely accepted therapeutic concepts concerning Chronic Mesenteric Ischemia (CMI). Nowadays an increasing number of patients are administrated to ER. To evaluate the significance of OR we analysed long-term outcomes in patients suffering from CMI in our hospital.

Methods: A retrospective single centre analysis of all patients, who underwent elective OR because of CMI between 2004 and 2016, was conducted based on quality control data. Primary outcomes were 30 day mortality and morbidity; secondary outcomes were survival, patency rates and symptom free survival from digestive disorders.

Results: Eighty-six vessels in 52 patients were revascularized. Number of treated patients per year remained similar during the observation period. The mean follow-up period amounted 58 ± 43 months. The 30 day mortality was 5,8%, the morbidity 21,1%. Five - year survival was 83,1%. The primary and secondary patency rates at 5 years were 77,0% and 91,5% respectively. Freedom from digestive symptoms at five years were achieved in 82,5% of the patients.

Conclusion: In accordance to international centre's OR offers improved rates of patency and long-term relief from digestive symptoms but is accompanied by a deterioration of morbidity and mortality. Nevertheless it remains necessary as a tailored approached therapy concept in a subgroup of patients suffering from CMI.

Keywords: Chronic mesenteric ischemia; Open surgical revascularization; Coeliac trunk; Superior mesenteric artery

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Introduction

Despite medical progress, the optimal treatment of Chronic Mesenteric Ischemia (CMI) remains controversial. Available options are the Open Surgical (OR) on the one hand and the Endovascular Revascularization (ER) on the other. Both therapy options are widely accepted in symptomatic patients, to avoid adverse complications like an acute mesenteric ischemia, which may cause bowel infarction and death. Nevertheless ER is rapidly rising due to its low in - hospital morbidity and mortality rates, while most centre's concerning OR a backup plan after failed interventional treatment. The international literature comprises a few series concerning the comparison between OR an ER for CMI, but large series studying long term outcomes associated with OR is rare. Recent meta analysis/reviews show lower in hospital complication rate after ER but decreased patency rates compared to OR, while both techniques comprises similar long - term survival rates [1-3]. Against this background we were lately wondering about the importance and necessity of OR nowadays. The purpose of this report was reviewing the experience with OR in patients suffering from CMI and its development in the course of time from a single centre view.

Methods

A retrospective analysis of all consecutive patients requiring surgical digestive revascularization for CMI between March 2004 and December 2016 was conducted. Patients' characteristics and data from in - hospital stay and of the patients were analysed from medical records. Inclusion criteria were patients with typical symptoms (postprandial abdominal pain, food fear, weight loss) and/or endoscopic signs of gastric or intestinal ulcerations in combination with an at least 70% or higher significant stenosis of one or more digestive arteries. Grad of stenosis was assessed by duplex ultrasound and CT angiography or contrast - enhanced MR angiography, whenever the

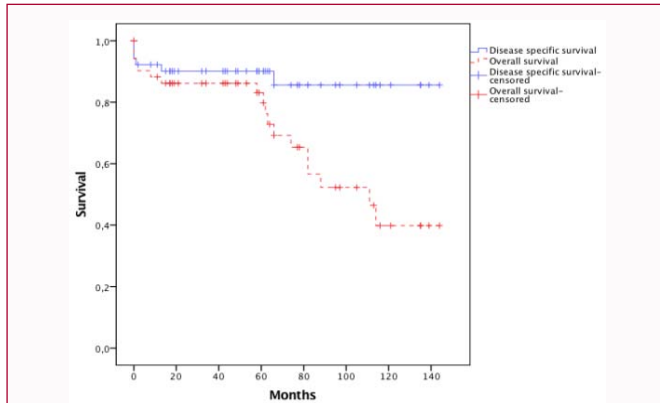


Figure 1: Overall and disease specific survival.

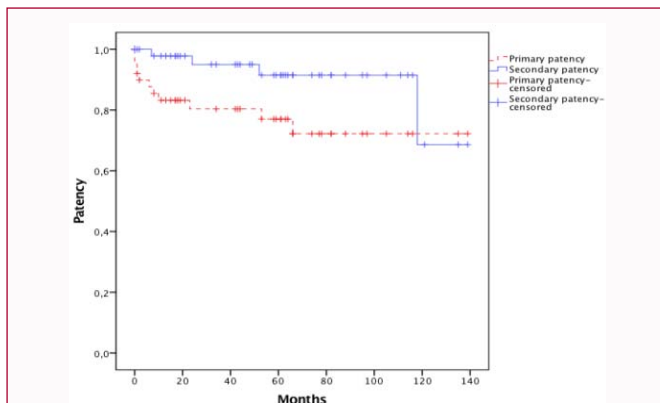


Figure 2: Primary and secondary Patency.

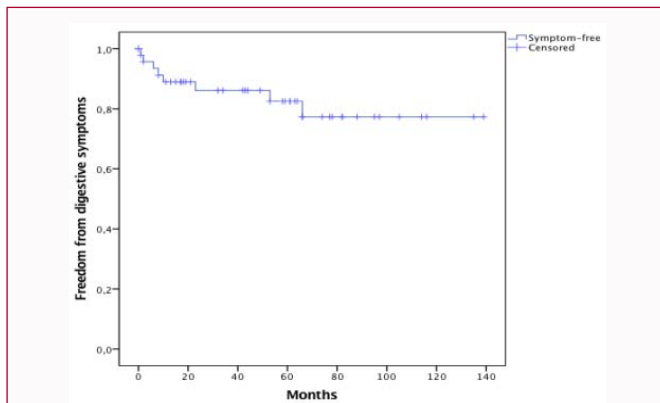


Figure 3: Freedom from digestive symptoms.

diagnosis was not clear additional digital subtraction angiography was performed. Preoperative demographic data, comorbidities and cardiovascular risk factors were recorded as well as performed surgical procedures. Peri - and postoperative complications were graded in accordance to Clavien - Dindo Classification [4]. Patients treated for arcuate ligament syndrome, non-occlusive visceral ischemia, acute or acute-on-chronic visceral ischemia and treatment in combination with another aortic procedure without CMI symptoms were excluded. Further exclusion criteria were prior operations of visceral arteries, high perioperative risk and contraindication for general anaesthesia. Follow-up examinations were conducted at 30 days, 6 months and annually thereafter. Duplex ultrasound was performed in each and CT angiography in non - conclusive cases. Survival, primary

Table 1: Patients' characteristics and risk factors.

Patients' characteristics		
Patients	n=52	%
Demographics data		
Age	62 ± 14	(mean ± SD)
BMI (kg/m ²)	21 ± 4	(mean ± SD)
Female Gender	30	57,7
ASA ^a classification ≥ 3	42	80,8
Symptoms		
Postprandiale pain	44	84,6
Weight loss	37	71,2
Food Fear	37	71,2
Gastric/intestinal ulcerations	11	21,2
Riskfactors		
Hypertension	38	73,1
Hyperlipidaemia	23	44,2
Coronary artery disease	18	34,6
Cardiac arrhythmia	11	21,2
Peripheral vascular disease	11	21,2
Chronic renal insufficiency	10	19,2
Diabetes mellitus Typ 2	9	17,3
Obstructive pulmonal disease	8	15,4
Current smoker	7	13,5

BMI: Body Mass Index; ASA: American Society of Anesthesiologists

and secondary patency as well as freedom from digestive symptoms were analysed. The total statistical evaluation was performed with Microsoft Excel und SPSS[®] Version 24.0. For categorical data results are presented as frequency distribution and percentage, while continuous data are show as mean ± SD. Survival, primary patency, secondary patency and freedom from digestive symptoms rates were calculated by Kaplan - Meier - method.

Results

Patients' characteristics: Fifty-two patients, 30 women and 22 men with a median age of 62 ± 14 years were included. Mean follow up was 58 ± 42 months; four patients were lost to follow-up. The numbers of treated patients per year remained approximately equal (~4 per year). Incidence of common cardiovascular risk factors were hypertension in 38 patients (73,1%), hyperlipidemia in 23 patients (44,2%), coronary artery disease in 18 patients (34,6%), cardiac arrhythmia and peripheral vascular disease in 11 patients (21,2%), chronic renal insufficiency in 10 patients (19,2%), diabetes mellitus in 9 patients (17,3%), pulmonary disease in 8 patients (15,4%) and current nicotine abuse in 7 patients (13,5%). Regarding typical symptoms, postprandial pain was present in 44 patients (84,6%), weight loss as well as food fear in 37 patients (71,2%) and gastric or intestinal ulceration in 11 patients (21,2%). Mean weight loss was 13 ± 8 kg. Mean preoperative body mass index amounted 21 ± 4 kg/m². An overview concerning demographic patient's data, symptoms and risk factors can be derived from (Table 1).

Perioperative Data: Numbers of pathological digestive arteries were one in 10 patients (19,2%), two in 30 patients (57,7%) and three in 12 patients (23,1%). The amount of treated arteries were one in 20 patients (38,4%), two in 30 patients (57,7%) and three in 2

Table 2: Extent of mesenteric disease and methods of reconstruction.

Extent of mesenteric disease and reconstruction		
patients/vessels	n=52/86	%
Extent of disease		
1- vessel- disease	10	19,2
2- vessel- disease	30	57,7
3- vessel- disease	12	23,1
Target vessel		
TC	36	41,9
SMA	47	54,6
IMA	3	3,5
Method of revascularisation		
Bypass aorto-TC	23	26,7
Bypass aorto- SMA	21	24,4
Reimplantation TC	3	3,6
Reimplantation SMA	16	18,6
Reimplantation IMA	1	1,2
TEA Truncus	10	11,6
TEA AMS	10	11,6
TEA AMI	2	2,3
Extent of revascularisation		
1-vessel- revascularisation	20	38,4
2- vessel- revascularisation	30	57,7
3- vessel- revascularisation	2	3,9

TC: Celiac Trunc; SMA: Superior Mesenteric Artery; IMA: Inferior Mesenteric Artery; TEA: Thrombendarterectomy

patients (3,9%) an overall of 86 vessels were revascularized. Extent of mesenteric disease and corresponding reconstruction are described in (Table 2). Type of performed operation were an aorto-TC bypass in 23 cases (26,7%), aorto-SMA bypass in 21 cases (24,4%), reimplantation of TC and SMA in 3 (3,6%) and 16 (18,6%) cases respectively, TC and SMA thrombendarterectomy each in 10 cases (11,6%) and AMI thrombendarterectomy in 2 cases (2,3%). One retrograde bypass was performed due to heavy calcification of the celiac part of the aorta, without technical possibility of safe clamping. Operation time was 136 ± 49 mins. Mean hospital stay and mean stay on the intensive care unit were respectively 11 ± 8 and 1 ± 8 days. Overall postoperative morbidity, according to the Clavien - Dindo - Classification stadium III or higher, amounted 21,1%, whereas 30 - day - mortality was 5,8% (Table 3). One patient died from bypass occlusion with consecutive bowel infarction on day 18. One patient due to duodenal perforation with massive gastrointestinal bleeding on day 20 and another one from heart failure on day 24.

Long term results: Overall Survival rate was 83,1% at 5 years, while disease specific survival rate (patients who have not died from CMI or a perioperative complication) was 90,1% at 5 years (Figure 1). Primary patency rate was 77,0% at 5 years, secondary patency rate was 91,5% at 5 years (Figure 2). Freedoms from digestive symptoms have been achieved in 82,5% at 5 years (Figure 3). Mean weight gain was 6 ± 7 kg.

Discussion

Diseases of the mesenteric arteries are relatively rare in comparison to other occlusive arterial entities. Therefore, prospective randomized

Table 3: Morbidity and mortality.

Perioperative complications (Clavien-Dindo ⁴ \geq stadium III)		
Patient	n=52	%
Complications overall	11	21,1
Myocardial infarction	0	-
Pleural effusion	1	1,9
Apoplex	0	-
Acute renal failure	3	5,8
Sepsis / Multiorgan failure	1	1,9
Mesenteric ischemia	1	1,9
Hemorrhage	3	5,8
Fascial dehiscence	1	1,9
Peritonitis	1	1,9
Mortality	pat. n = 52	%
30-day mortality	3	5,8
In-hospitalmortality	4	7,7

controlled studies concerning open surgical therapy especially in a long - term follow-up setting are rare or surprises weak numbers of patients. Subsequently the decision - making process is not sustained by strong evidence and numerous question (vascular accesses, surgical technique, types of revascularisation, source of inflow - vessel) remain unanswered. Treatment strategies on diseases of the mesenteric arteries and veins have been recently publish in 2017 by the European Society of Vascular Surgery (ESVS) and also comprise recommendations regarding patients suffering from CMI [6]. Most of the studies on treatment of CMI, especially those containing large numbers of patients report in hospital outcomes, while just a few series comprises long term data of performed mesenteric revascularisation [7,8]. Concerning the comparison between OR and ER for CMI even recent reviews were inhomogeneous. While all meta - analysis shown decreased patency rates of ER compared to OR and both techniques comprises similar long - term survival rates there are divergent descriptions about the in hospital stay [1,3]. While Pecorar et al. [3] stated a lower in hospital complication rate after ER in contrast to the findings of Seadon et al. [1] and Can et al. [2], the study group of Tallarita et al. [9] showed, by using propensity score match comparisons, that 5 year patient survival was not influenced by the type of revascularization (OR or ER). Decision making of patient administration to either OR or ER consequently requires large prospective randomized studies but remains unrealistic due to low incidence of chronic mesenteric ischemia and patients suitable for both types of repair. Nevertheless the purpose of this study was not to compare OR versus ER or establish a new administration - process to the one or the other type of revascularization, but to evaluate the long - term results and preferred technique of OR, which is described below. Allocation of patients to either open OR or ER in this study was based on an interdisciplinary team approach; we were able to report an approximately equal number of treated patients over the last 13 year with over 80% classified as ASA 3 or 4 and a mean age of 62 ± 14 years. Perioperative morbidity and mortality remains high after OR in comparison to ER amounting 13% to 42% and respectively 2% to 13%. The result a of the present study (morbidity 21,1% and mortality 5,8%) are therefore comparable to rates found in the international literature concerning outcomes of CMI after OR [9,11-25]. Even though they are hardly comparable towards morbidity given the fact, that their evaluation are inconsistent, because of heterogeneous

Table 4: Review of published series on open surgical treatment of chronic mesenteric ischemia.

Author, Year	Pat.	Vessels	Follow-Up		Mortality 30- days	Morbidity	Overall survival			Primary Patency			Secondary Patency			Freedom from symptoms		
			Median	Mean			1-year	2-year	5-year	1-year	2-year	5-year	1-year	2-year	5-year	1-year	2-year	5-year
Own data	52	86		58	5,8%	21,1%			83,1%			77,0%			91,5%			82,5%
Wagenhäuser 2017 [11]	100	160	35		5,0%	NA	85,0%		73,0%	NA			NA			NA		
Arya 2016 [13]	55	84		34,9	0,0%	18,1%	NA			92,0%			98,0%		83,0%			74,0%
Lejay 2015 [12]	86	132	82,8		3,5%	13,9%	NA					88,2%			93,6%			77,1%
Tallarita 2013 [9]	187	327	131		2,7%	NA			60,0%	NA			NA			NA		
Rawat 2010 [14]	40	75		41	13,0%	32,0%	85,0%		63,0%	81,0%		69,0%			89,0%	NA		
Oderich 2009 [15]	146	265	36		2,7%	36,0%			72,0%			88,0%			97,0%			89,0%
Davies 2009 [16]	17	44		34	6,0%	35,0%		86,0%			83,0%			100,0%	NA			
Zerbib 2008 [17]	15	21		21,5	0,0%	20,0%		64,0%			70,0%		NA				71,4%	
Atkins 2007 [18]	49	88		42	2,0%	22,4%		74,0%		96,0%				NA		91,0%		
Biebl 2007 [19]	26	30		25	8,0%	42,0%		69,0%			92,0%			NA				83,0%
Sivamurthy 2006 [20]	41	67	NA	NA	15,0%	46,0%		62,0%			83,0%		NA				59,0%	
English 2004 [21]#	58	80		34	29,0%	62,0%	NA					81,0%			89,0%			57,0%
Jimenez 2002 [22]	47	92		31	11,0%	66,0%			74,0%			69,0%			100,0%			92,0%
Park 2002 [23]	98	179	22,8		5,1%	NA	83,0%		63,0%	NA			NA			95,0%		92,0%
Cho 2002 [24]#	48	66		63	25,0%	60,0%			77%			57,0%		NA				79,0%
Kisirajan 2001 [25]	85	130		60	8,2%	32,9%			64,0%		76%*			NA				87%*

*Acute and chronic mesenteric ischemia; *3-year-rates; NA: Not Available

classification systems or different cutoffs in the same classification system. Actually there is no doubt about the superior durability of OR in comparison to ER but controversy remains about the extent of performed OR (single or multiple vessel - revascularisation). While some authors pointed out an positive impact of multiple vessel revascularisation on long - time freedom from digestive symptoms others could not recognize any significant difference in primary or secondary patency rates type of revascularization [11,12]. Depending on our own experience, we recommend a multiple - vessel approach if both, the TC and the SMA are involved. Even though we could not observe a difference in long - term follow-up between single or multiple vessel - revascularisation, we had at least two patients after 2 - vessel - revascularisation with an re - occlusion of the SMA but still patent TC, which had no signs of recurrent digestive symptoms and therefore weren't in need of any further interventions. Regarding the type of revascularization over the last years we have changed our concept from reimplantation of the TC or SMA to a mainly use of antegrade aorto - celiac/mesenterial - bypass implantation. Also there is no evidence in international literature, that the different types of revascularization have a significant influence on long - time patency rates, in the present study out of an overall of 11 occlusion 7 occurred in the reimplantation group (1x TC, 6x SMA) [11,12]. Which leads us to an primary patency rate of 77,0% at 5 years (72,2% at 10 years) and a secondary patency rate of 91,5% at 5 years (68,6% at 10 years). While international literature comprises primary and secondary patency - rates which vary between 57% and 88% for 5 - year primary and respectively 83% and 100% in terms of secondary patency rates [12-15,21,22,24]. Astonishingly in this study we could observe a deterioration of the secondary patency in comparison to the primary patency rate at 10 year, the cause was a late occlusion of an already operative revised reinserted TC 118 month after the initial operation. Also long-time - survival rates seems to be independent of type of revascularization. In this context several studies have reported long term results for CMI after OR with overall 5 - year - survival rates

between 64% and 77% [9,11,12,14,15,22-25] and 5 - year - freedom from digestive symptoms in 57% to 92% [12,13,15,21,23,24] which are comparable to our own data. A review regarding in - hospital and long - term results after open surgical treatment of CMI can be established from (Table 4). The present study has several limitations like its retrospective non - randomized single - centre character. To mention is also the long study period with approximately 4 patients operated on every year, due to the low incidence of symptomatic CMI. During this period of time there has been significant progresses' concerning medical, surgical a perioperative therapy that possibly could have affected patients outcomes. Furthermore the significance is limited by the size of the patient collective only 52 patient's respectively 86 revascularized vessels could be analysed. In long term follow - up the numbers of patients at risk is even smaller and could lead to a severe falsification like we discussed it previously with regards to primary and secondary patency - rates.

Conclusion

In accordance to international centre's OR offers improved rates of patency and long - term relief from digestive symptoms but is accompanied by a deterioration of morbidity and mortality. Nevertheless it remains necessary as a tailored approached therapy concept in a subgroup of patients suffering from CMI, given the fact, that the numbers of patients per year, in need of an OR, remained approximately equal. Furthermore we recommend fit patients with suitable anatomy to be considered for OR instead of a categorical administration to ER at first presentation. In accordance to our own data we prefer a multiple vessel revascularization using an antegrade aorto - celiac/mesenterial - bypass technique whenever possible.

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