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Original Article / Özgün Makale

The outcomes of prosthetic bypass grafting for chronic mesenteric ischemia

Kronik mezenter iskemide protez baypas greftleme sonuçları

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ABSTRACT

Background: This study aims to analyze early and late outcomes of the prosthetic bypass grafting procedure in the treatment of chronic mesenteric ischemia.

Methods: Twenty-two patients (15 males, 7 females; mean age 60±10 years; range, 32 to 78 years) who underwent prosthetic bypass grafting for chronic mesenteric ischemia due to atherosclerosis between March 2009 and March 2017 were included in this study. The demographic and operative data were analyzed retrospectively.

Results: The most common risk factors for atherosclerosis were hypertension, diabetes, and hyperlipidemia. A total of 72% of the patients were active tobacco users. The common symptoms were postprandial angina and weight loss. Six patients (27%) had a history of endovascular intervention for mesenteric revascularization. Celiac artery bypass grafting was performed in 17 patients, while superior mesenteric artery bypass grafting was performed in 21 patients. Retrograde bypass was done in all patients and polytetrafluoroethylene grafts were used in 20 patients (90%). The mean hospital stay was 10.5 days and the mean follow-up was 44.7 months. The most common postoperative complications were respiratory failure (9%) and infection (9%). In-hospital mortality was observed in one patient (%4.5)who had acute myocardial infarction-related low cardiac output. One patient had graft thrombosis resulting in early graft infection a month after discharge. Late graft thrombosis was observed in two patients at 44 and 85 months, respectively. Late mortality was observed in two patients due to malignancy and cerebral bleeding, respectively.

Conclusion: Prosthetic bypass grafting via open surgery for chronic mesenteric ischemia seems to be an effective treatment in long-term and can be implemented with low surgical risks.

Keywords: Atherosclerosis; chronic mesenteric ischemia; surgical bypass grafting.

ÖZ

Amaç: Bu çalışmada kronik mezenterik iskemi tedavisinde prostetik baypas greftleme işleminin erken ve geç dönem sonuçları analiz edildi.

Çalışma planı: Mart 2009 - Mart 2017 tarihleri arasında ateroskleroza bağlı kronik mezenterik iskemi nedeniyle prostetik baypas greftleme yapılan 22 hasta (15 erkek, 7 kadın; ort. yaş 60±10 yıl; dağılım, 32-78 yıl) çalışmaya dahil edildi. Hastaların demografik ve ameliyat verileri retrospektif olarak incelendi.

Bulgular: Aterosklerozun en yaygın risk faktörleri hipertansiyon, diyabet ve hiperlipidemi idi. Hastaların toplam %72'si aktif tütün kullanıcısı idi. En sık görülen semptomlar postprandiyal anjina ve kilo kaybı idi. Altı hastada (%27) mezenterik revaskülarizasyon için endovasküler girişim öyküsü vardı. On yedi hastada çölyak artere ve 21 hastada superior mezenterik artere baypas greftleme uygulandı. Tüm hastalarda retrograd baypas uygulanırken, 20 hastada (%90) politetrafloroetilen greft kullanıldı. Ortalama hastanede yatış süresi 10.5 gün ve ortalama takip süresi 44.7 ay idi. En sık görülen ameliyat sonrası komplikasyonlar solunum yetmezliği (%9) ve enfeksiyon (%9) idi. Ameliyat sonrası akut miyokard enfarktüsüne bağlı düşük kalp debisi olan bir hastada (%4.5) hastane içi mortalite gözlendi. Bir hastada taburcu olduktan bir ay sonra erken greft enfeksiyonuna bağlı greft trombozu gelişti. İki hastada sırasıyla 44. ve 85. aylarda geç greft trombozu gözlendi. Geç dönemde iki hastada sırasıyla kanser ve serebral kanama nedeniyle mortalite gözlendi.

Sonuç: Kronik mezenterik iskemide açık cerrahi ile prostetik baypas greftleme uzun dönemde etkili bir tedavi gibi görünmektedir ve düşük cerrahi risk ile uygulanabilir.

Anahtar sözcükler: Ateroskleroz; kronik mezenterik iskemi; cerrahi baypas greftleme.

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Atherosclerosis is the most common cause of cardiovascular death worldwide.[1] Although intestinal vascular network is rarely involved by atherosclerosis, it is the indicator of diffuse atherosclerotic disease. Postprandial angina and irrepressible weight loss are the most common symptoms. Only one of each 1,000 hospital admissions due to abdominal pain is caused by mesenteric ischemia.[2] Therefore, the diagnosis of the disease is often delayed, and patients are at a high risk at the time of intervention due to chronic malnutrition and related complications.[3]

Significant stenosis or occlusion of the celiac and mesenteric artery accompanying clinical symptoms requires an intervention for visceral reperfusion.[4] According to current practice, the usual first-line treatment for chronic mesenteric ischemia (CMI) is percutaneous approach, including balloon dilatation and stent implantation thanks to its lower peri-procedural mortality and morbidity.[5,6] In patients with a low operative risk and for vascular lesions which are not amenable to endovascular approach, surgical bypass grafting (SBG) of the celiac and/or superior mesenteric artery (SMA) and, in rare occasions, the inferior mesenteric artery (IMA) by autologous or synthetic materials is performed.

In the present study, we aimed to analyze early and late outcomes of the prosthetic bypass grafting procedure in the treatment of CMI.

PATIENTS AND METHODS

Twenty-two patients (15 males, 7 females; mean age 60±10 years; range, 32 to 78 years) who underwent prosthetic bypass grafting due to atherosclerotic involvement of the intestinal vessels between March 2009 and March 2017 were included in this study. The study was conducted in accordance with the principles of the Declaration of Helsinki. The demographic and operative data were collected retrospectively. Preoperative imaging was done by angiographic computed tomography (CT) scans (Figure 1a). The follow-up data regarding the clinical course of the patients were collected based on the hospital visits. Control CT scans were repeated periodically (Figure 1b).

Surgical technique

Transperitoneal approach through median laparotomy was performed in all patients. First, the distal part of the celiac artery (CA), mostly common hepatic artery, was explored and prepared for the bypass. Then, SMA was explored by the upward mobilization of the second part of the duodenum by freeing the ligamentum of Treitz. A segment of the SMA, long and large enough for the anastomosis was prepared. The infrarenal abdominal aorta or common iliac artery were used based on the vessel wall quality for the proximal anastomotic site. Polytetrafluoroethylene (PTFE) and Dacron grafts were used for the bypass procedure. The diameter

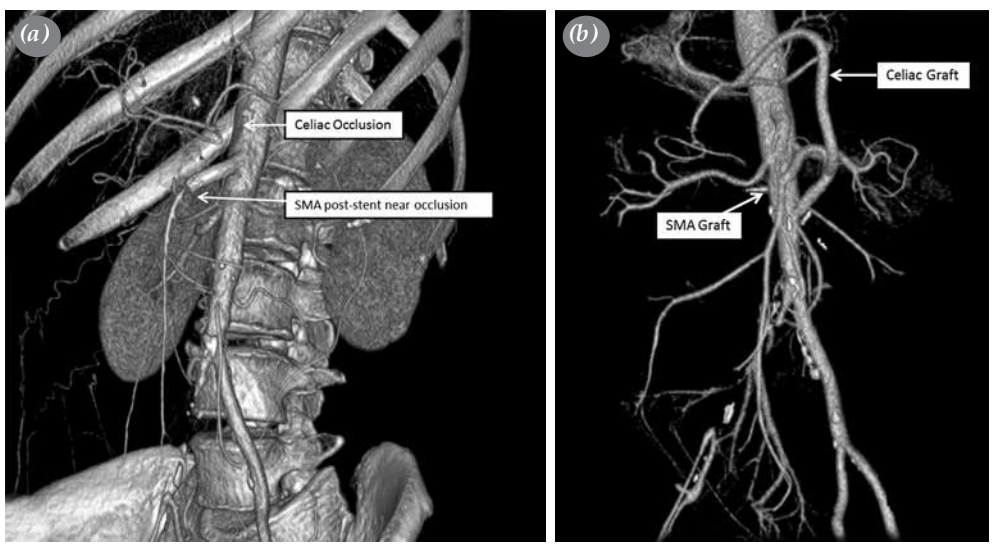


Figure 1. (a) A preoperative computed tomography scan of the patient with chronic mesenteric ischemia with previous superior mesenteric artery stenting. **(b)** A postoperative fourth month computed tomography scan of the patient. The Dacron graft of superior mesenteric artery and celiac arteries are patent.

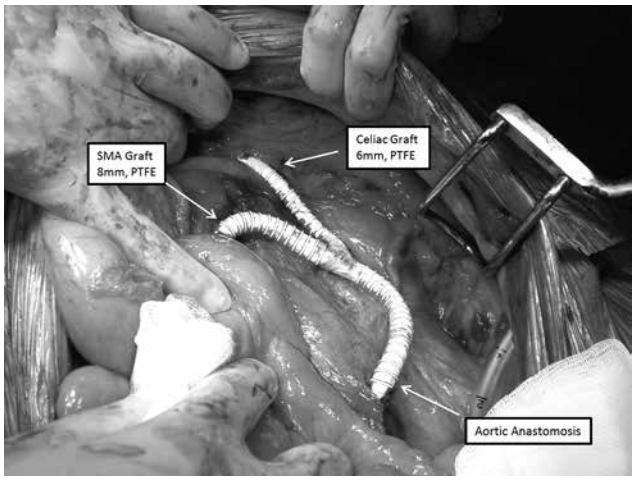


Figure 2. Common anastomosis technique of visceral bypass. An intraoperative view of the superior mesenteric artery and celiac grafts.

of the graft was chosen according to the target vessel diameter. The graft that was anastomosed to the CA was tunneled between the stomach and pancreas and usually anastomosed to the SMA graft, forming a Y graft. In rare occasions, the CA graft was anastomosed to the iliac artery as a separate graft. During distal anastomosis, target vessels were occluded for optimal exposure (Figure 2). The SMA graft was covered with retroperitoneum to prevent aorta from enteric fistulation. To prevent thrombotic events, combination of acetylsalicylic acid (100 mg) and clopidogrel (75 mg) or acetylsalicylic acid (100 mg) and rivaroxaban (20 mg) were given after the operation and prescribed to be taken in the long-term.

Statistical analysis

Statistical analysis was performed using the IBM SPSS for Windows version 22.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed in mean ± standard deviation (SD) when normally distributed. The categorical variables were expressed in numbers and percentage. Overall survival, symptom-free survival and/or graft thrombosis-free survival were analyzed using the Kaplan-Meier estimations.

RESULTS

The common symptoms were abdominal pain induced by feeding and weight loss. The most common risk factors for atherosclerosis were hypertension, diabetes, and hyperlipidemia. A total of 72% of the patients were active tobacco users. Six patients (27%) had a previous percutaneous intervention for mesenteric revascularization before the surgical procedure. The other characteristics are shown in Table 1.

Celiac artery bypass grafting was performed in 17 patients, while SMA bypass grafting was performed in 21 patients due to the occlusion or critical stenosis. No patients underwent IMA bypass. The PTFE grafts were used in 90% of the patients. Additional surgical procedures were aortobifemoral bypass grafting in one patient and left renal artery bypass in another. One patient had re-exploration for bleeding from the abdominal wall. Other surgical data are shown in Table 2.

The mean hospital stay was 10.5±3.7 (range, 5 to 20) days. The most common postoperative complications were respiratory failure and infection (9%). No early complications of gastrointestinal or vascular systems

Table 1. Baseline characteristics of the patients before surgical bypass grafting

Characteristics	n	%	Mean±SD
Age (year)			60±10.9
Gender			
Male	15	68	
Female	7	32	
Hypertension	12	54	
Diabetes	7	31	
Hyperlipidemia	8	36	
Active smoker	16	72	
Chronic renal insufficiency	2	9	
Peripheral arterial disease	6	27	
Coronary artery disease	7	31	
Previous endovascular procedure	6	27	

SD: Standard deviation.

Table 2. Operative data of the patients

Operative data	n	%
Target vessel		
Celiac only	1	4
Superior mesenteric artery only	5	22
Both	16	72
Prosthesis type		
Polytetrafluoroethylene	20	91
Dacron	2	9
Bypass type		
Retrograde	22	100
Graft diameter		
Celiac		
6 mm	11	64
8 mm	6	36
Superior mesenteric artery		
6 mm	12	57
8 mm	9	43
Source		
İnfrarenal aorta	8	36
Common iliac artery	14	64

were observed. In-hospital mortality was observed in one patient who had acute myocardial infarction immediately after the operation leading to low cardiac output. This patient died due to sepsis and multiorgan failure. One patient had graft infection resulting in early graft thrombosis a month after discharge. This patient underwent re-exploration due to abdominal abscess three months after the procedure and died due to intractable infection and sepsis.

The mean follow-up was 44.7±34 (range, 1 to 101) months. Late graft thrombosis was observed in two patients. One of them had thrombosis of both grafts (SMA and CA) leading to recurrence of symptoms. The other patient had thrombosis of the CA graft alone and still remained asymptomatic due to the patent SMA graft. Overall primary graft patency was 68% during long-term follow-up. Late mortality was observed in two (9%) patients. The causes were malignancy and cerebral bleeding. The causes of morbidity and mortality are shown in Table 3. The Kaplan-Meier estimates of overall survival, symptom-free and graft thrombosis-free survival are shown in Figure 3.

DISCUSSION

Chronic mesenteric ischemia is commonly caused by due to progressive occlusion secondary to atherosclerotic process.[2] Mesenteric circulation has three main arterial sources (CA, SMA, IMA) arising from the abdominal aorta. Two critical connections (pancreatico-duodenal and Bühler's arcade) between the CA and SMA, another two vascular arcade (Drummond and Riolan) between the SMA and IMA provide adequate blood supply for the intestinal system.[7] In case of simultaneous obstruction of two of these main vessels, symptoms of intestinal ischemia may occur and result in chronic malnutrition and critical weight loss. In this study, acute mesenteric events were excluded and patients with CMI due to atherosclerosis were analyzed to provide a homogenous group.

Percutaneous interventions are usually preferred as the first-line treatment for many reasons such as less complications, early post-procedural recovery, short hospital stay, and low-risk of mortality.[8]

Table 3. Postoperative early and late complications of visceral bypass

Results	n	%	Mean duration	Min-Max	Details
Mean hospital stays (days)			10.5	5-20	
Cardiac complications	1	4			AMI
Pulmonary complications	2	9			Pneumonia
Infective complications	2	9			Pneumonia graft infection
Renal complications	1	4			Temporary hemodialysis
Graft thrombosis					
Early	1	4			Due to graft infection
Late	2	9			Unknown
Graft infection	1	4			
Duration of follow-up (months)		NA	44.7	1-101	
In-hospital mortality	1	4			Multiorgan failure due to AMI
Late mortality	3	13			Sepsis, cranial bleeding, cancer

Min: Minimum; Max: Maximum; AMI: Acute myocardial infarction; NA: Not applicable.

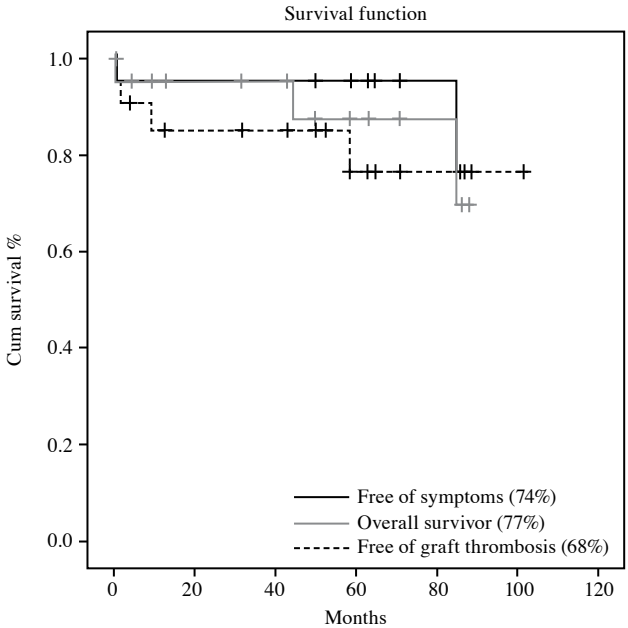


Figure 3. Kaplan-Meier estimates of overall survival, recurrent symptoms, and graft thrombosis following visceral bypass.

In 2009, Schermerhorn et al.[9] analyzed the outcomes of the mesenteric revascularization in the United States. The subgroup analysis of CMI showed that overall mortality (3.7% vs 15%) and morbidity (20% vs 38%) were lower with the percutaneous approach. Although, early outcomes such as patency and relief of symptoms were satisfactory following endovascular treatment, the risk of symptom recurrence and re-intervention for restenosis were found to be higher at long-term period.[7,8] This therapy seems to be the most optimal option for high-risk patients with severe malnutrition or multiple co-morbidities.[10] In addition, if anatomic features of the lesion are suitable, percutaneous approaches are preferred performed as bridging therapy, before open repair in low-risk group. Blauw et al.,[7] suggests that surgical revascularization should be used in low-risk patients in case of unfavorable anatomy, failing percutaneous intervention, and multiple recurrent stenoses. However, it should be kept in mind that the possibility of successful revascularization of both CA and SMA in a single session is quite low by percutaneous intervention, and the symptoms of patients may persist.[11] In our group, six patients (27%) had a history of endovascular intervention. We believe that, in suitable cases, endovascular approach should be considered as the first-line treatment.

To date, many studies were published comparing the early and late outcomes of endovascular treatment and SBG.[6,8-13] Nevertheless, these studies have received criticism due to their observational and non-randomized nature, and lack of direct comparison of patients due to rarity and the heterogeneity of the disease. In the literature, long-term results were analyzed in only few reports.[6,8,10,11,13] One of them is a meta-analysis published by Saedon et al.,[6] including 12 studies (a total of 4,255 patients in the endovascular arm and 3,110 patients in the surgical arm) about endovascular versus surgical revascularization for CMI. The authors concluded that short-term outcomes (mortality and morbidity) were similar in both groups, and surgical bypass was superior in terms of long-term patency. Similarly, Oderich et al.,[8] in their comparative study, found that the rate of freedom from symptoms was 89% at five years in the SBG group, but 51% in the endovascular group. Additionally, this study showed that the primary patency rate was evidently better (88% vs 41%) in the SBG group at five years. However, postoperative recovery was prolonged and early mortality risk was higher following SBG. Therefore, in another study, Pecoraro et al.[10] suggested that SBG should be only considered in patients with a low operative risk and long-life expectancy. Our current practice is also to perform SBG in case of inappropriate anatomic features for endovascular interventions and stent restenosis, irrespective of the risk scale for surgery.

Surgical bypass grafting techniques differ in terms of incision, graft choice, type of bypass, and number of vessels. Transaortic or selective endarterectomy, splenic artery-to-SMA bypass, and SMA re-implantation can be used for revascularization.[11,14,15] However, surgical experiences were reported as rare cases rather than case series, and long-term results are still uncertain. Antegrade bypass from the supraceliac aorta or retrograde bypasses from the infrarenal aorta or iliac arteries were preferred by many surgeons. However, the exposure of the supraceliac aorta requires extensive dissection and retraction. Therefore, we prefer retrograde bypass technique by transperitoneal incision to shorten the duration of operation by minimizing surgical trauma and related complications.

Another debate is about the selection of the most appropriate graft for the bypass procedure. Autologous or prosthetic grafts were reportedly used for mesenteric revascularization. Vein grafts larger than 4 mm in diameter, namely great saphenous veins or superficial femoral veins, were mostly used in the literature.[3,16] The disadvantages of the vein grafts, however, are the size and the risk of kinking.[15] A vein with a small diameter may not feed the need of the intestinal

vascular bed. Interestingly, the study of Davenport et al.,[16] showed that, in the vein group, the risk of bowel resection, sepsis, systemic inflammatory response syndrome, and mortality was higher than the prosthetic group. However, they reported that the patients in the vein group had more contaminated field due to bowel infarction causing selection bias towards non-prosthetic material. Other options are PTFE and Dacron materials. Kruger et al.,[3] in their report, analyzed 39 patients with 67 bypasses by polyester, PTFE, and vein grafts. However, the authors found no differences in the outcomes related to graft selection and configuration (antegrade vs retrograde). In another study, Illuminati et al.,[17] published a series of 24 patients who underwent only prosthetic bypass grafting with PTFE or Dacron by retrograde anastomosis. The graft patency and freedom of symptom recurrence was found 87% at 60 months. In line with this article, we preferred using the PTFE grafts (with external ring) in most of the patients (90%) and Dacron grafts in two patients (10%) in case of unavailability of the PTFE graft. The graft patency was found 68% throughout 100-month follow-up. To the best of our knowledge, the effects of the graft choice and surgical technique on the long-term outcomes were not clear in the current literature.

Nonetheless, this study is limited by being retrospective in design, relatively small sample size, and lack of a comparative group. Additionally, the analysis of the effect of surgical strategies on clinical outcomes was unable to be performed due to low number of events.

In conclusion, based on our study results, SBG seems to be an effective treatment of CMI, which can be implemented with a low risk of complications and long-term patency.

Declaration of conflicting interests

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REFERENCES

1. Available at: http://www.who.int/cardiovascular_diseases/en/
2. Clair DG, Beach JM. Mesenteric Ischemia. N Engl J Med 2016;374:959-68.
3. Kruger AJ, Walker PJ, Foster WJ, Jenkins JS, Boyne NS, Jenkins J. Open surgery for atherosclerotic chronic mesenteric ischemia. J Vasc Surg 2007;46:941-5.
4. Aboyans V, Ricco JB, Bartelink MEL, Björck M, Brodmann M, Cohnert T, et al. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS): Document covering atherosclerotic disease of extracranial carotid and vertebral, mesenteric, renal, upper and lower extremity arteriesEndorsed by: the European Stroke Organization (ESO) The Task Force for the Diagnosis and Treatment of Peripheral Arterial Diseases of the European Society of Cardiology (ESC) and of the European Society for Vascular Surgery (ESVS). Eur Heart J 2018;39:763-816.
5. Blauw J, Bulut T, Eenhoorn P, Beuk RJ, Brusse-Keizer M, Kolkman JJ, et al. Chronic mesenteric ischemia: when and how to intervene on patients with celiac/SMA stenosis. J Cardiovasc Surg (Torino) 2017;58:321-8.
6. Saedon M, Saratzis A, Karim A, Goodyear S. Endovascular Versus Surgical Revascularization for the Management of Chronic Mesenteric Ischemia. Vasc Endovascular Surg 2015;49:37-44.
7. Blauw JT, Bulut T, Oderich GS, Geelkerken BR; Dutch Mesenteric Ischemia Study Group. Mesenteric vascular treatment 2016: from open surgical repair to endovascular revascularization. Best Pract Res Clin Gastroenterol 2017;31:75-84.
8. Oderich GS, Bower TC, Sullivan TM, Bjarnason H, Cha S, Gloviczki P. Open versus endovascular revascularization for chronic mesenteric ischemia: risk-stratified outcomes. J Vasc Surg 2009;49:1472-9
9. Schermerhorn ML, Giles KA, Hamdan AD, Wyers MC, Pomposelli FB. Mesenteric revascularization: management and outcomes in the United States, 1988-2006. J Vasc Surg 2009;50:341-8.
10. Pecoraro F, Rancic Z, Lachat M, Mayer D, Amann-Vesti B, Pfammatter T, et al. Chronic mesenteric ischemia: critical review and guidelines for management. Ann Vasc Surg 2013;27:113-22.
11. Atkins MD, Kwolek CJ, LaMuraglia GM, Brewster DC, Chung TK, Cambria RP. Surgical revascularization versus endovascular therapy for chronic mesenteric ischemia: a comparative experience. J Vasc Surg 2007;45:1162-71.
12. Indes JE, Giacovelli JK, Muhs BE, Sosa JA, Dardik A. Outcomes of endovascular and open treatment for chronic mesenteric ischemia. J Endovasc Ther 2009;16:624-30.
13. Gupta PK, Horan SM, Turaga KK, Miller WJ, Pipinos II. Chronic mesenteric ischemia: endovascular versus open revascularization. J Endovasc Ther 2010;17:540-9.
14. Nazlı Y, Çolak N, Şahin H, Akın K, Akkaya İO, Bozer M, et al. Surgical treatment of chronic mesenteric ischemia with splenic artery-to-superior mesenteric artery bypass: A case report. Turk Gogus Kalp Dama 2013;21:463-6.
15. Kuralay E, Karaca Y, Yoldaş S, Kaya T. Superior mesenteric artery preimplantation in chronic intestinal ischemia. Turk Gogus Kalp Dama 2013;21:793-5.
16. Davenport DL, Shivazad A, Endean ED. Short-term outcomes for open revascularization of chronic mesenteric ischemia. Ann Vasc Surg 2012;26:447-53.
17. Illuminati G, Pizzardi G, Calio' FG, Pasqua R, Masci F, Vietri F. Infrarenal aorta as the donor site for bypasses to the superior mesenteric artery for chronic mesenteric ischemia: A prospective clinical series of 24 patients. Surgery 2017;162:1080-7.