THE MEDICAL BULLETIN OF
SISLI ETFAL HOSPITAL

DOI: 10.14744/SEMB.2024.19971
Med Bull Sisli Etfal Hosp 2024;58(3):319–324

Original Research

Iatrogenic Vascular Injuries in Elective Abdominal and Pelvic Surgery Patients: Retrospective, Single Center, 30-Day Results

Mehmet Ali Yesiltas, Yasar Gokkurt, Serkan Ketenciler, Cihan Yucel, Melek Yilmaz, Ilhan Ozgol, Mehmet Kursat Kurt, Seran Gulbudak

Deparment of Cardiovascular Surgery, Prof. Dr. Cemil Tascioglu City Hospital, Istanbul, Türkiye

Abstract

Objectives: Although rare, vascular injuries are common in elective abdominal or pelvic surgeries. When encountered, any problem in the relevant artery/vein (occlusion, stenosis, dissection, pseudoaneurysm or arteriovenous fistula) is associated with mortality and morbidity in both the short and long term. We aimed to share our treatment approach and short-term results for vascular injuries in elective surgery.

Methods: In this study, the clinical data of patients who underwent elective abdominal and pelvic surgery performed by a vascular surgeon and who sustained iatrogenic vascular injury between January 2018 and July 2023 were retrospectively examined. All patients with no iatrogenic vascular injuries were excluded from the study.

Results: In the present study, a total of 72 patients had iatrogenic vascular injuries and underwent vascular surgery. The average age of the patients was 50.8±14.6 years. Twenty-eight (38.8%) of the patients were male, and 44 (61.1%) were female. Iatrogenic vascular injury occurred in 21 (29.2%) patients who underwent urologic surgical interventions, 35 (48.6%) who underwent gynecologic surgical treatments, and 16 (22.2%) who underwent abdominal surgeries. Twenty-nine patients had isolated arterial injuries, 37 patients had isolated venous injuries, and 6 patients had both arterial and vein injuries. Embolectomy was performed on 24 patients. Primary sutures were applied in 22 patients, end-to-end anastomosis with a vein graft was performed in 13 patients, and end-to-end anastomosis with Dacron/PTFE was performed in 11 patients. In 10 patients, native vein end-to-end anastomosis was performed. During the 30-day follow-up period, 3 patients experienced arterial occlusion, and 2 patients experienced venous thrombosis. There was no mortality in the hospital or during the 30-day follow-up period.

Conclusion: Vascular injuries rarely occur in elective abdominal and pelvic surgeries. However, when they happen, they are fatal. For this reason, preoperative, multidisciplinary evaluation will minimize the risk of vascular complications, especially in patients requiring mass excision and lymph node dissection with close vascular proximity.

Keywords: Abdominal surgeries, iatrogenic injuries, iatrogenic vascular trauma

Please cite this article as "Yesiltas MA, Gokkurt Y, Ketenciler S, Yucel C, Yilmaz M, Ozgol I, et al. Iatrogenic Vascular Injuries in Elective Abdominal and Pelvic Surgery Patients: Retrospective, Single Center, 30-Day Results. Med Bull Sisli Etfal Hosp 2024;58(3):319–324".

Although rare, vascular injuries are sustained during elective abdominal or pelvic surgeries. The increased rate of repeat abdominal surgeries and the increased use of laparoscopic techniques increase the frequency of vascular injury in these elective patients.[1-3] In addition, extensive lymphadenectomy in patients with pelvic cancers has caused an increase in iatrogenic vascular injuries during elective surgery.[4,5]

Address for correspondence: Mehmet Ali Yesiltas, MD. Deparment of Cardiovascular Surgery, Prof. Dr. Cemil Tascioglu City Hospital, Istanbul, Türkiye
Phone: +90 212 221 77 77 **E-mail:** dr.maliyes@gmail.com

Submitted Date: March 05, 2024 **Revised Date:** April 13, 2024 **Accepted Date:** April 19, 2024 **Available Online Date:** September 30, 2024

In elective patients, unexpected bleeding or occlusion appears to be a serious cause of mortality and morbidity. Injury to arterial structures such as the aorta and venous structures such as the inferior vena cava and portal and iliac veins may cause hemodynamic instability in a short time. In this case, it is significantly associated with mortality. In addition, any problems in the relevant vascular structure, such as occlusion, stenosis, dissection, pseudoaneurysm or arteriovenous fistula, are associated with mortality and morbidity in both the short and long term.[6,7]

Although many studies have been conducted on iatrogenic vascular injuries, both venous and arterial, most of them included emergency cases. In our study, we aimed to evaluate the iatrogenic vascular injury area, surgical treatment methods and one-month follow-up results in patients who underwent elective and planned abdominal and pelvic surgeries.

Methods

This study retrospectively examined the clinical data of patients who underwent elective surgery and sustained iatrogenic vascular injuries during abdominal and pelvic surgery performed by a vascular surgeon between January 2018 and July 2023. All patients with no iatrogenic vascular injuries were excluded from the study. The study was approved by Prof. Dr. Cemil Tascioglu City Hospital Ethics Committee (Number: 06, Date: 05.02.2024)

We evaluated the following clinical characteristics: preoperative data, type of arterial and/or venous injury, and associated injuries and per/postoperative complications and mortality. We also checked the operative records for descriptions of injuries, type of arterial and venous repair, and additional procedures.

Surgical Procedure

Perioperative involvement was included if the relevant branch needed it. The primary aim was to provide bleeding control and hemodynamic stabilization in cases of vascular bleeding. After bleeding was controlled, primary repair was preferred if vascular injury did not cause any occlusion or stenosis. However, if the integrity of the vascular structure was impaired, 5000 IU of heparin was administered intravenously to injure the arterial and venous structures before repair. If there was no tissue loss or dissected segment and the vascular structures were suitable for end-to-end repair, priority was given to end-to-end repair. When grafting was needed, the vena saphenous magna (VSM) was the preferred graft option. In cases that were entered as planned, pre-planning was done with Doppler USG. However, since most of these cases were unexpected injuries, planning was made according to the emergency situation during the operation. If there were structures with high need for arterial nutrition, a graft was used to perform the procedure urgently. However, if there was a clinical condition that would tolerate the VSM graft until it was harvested, the VSM graft was prepared. and during this preparation, the surgeon acted according to the suitability of the VSM diameter to the vessel diameter in the area to be applied.

Medical Treatment

In all patients who underwent arterial repair, low molecular weight heparin (LMWH) was started at the treatment dose on the evening of the operation and continued during hospitalization, and both LWMH and 100 mg ASA were started the next day. After discharge, treatment with 100 mg of ASA was continued.

In all patients who underwent venous repair, LMWH was started at the treatment dose during hospitalization and after discharge. If primary repair was performed, it was followed by LMWH for 15 days, and if the graft was interposed, it was followed by warfarin or a new generation of oral anticoagulant.

Follow-up

Patients were called for a check-up 7, 10 and 30 days after discharge. Duplex venous/arterial ultrasound scanning was performed if the patient experienced venous/arterial symptoms or at the discretion of the evaluating physician.

Results

In the present study, a total of 72 patients had iatrogenic vascular injuries and underwent vascular surgery. The average age of the patients was 50.8±14.6 years. Twenty-eight (38.8%) of the patients were male, and 44 (61.1%) were female. Iatrogenic vascular injury occurred in 21 urologic surgeries (29.2%), 35 (48.6%) gynecologic surgeries, and 16 (22.2%) abdominal surgeries (Table 1). Twelve patients (16.7%) had a history of previous pelvic or abdominal surgery. When the details of the operations performed were examined, they were more common during laparoscopic procedures (Table 1). In addition, when looking at the location of vascular injuries, venous injuries were more common in patients who underwent lymph node dissections, as venous neighborhoods were more common (Fig. 1).These injuries are often more prevalent in primary repair. Ligation was performed because cystic vein injuries occurred during cholecystectomy. In 2 (2.8%) of the gynecological patients, the mass involved the iliac artery, and for complete tumor resection, the external iliac artery vein was resected, and the graft was interposed according to the vessel diameter.

Table 1. Procedures that involve iatrogenic vascular injury

	n	%
Department of Surgery		
Urology	21	29.2
Gyneco-oncology	35	48.6
General Surgery	16	22.2
Surgical procedure		
Cholecystectomy	2	2.8
Laparoscopic cholecystectomy	3	4.1
Tumor resection	4	5.5
Intestinal perforation	2	2.8
Iliostomy	1	1.4
Renal mass	14	19.5
Retroperitoneal tumor resection	10	13.9
Radical cystectomy, Left-Right Lymph node dissection	12	16.7
Pelvic and para-aortic lymph node dissection	20	27.8
Debulking (adnexal mass)	4	5.5

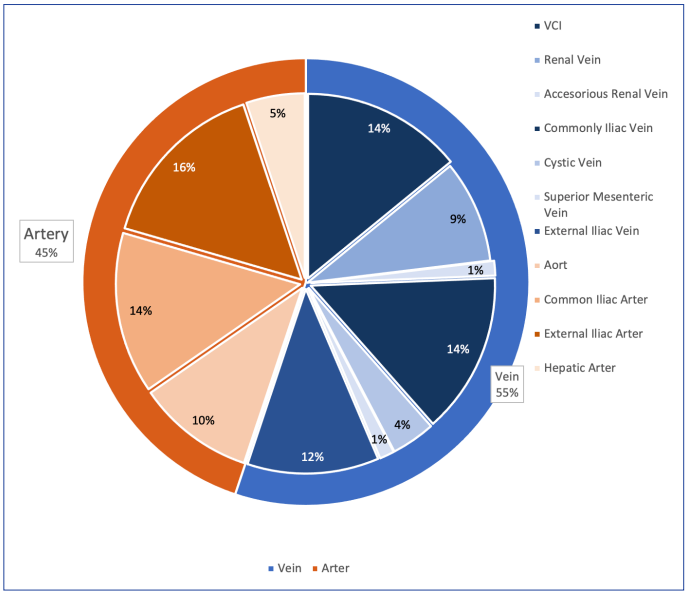

Figure 1. Location of vascular injuries.

There was no flow or thrombus in 24 patients (33.3%) with arterial and/or venous occlusion. In these patients, embolectomy was performed in accordance with the diameter in both the proximal and distal directions. Since there was no pulse on the anastomosis in 1 patient (1.4%) who received a PTFE graft, occlusion and bypass were considered. In 1 patient (1.4%) whose PTFE graft was interposed end-to-end into the external iliac artery, the graft needed renewal due to serious bleeding. During the operation, an average of 1 U (min.: 0, max.:4 U) of ES and 1 U (min.: 0, max.:2 U) of FFP were given (Table 2).

Table 2. Surgical technique, intraoperative and postoperative complications

	n	%
Surgical Technique for Repair		
Embolectomy	24	25
Ligation	3	3.1
Primary suturation	22	22.9
End-to-end anastomosis	10	10.4
Patch plasty	5	5.2
Bypass with vein graft	5	5.2
End-to-end with vein graft	13	13.6
Bypass with PTFE/Dacron	3	3.1
End-to-end with PTFE/Dacron	11	11.5
Intraoperative vascular complication		
Occlusion	1	1
Bleeding	1	1
Complication in hospital		
Arterial occlusion	0	0
Deep vein thrombosis	1	1.4
Pseudoaneurysm	0	0
AVF	0	0
Mesenteric ischemia	0	0
Renal infarction	0	0
Enteric fistula	0	0
Multiorgan dysfunction	0	0
Sepsis	3	4.2
Postoperatif vascular Complication (30 days)		
Artery	3	9.4
bleeding	0	0
occlusion	3	9.4
Venous	2	5
Bleeding	0	0
DVT	2	5
Mortality		
In hospital	0	0
In 30 days	0	0

PTFE: Polytetrafluoroethylene; AVF: arteriovenous fistula; DVT: Deep Vein Thrombosis.

Deep vein thrombosis developed in 1 patient (1.4%) whose PTFE graft was interposed into the iliac vein. Medical symptomatic treatment was started for this patient due to his complaints. Three patients (4.2%) who underwent abdominal surgery did not have any vascular pathology, but sepsis developed due to the accompanying surgery. During post-discharge follow-up, occlusion was observed on the 13th day in 1 patient (1.4%) in whom a PTFE graft was applied to the common iliac artery; occlusion was observed on the 19th day in 1 patient (1.4%) in whom a PTFE graft was applied to the external iliac artery; and occlusion was observed in 1 patient (1.4%) in whom a bypass was applied

from the common iliac artery to the femoral artery. Occlusion was detected on the 16th day. Two of these patients did not receive antiplatelet treatment. All these patients underwent emergency surgery due to ischemic findings, and embolectomy was performed in 2 of them. In 1 patient, PTFE graft interposition was applied again. After discharge, DVT developed in 1 patient (1.4%) in whom a PTFE graft was placed in the external iliac vein and in 1 patient (1.4%) in whom VSM end-to-end anastomosis was performed on the external iliac vein. These patients had drug incompatibility and did not tolerate LMWH treatment. At the 1-month follow-up, no mortality was observed (Table 2).

Discussion

Although vascular injuries are very rare during elective abdominal and pelvic operations, they are inevitable. When it occurs, it is a priority to eliminate the vascular pathology as soon as possible. Large-scale arterial injuries such as those involving the aorta, high-flow VCI or portal vein injuries should be treated quickly. Vascular injury that is not resolved quickly is associated with mortality. Additionally, vascular injuries should not be considered only as bleeding. A full-thickness incision in the arterial structures, causing occlusion or stenosis, disrupts tissue nutrition and causes ischemia. In addition, any injury to the common iliac arteries or external iliac artery will compromise extremity health by disrupting the distal blood supply, and if not treated immediately, it will lead to limb necrosis and thus limb amputation.[8] Although iatrogenic vascular injury is always possible in elective patients, it is more difficult to explore vascular structures and control bleeding because it occurs in an unplanned manner.[8,9] It is an urgent situation after a vascular injury occurs. In some abdominal/pelvic cases, the risk of vascular injury is high in pathologies such as mass excisions adjacent to vascular structures. Especially in excisions of masses with vascular invasion, vascular repair should be done before planning. Vascular surgeons should definitely be included in these processes. Surgical planning with a multidisciplinary approach prevents vascular complications and minimizes mortality.

Our study revealed that iatrogenic vascular injury occurs most frequently in gynecologic-oncological surgeries. It has been observed that the increased frequency of iatrogenic vascular injury in gynecologic-oncological surgeries is due to full lymphadenectomy, which is required to complete oncological treatment.[10] In recent years, full lymphadenectomy, even at the most distant lymph node, during surgery has been beneficial in terms of oncological surveillance.[11] However, due to the inflammatory process of the lymph node in oncological patients, it is more difficult to dissect it in the vicinity of the vascular structure because it does not have clear boundaries with the surrounding tissue or because it invades the surrounding tissue.[12,13] In addition, the risk of vascular injury is greater in patients who undergo repeat abdominal surgery.[14] In our study, vascular injury occurred in 11 patients who underwent lymphadenectomy during radical cystectomy and in 20 patients who underwent pelvic and para-aortic lymphadenectomy. Additionally, 12 patients (16.7%) were observed to have had previous abdominal or pelvic surgery. In addition, considering the learning curve for laparoscopic surgeries we observed in our study, we observed that more complications were encountered in the initial phase.

During these operations, there is a greater risk of injury to the pelvic vessels, and more incisions are made, as lymphadenectomy is performed adjacent to the VCI.[11] Even though the venous vessels in the abdomen have low pressure, they seem to be associated with a high risk of mortality because of their high volume. However, since they are in deep anatomical areas, bleeding control is more difficult.[15] In our study, 11 patients (25.6%) had VCI injuries, 11 patients (25.6%) had injuries in the common iliac vein, and 9 patients (20.1%) had injuries in the external iliac vein. Although these injuries are not thought to cause hypovolemic shock because of rapid arterial bleeding, they may cause bleeding that is directly related to mortality due to the high celiac load. Oderich et al.[16] reported that the rate of complications with injury-related causes was 70%, and the mortality rate was 18%. In our study, a significant difference was that no mortality was observed during hospitalization or during the 30-day follow-up period.

If a patient who sustains a vascular injury during a procedure and has an unstable condition, the vascular surgeon can perform primary suturing, if possible (if there is no tension), end-to-end anastomosis, or if the vascular structures are not suitable for end-to-end anastomosis, vascular repair with a graft can be performed.[16] If the vessel diameters are suitable, autologous grafts should be prioritized. However, since this is an unexpected situation, sterile draping should also cover venous grafts for lower extremity venous graft harvesting. Additionally, if there is no saphenous vein or if there is a diameter discrepancy, anastomosis with a PTFE/Dacron graft is a treatment option.[17] We also applied a similar treatment sequence in our own clinic, prioritizing primary treatment, end-to-end anastomosis, and anastomosis with saphenous vein grafts. Vascular repair was performed with primary suturing in 22 patients (30.5%), end-to-end anastomosis in the injured vessel in 10 patients (13.9%), and saphenous vein grafting in 13 patients (18.0%). Here, we had the advantage of frequently using the saphenous vein as a graft. With this advantage, patients at high risk of vascular trauma were covered with a sterile drain to the

knee, and the vena saphenous magna was easily harvested and used as a graft. Notably, most patients with this type of vascular injury are oncological patients and are likely to receive radiotherapy. Therefore, it is more appropriate to use a saphenous vein graft instead of a PTFE/Dacron graft, which is an artificial graft, in this patient group. On the other hand, in patients with severe blood loss, prosthetic grafts are faster to apply and have a shorter harvesting time. In addition, although it is a rapid treatment method, it increases the risks of infection and early graft thrombosis.[18] In our study, a PTFE/Dacron graft was used in 14 patients (19.4%) with inappropriate saphenous diameters. No graft-related infection was encountered. Arterial occlusion occurred in 3 patients (4.2%) during the 30-day follow-up period. Patients with occlusion were retreated with embolectomy and replacement of the occluded graft. The most important risk factor is patient noncompliance with medical treatment.

Venous reconstruction is technically challenging, and the long-term patency of the graft is unknown; however, restoration of flow is associated with improved short-term outcomes. Due to the location and size of the pelvic veins, finding the appropriate conduit can be difficult, as it can provide good exposure for satisfactory repair.[19,20] Additionally, the saphenous vein is considered the most suitable vessel for venous reconstruction, but it poses a problem for use because its diameter in the iliofemoral segment is smaller, as seen in late venograms.[21] When venous congestion occurs, it usually occurs within a few weeks after the injury, and prolonged patency is normal.[22] In our study, DVT developed in 2 patients (2.8%). It developed in 1 patient during hospitalization. In the other patient, the external iliac vein graft was occluded during the 30-day follow-up. It was determined that anticoagulant therapy was not effective for either patient. Since the patients' foot swelling was mildly symptomatic, no reintervention was considered, and symptomatic treatment was continued.

With technological advancements, endovascular and vascular surgeries have begun to be used frequently in emergencies. It becomes more important, especially in cases where anatomical access is difficult. In iatrogenic vascular injuries, if there is no tissue loss and there is vascular rupture or short-segment perforation, endovascular treatment can often be used.[23-25] In the study by Xiong et al.[26], 7 patients underwent endovascular intervention for injuries during abdominal or pelvic surgery. Most of these are in the form of lacerations. In our study, no endovascular treatment was applied. The most important reasons for this are the difficulty in selecting and the cost-effectiveness of appropriately sized covered stents. However, considering that anatomical access is a problem during surgery for some of our patients, accelerating the treatment process is highly important for both patient and surgical comfort. We believe that it will become more prevalent in the future with further developments in covered stent technology.

Our study had limitations. Most importantly, these studies were retrospective, and the number of patients was insufficient. Additionally, not all patients received preoperative vascular surgery consultation. Furthermore, no follow-up data were available to assess survival, other late outcomes or the long-term impact of the injury.

Conclusion

Vascular injuries in the abdomen or pelvis are often noted during general surgery and during urological and gynecologic-oncological procedures. Considering the importance of entire tissue excision in oncological treatment, vascular neighborhoods are even more important in this patient group. Therefore, mortality may remain low when vascular consultation is requested early for this group of patients. Preoperative, multidisciplinary evaluation will minimize the risk of vascular complications.

Disclosures

Ethics Committee Approval: This study was carried out at Istanbul Prof. Dr. Cemil Tascioglu City Hospital, Department of Cardiovascular Surgery. The study was approved by Prof. Dr. Cemil Tascioglu City Hospital Ethics Committee (Number: 06, Date: 05.02.2024).

Informed Consent: Informed consent was obtained from the participants.

Financial Disclosure: The authors have not declared financial support.

Conflict of Interest: No conflict of interest was declared by the authors.

Authorship Contributions: Concept – M.A.Y., S.K.; Design – M.A.Y., S.K.; Supervision – M.A.Y., Y.G., I.O.; Fundings – M.A.Y., C.Y., M.K.K.; Materials – M.A.Y., M.Y., I.O., S.G.; Data collection &/or processing – M.A.Y., S.G., M.K.K., C.Y.; Analysis and/or interpretation – M.A.Y., S.K., Y.G., C.Y.; Literature search – M.A.Y., C.Y., Y.G., M.Y.; Writing – M.A.Y., S.K., C.Y.; Critical review - M.A.Y., C.Y., S.K.

Use of AI for Writing Assistance: No artificial intelligence-supported technology was used.

References

1. Giswold ME, Landry GJ, Taylor LM, Moneta GL. Iatrogenic arterial injury is an increasingly important cause of arterial trauma. Am J Surg 2004;187:590–3. [CrossRef]
2. Lazarides MK, Tsoupanos SS, Georgopoulos SE, Chronopoulos AV, Arvanitis DP, Doundoulakis NJ, et al. Incidence and patterns of iatrogenic arterial injuries. A decade's experience. J Cardiovasc Surg (Torino) 1998;39:281–5.

3. Jafari MD, Pigazzi A. Techniques for laparoscopic repair of major intraoperative vascular injury: case reports and review of literature. Surg Endosc 2013;27:3021–7. [CrossRef]
4. Levin SR, de Geus SWL, Noel NL, Paasche-Orlow MK, Farber A, Siracuse JJ. Vascular repairs in gynecologic operations are uncommon but predict major morbidity and mortality. J Vasc Surg 2020;72:1059–66. [CrossRef]
5. Temizkan O, Aşıcıoğlu O, Şanverdi İ, Arıcı B, Ayhan I, Çetin Ö. Our experience in nerve sparing laparascopic radical hysterectomy in treatment of early stage cervical cancer. Med Bull Sisli Etfal Hosp [Article in Turkish] 2015;49:112–7. [CrossRef]
6. Mandolfino T, Canciglia A, Taranto F, D'Alfonso M, Tonante A, Mamo M, et al. Outcome of iatrogenic injuries to the abdominal and pelvic veins. Surg Today 2008;38:1009–12. [CrossRef]
7. Danczyk RC, Coleman J, Allensworth J, Azarbal AF, Mitchell EL, Liem TK, et al. Incidence and outcomes of intraoperative vascular surgery consultations. J Vasc Surg 2015;62:177–82. [CrossRef]
8. Filis K, Sigala F, Stamatina T, Georgia D, Zografos G, Galyfos G. Iatrogenic vascular injuries of the abdomen and pelvis: the experience at a Hellenic University Hospital. Vasc Endovascular Surg 2019;53:541–6. [CrossRef]
9. Ramos CR, Rajani RR. Management of iatrogenic abdominal vascular injuries. In: Gilani R, Mills Sr JL, eds. Vascular Complications of Surgery and Intervention. Cham: Springer; 2022. p. 161–73. [CrossRef]
10. Northup PG, Garcia-Pagan JC, Garcia-Tsao G, Intagliata NM, Superina RA, Roberts LN, et al. Vascular liver disorders, portal vein thrombosis, and procedural bleeding in patients with liver disease: 2020 Practice Guidance by the American Association for the study of liver diseases. Hepatology 2021;73:366–413. [CrossRef]
11. Mendez LE. Iatrogenic injuries in gynecologic cancer surgery. Surg Clin North Am 2001;81:897–923. [CrossRef]
12. Rudström H, Bergqvist D, Ogren M, Björck M. Iatrogenic vascular injuries in Sweden. A nationwide study 1987-2005. Eur J Vasc Endovasc Surg 2008;35:131–8. [CrossRef]
13. Follen M, Levenback CF, Iyer RB, Grigsby PW, Boss EA, Delpassand ES, et al. Imaging in cervical cancer. Cancer 2003;98:2028–38. [CrossRef]
14. Bourgioti C, Chatoupis K, Moulopoulos LA. Current imaging strategies for the evaluation of uterine cervical cancer. World J Radiol 2016;8:342–54. [CrossRef]
15. Sugrue M, D'Amours SK, Joshipura M. Damage control surgery and the abdomen. Injury 2004;35:642–8. [CrossRef]
16. Oderich GS, Panneton JM, Hofer J, Bower TC, Cherry KJ Jr, Sullivan T, et al. Iatrogenic operative injuries of abdominal and pelvic veins: a potentially lethal complication. J Vasc Surg 2004;39:931–6. [CrossRef]
17. Nehler MR, Taylor LM Jr, Porter JM. Iatrogenic vascular trauma. Semin Vasc Surg 1998;11:283–93.
18. Mechchat A, Bagan P. Management of major vascular complications of laparoscopic surgery. J Visc Surg 2010;147:e145–53. [CrossRef]
19. Feliciano DV, Mattox KL, Graham JM, Bitondo CG. Five-year experience with PTFE grafts in vascular wounds. J Trauma 1985;25:71–82. [CrossRef]
20. Zamir G, Berlatzky Y, Rivkind A, Anner H, Wolf YG. Results of reconstruction in major pelvic and extremity venous injuries. J Vasc Surg 1998;28:901–8. [CrossRef]
21. Sandadi S, Johannigman JA, Wong VL, Blebea J, Altose MD, Hurd WW. Recognition and management of major vessel injury during laparoscopy. J Minim Invasive Gynecol 2010;17:692–702. [CrossRef]
22. Aitken RJ, Matley PJ, Immelman EJ. Lower limb vein trauma: a long-term clinical and physiological assessment. Br J Surg 1989;76:585–8. [CrossRef]
23. Bermudez KM, Knudson MM, Nelken NA, Shackleford S, Dean CL. Long-term results of lower-extremity venous injuries. Arch Surg 1997;132:963–8. [CrossRef]
24. Weir A, Kennedy P, Joyce S, Ryan D, Spence L, McEntee M, et al. Endovascular management of pelvic trauma. Ann Transl Med 2021;9:1196. [CrossRef]
25. Zhou W, Bush RL, Terramani TT, Lin PH, Lumsden AB. Treatment options of iatrogenic pelvic vein injuries: conventional operative versus endovascular approach - case reports. Vasc Endovascular Surg 2004;38:569–73. [CrossRef]
26. Xiong J, Liu M, Guo W, Liu X, Yin T, Jia X, et al. A retrospective study on endovascular management of iatrogenic vascular injuries. Vascular 2012;20:65–71. [CrossRef]