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의학석사 학위논문

# Crucial roles of Vascular Surgeons in Oncovascular and Nonvascular Surgery

중앙혈관외과 수술과 비혈관외과 수술에서  
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# Crucial roles of Vascular Surgeons in Oncovascular and Nonvascular Surgery

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# Abstract

**Objective:** Vascular surgeons can be useful in nonvascular surgery cases, especially in oncology where complete resection is important. Such activity has not yet been quantified. This study aimed to analyze the roles of vascular surgeons in oncovascular surgery (OVS) and nonvascular surgery (NVS).

**Methods:** Between January 2014 and December 2018, the vascular surgery registry data of Seoul National University Hospital were reviewed for OVS or NVS assisted by vascular surgeons or operations primarily done by vascular surgeons. Electronic medical records and images were retrospectively reviewed. Demographic data, clinical characteristics, operative data, vascular-related data and operative outcomes were collected. The operations were classified into primary surgery or consult surgery. Consult surgeries were divided into planned or unplanned surgery.

**Results:** Out of 564 cases, vascular surgeons performed 74 OVS as primary surgery, and retroperitoneal tumor was the most frequent diagnosis (n=34, 45.9%). There were 490 intraoperative requests for a vascular surgeon's assistance, of which 109 (22.2%) were emergency calls. Total intraoperative consultations increased by 115.9% over 5 years, and the proportion of unplanned operations

also increased. General surgery made most requests (n=165, 33.7%). Unplanned assistance was most commonly requested for bleeding, whereas node dissection was the most common reason for planned surgery. The mortality rate was not different between planned and unplanned surgery groups, but the latter showed worse outcomes in total operative time, length of hospital stay, postoperative consultations, and postoperative vascular-related complications.

**Conclusions:** Vascular surgeons have an essential role to play in the modern practice of cancer surgery. Oncovascular surgery enables gross resection of a tumor even in the presence of major vessel invasion. Emergency unplanned surgery showed worse outcomes; therefore, preoperative vascular consultation and multidisciplinary management are highly recommended for better patient outcomes.

**Keywords :** Oncovascular surgery, Consult surgery, Unplanned consultation, Vascular reconstruction, Retroperitoneal tumor, Vessel-origin tumor

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# Introduction

Vascular surgeons are generally defined as surgeons who treat diseases of the vascular system including arteries, veins, and lymphatics by medical therapy, endovascular intervention, and open surgery. Recent advances in endovascular surgery and hybrid surgery combining open and endovascular surgery have made vascular surgeons very versatile. In the real world, however, especially in tertiary referral centers, one of the major roles of vascular surgeons is helping surgical colleagues during nonvascular surgery, so-called consult operation, co-operation, or rescue surgery. These elective or emergency intraoperative consultations for iatrogenic vascular injuries are an undervalued part of vascular surgical practice (1).

Vascular reconstruction can be difficult for non-vascular surgeons who do not routinely perform vessel manipulation and they frequently call for aid from vascular surgeons especially when extensive oncologic resection is needed (1-4). Complete surgical resection remains the basic principle of treatment for most malignancies despite many advances in systemic therapeutic options (5, 6). The concept of "Oncovascular Surgery (OVS)" is

becoming popular and it is considered a critical part of the curative therapy of advanced cancers to improve the quality and safety of R0 resection (7, 8). OVS can be defined as cancer resection with concurrent ligation or reconstruction of a major vascular structure (9).

The benefit of OVS for patients with advanced cancers has been well reported. In pancreatic cancer, vascular resection and reconstruction of the portal vein or hepatic artery can be safely done without increasing the morbidity and mortality rate, which increases the likelihood of R0 resections (4, 10–12). In extremity soft tissue sarcoma (ESTS), limb preservation rates have been reported to be as high as 94% with recurrence-free survival of 80% (13). In retroperitoneal soft tissue sarcoma (RSTS), OVS has also shown acceptable disease-free survival and overall survival advantages with increasing resectability (3, 14). Because critical vascular structures are ubiquitous, many surgeons other than surgical oncologists also benefit from vascular surgeons' expertise in anatomic exposure (15–17) and repair of vascular injury (8, 18, 19).

The number of reports dealing with the contributions of vascular surgeons is growing gradually. Previous studies have documented their roles in specific fields, including portal vein

reconstruction during pancreatectomy (4, 11), urologic operation (20) and major oncologic resections (2). Also the multiple roles of vascular surgeons in tertiary care hospitals have been addressed (21). Other studies have further described the intraoperative role of the vascular surgeon (7, 22). However, most of these studies are limited by small sample size and underestimation of the overall contribution of vascular surgical expertise focusing only on the intraoperative role. The role of vascular surgeons in preoperative planning, postoperative consultation and surgery as the primary surgeon for vessel–origin tumors were not included in most studies.

This study is a retrospective collective review of the role of vascular surgeons in various settings at a tertiary care hospital during a 5–year period. The aims of the study were to describe the detailed spectrum of roles of the vascular surgeon in OVS and NVS and to analyze the yearly trends of consult surgery and risk factors for poor outcomes.

## Materials and Methods

Between January 2014 and December 2018, the vascular surgery registry data of Seoul National University Hospital, a tertiary referral center in the metropolitan city of Korea, were reviewed. The data of cases of OVS primarily done by vascular surgeons and planned or unplanned consult operations during NVS were collected retrospectively. Electronic medical records were reviewed, and demographic data, clinical characteristics, operative data, and operative outcomes including 30-day mortality and vascular-related complications were collected.

The operative data included the requesting specialties, indication, and procedures for vascular consults, yearly trend of the cases of OVS and consult surgery, the proportion of the consult surgeries, estimated blood loss (EBL) for the entire procedure and operating time. The specialties requesting consult surgery included general surgery, plastic surgery, urology, orthopedics, gynecology, neurosurgery, and internal medicine. Endovascular cases by interventionalists outside the operating room that require surgical rescue were classified as a separate specialty.

The operations were classified as either primary surgery or

consult surgery. Primary surgery was defined as an operation for tumor resection primarily done by vascular surgeons, which included vessel–origin tumors, such as aortic angiosarcoma, leiomyosarcoma (LMS) of the vena cava, intravenous leiomyomatosis (IVLM), and retroperitoneal tumors encasing or abutting major vessels. Consult surgery was further subdivided into unplanned and planned surgery. Unplanned surgery was defined as an operation in which the vascular surgeon had no prior contact and was requested to provide an emergency intraoperative consult. Planned surgery was defined as an operation after prior consultation in which the vascular surgeon had prior knowledge of a potential need, or had been involved in preoperative planning and had scheduled to be available on the day of the operation. The primary outcomes were a composite endpoint of 30–day mortality and vascular–related morbidity.

Data were analyzed using SPSS 25.0 software (IBM Corp, Armonk, NY), and a *p*–value of less than .05 was considered statistically significant. Continuous variables were compared using Mann Whitney U–test, and categorical variables including indication for consult surgery and postoperative outcomes including complications were compared using  $\chi^2$  testing and Fisher’s exact test as appropriate.

# Results

## Patient Characteristics

Vascular surgeons performed 74 operations for vessel–origin tumors and retroperitoneal tumors as primary surgery. Consult operations were requested in 490 cases, of which 109 (22.2%) were unplanned. There were 287 males (50.9%), and the mean age was 58.0±15.0 years. Comorbidity included hypertension, 199 cases (35.3%), diabetes mellitus, 114 (20.2%), hyperlipidemia, 62 (12.2%), coronary artery disease, 59 (10.5%), cerebrovascular disease, 19 (3.4%), and congestive heart failure, 4 (0.7%).

Before surgery, 64 patients were taking aspirin, 12 clopidogrel, 2 cilostazol, 10 warfarin, and 7 rivaroxaban. Patients were instructed to stop their antiplatelet drugs or anticoagulants temporarily except for one patient who had an emergency operation. Past medical history included 244 (43.3%) prior operations, 57 (10.1%) radiotherapy, and 124 (22.0%) chemotherapy. (Table 1)

## Yearly trends

Figure 1. presents the trend of surgery by categories. The total number of operations increased by 115.9%, from 69 procedures in 2014 to 149 procedures in 2018. Primary surgery rates were relatively steady, however, the number of consult surgeries continued to increase.

## Details of primary surgery

Vascular surgeons performed 74 primary surgeries for vessel-origin tumors, retroperitoneal tumors encasing major vessels and other tumors requiring vascular procedures. Retroperitoneal tumor was the most frequent diagnosis (n=34, 45.9%) and consisted of malignant tumors including retroperitoneal sarcoma, metastatic renal cell carcinoma, and adrenal cortical carcinoma (n=8, 23.5%), metastatic tumors from other origins (n=8, 23.5%) and benign tumors including schwannoma, paraganglioma, and lymphangioma (n=18, 52.9%). A less frequent tumor for primary surgery was vessel-origin tumor (n=20, 27.0%) including LMS of the vena cava, IVLM, ESTS and benign soft tissue tumors of the lower extremity. Other tumors included 20 cases of lymph node biopsy or dissection, carotid body tumor, soft tissue

tumor and intraabdominal lymphangioma. (Figure 2)

The mean operative time for primary surgery was 184 minutes and the mean operative blood loss was 1,251 mL. The mean length for hospital stay was 11 days.

Postoperative complications occurred in 2 patients (2.7%) including fluid collection in the operative field and graft infection after vena cava reconstruction for LMS. There was one case of postoperative mortality within 30 days (1.4%). The patient died of suspected air embolism caused by self-removal of central venous catheter.

## Details of consult surgery

**Specialties requesting assistance.** The requesting specialties are listed in Table 2. The specialty requesting assistance most often was general surgery (n=165, 33.7%). The specialty with the highest proportion of unplanned surgery was gynecology (20/40, 50.0%), and the specialties with a high proportion of planned surgery were neurosurgery (10/10, 100%) and plastic surgery (122/123, 99.2%). Most requests from plastic surgery were for inguinal, iliac or popliteal node dissection in malignant melanoma or squamous cell carcinoma. Medical oncologists requested excisional biopsy of enlarged lymph nodes or metastatic lymph node dissection



before or after chemotherapy. Emergency rescue surgery was done in 6 endovascular cases including the removal of a foreign body of entrapped guidewire and stent, malpositioned vascular closure device, and pseudoaneurysm or bleeding from the femoral puncture site.

The trends and the unplanned surgeries as a proportion of all consult surgeries were analyzed by specialty over 5 years. The number of unplanned and planned consult operations increased in both. Unfortunately, the proportion of unplanned surgery increased during the period (Figure 3). That of general surgery increased from 7.1% in 2014 to 52.0% in 2017 and then slightly decreased to 40.0% in 2018. In neurosurgery and plastic surgery, consult operations were done in most cases as planned surgery with preoperative consultation and planning.

**Indications for consult.** Consult surgery was requested for several indications: node dissection (n=208, 42.4%), vascular exposure (n=76, 15.5%), vascular invasion (n=128, 26.1%), bleeding control (n=58, 11.8%), thrombosis (n=6, 1.2%), and others (n=14, 2.9%). Others included vessel injury by energy device without bleeding (n=4), entrapped guidewire or stent during intervention (n=2), malpositioned vascular closure device (n=2),

complicated vascular structure (n=2), aneurysmal disease (n=1), adventitial hematoma (n=1), loss of hepatic artery flow after gastroduodenal artery ligation during Whipple's operation (n=1), and lymphatic leakage after paraaortic dissection (n=1). An unplanned consult surgery was most commonly requested for bleeding (n=44, 40.4%), whereas a planned surgery was most commonly requested for node dissection (n=200, 52.5%). There was statistically significant difference in the initial indication for consult between both groups. We analyzed the number of procedures performed during the consult surgery. Single procedure was most commonly performed in both groups. However, 22.2% of total consult surgeries required more than 2 procedures, and 3 cases required 4 combined procedures. Therefore, vascular surgeons often conducted more complex procedures beyond the initial request by the primary surgeon (Table 3).

**Intraoperative details and postoperative outcomes.** The total operating time was significantly longer in unplanned surgery ( $p<.001$ ). The median value of EBL was also higher in unplanned surgery with a statistically significant difference ( $p<.001$ ). Intraoperative death occurred in one case (0.2%) due to uncontrolled intraoperative bleeding during retroperitoneal

liposarcoma resection, which requested emergent intraoperative consult without prior contact to vascular surgeons.

The length of hospital stay was significantly longer in the unplanned surgery group ( $p=.002$ ). The postoperative consultation rates were significantly higher after unplanned surgery ( $p<.001$ ), including antithrombotic medication after vessel reconstruction, and evaluation of the affected vascular patency.

Vascular related complications occurred in 20 (4.1%), and the incidence was significantly higher in the unplanned surgery group ( $p=.012$ ). The most common complication was vessel occlusion ( $n=10$ , 2.0%). Postoperative hemorrhage occurred more frequently in unplanned surgery ( $n=3$ , 2.8%) ( $p=.036$ ). Wound infection and lymphatic leakage occurred in 6 cases after consult surgery, 5 of those occurred after inguinal lymph node dissection and one occurred because of the progression of toe gangrene on a diabetic foot after consult surgery for revascularization. Reoperation within 30 days was done in 4 patients (1.0%); 2 cases for bleeding control, thrombectomy of autologous graft for axillary artery reconstruction and wound debridement.

Mortality within 30 days occurred in 5 patients (1.0%), three in the unplanned surgery group and two in the planned surgery group, this difference was not statistically significant ( $p=.076$ ). In the

unplanned surgery group, 3 patients died of multiorgan system failure as a result of massive intraoperative bleeding. In the planned consult surgery group, 1 patient also died of multiorgan system failure caused by massive hemorrhage and transfusion, and the other of septic shock caused by aspiration pneumonia. (Table 4)

When we analyzed outcomes between unplanned and planned surgery according to the category of initial indication, there was no significant difference in each variable.

# Discussion

Although oncoplastic surgery is a widely accepted term, “oncovascular surgery” is not yet as popular even though the concept is similar. Oncoplastic surgery means simultaneous cancer resection and breast cosmetic reconstruction, and the basic aim is to preserve aesthetic appearance and the quality of life (QOL) outcomes, without compromising oncological effectiveness. Oncovascular surgery means simultaneous cancer resection and major vessel reconstruction, and the basic aim is that major vessel involvement of a tumor mass should not necessarily be a barrier to en bloc resection and curative surgery. Radical surgical resection may offer the only chance for cure or palliation for these patients (9).

Previous studies have focused on the specific roles of the vascular surgeons in providing assistance to other surgeons during NVS, especially during cancer surgery (2–4, 14). The roles were called consultation surgery or exposure surgery. Emergency intraoperative vascular surgery consultations in nonvascular procedures are being reported with increasing frequency, but the reports have not usually included detail on preoperative

consultations for intraoperative assistance (7, 22). In this study, we evaluated a broad spectrum of vascular surgeons' roles as a primary surgeon or a consult surgeon during OVS.

Despite the rarity of primary cancer originating from blood vessels, there were vessel-origin tumors that could be treated surgically by vascular surgeons. As in other nonvascular tumors, curative resection of R0 or R1 is important to achieve better survival outcome than debulking surgery in vessel-origin tumors, including aortic angiosarcoma, LMS of the vena cava, IVLM, and ESTS (9, 23). Retroperitoneal tumors have diverse pathological subtypes. Although 40% of these tumors are benign, complete surgical resection is difficult because retroperitoneal tumors often adhere to, encase or invade other organs and major blood vessels (24). Even if a retroperitoneal tumor is diagnosed as benign, complete removal is necessary, because any residual tumor will continue to grow and cause complications (25). In this series, retroperitoneal tumors including malignant, benign and metastatic tumors were the most common tumor type operated on primarily by vascular surgeons (n=34, 45.9%). Because of the risk of major vessel injury, oncologists and oncologic surgeons usually refer these tumors to vascular surgeons in our center. Many of those were confirmed as benign after curative resection (18/34, 52.9%).

It has been reported that complete vascular resection for various types of cancer improves survival compared with patients treated by palliative therapy alone or those with R2 resection (26). Therefore, a multidisciplinary team approach with preoperative planning is very important for complex cancer surgery. However, in this series, the proportion of planned consult surgery that was planned with prior notification to vascular surgeons did not increase. Unfortunately, emergency intraoperative calls have increased. Assistance for control of bleeding was the most common reason for calling a vascular surgeon without prior notification. Emergency calls can be challenging and stressful, with the vascular surgeons being summoned to a strange operating theater where most staff are not familiar with the vascular surgical technique, instruments, and devices. In the case of massive bleeding, it can be like a chaotic battlefield and the vascular surgeon may not be fully informed of the disease anatomy, characteristics, or the mechanism of injury. Unplanned emergency operations are not always successful and sometimes are a 'mission impossible'. In this study, the incidence of postoperative complications was significantly higher in unplanned surgery than planned surgery ( $p=.012$ ).

The best way to perform these complex cancer operations safely is to appoint a multidisciplinary team including an oncologist,

oncologic surgeon, and vascular surgeon. They will conduct detailed preoperative planning selecting the best surgical option, and postoperative medication. It is important to identify the pathologic and anatomical characteristics of the tumor, to design the appropriate surgical approach through an avascular plane. This will enable meticulous dissection of the vessel away from the tumor minimizing vessel injury, and allows for optimal vascular reconstruction with the preparation of appropriate materials.

Vascular surgeons can be isolated from professional societies for cancer treatment and vascular surgeons often consider this kind of cancer surgery as a collateral job. However, nonvascular surgeons who do not routinely perform vascular procedures often find it difficult to safely remove many of these tumors. Vascular surgeons need to show leadership in cancer surgery especially for the sake of patients with complex advanced disease. With continued advances in medical and surgical oncology, the indications for resection will expand and the value of vascular surgical expertise will be in greater demand (27).

The limitations of this study include its retrospective nature. Patients who required vascular repair had a higher incidence of baseline comorbidities, which placed them at higher risk of postoperative morbidity and resulted in a bias in the study. Long-



term follow-up data, which may have proven the survival benefits of OVS was not available.

The study had some strengths. The roles of vascular surgeons in cancer surgery are summarized with the term “OVS”. Proper use of the term may increase the MDT approach in complex cancer surgery, minimize vascular-related complications, and possibly increase patient outcomes of survival. The role of oncovascular surgeons is clearly defined and stratified as a primary surgeon and a consult surgeon. This approach may encourage vascular surgeons to show leadership in cancer surgery for the sake of patients with complex advanced disease.

In conclusion, vascular surgeons are playing various roles in advanced cancers as a primary or consult surgeon. The need for vascular surgery services is substantial and is increasing, across multiple specialties. Vascular surgeons need to take leadership in building a multidisciplinary team for resecting advanced tumors with major vessel invasion and making vascular surgery the primary specialty for treating retroperitoneal tumors or vessel-origin tumors. Preoperative consultation results in better outcomes than emergency intraoperative calls.

Table 1. Patient demographics and clinical characteristics

	n = 564
<b>Age (years)</b>	58.0 ± 15.0
<b>Sex, M/F</b>	287/277
<b>Body mass index (kg/m<sup>2</sup>)</b>	23.8 ± 3.7
<b>Comorbidities</b>	
Hypertension	199 (35.3)
Diabetes mellitus	114 (20.2)
Hyperlipidemia	62 (12.2)
Chronic liver disease	22 (3.9)
Chronic kidney disease	19 (3.4)
Coronary artery disease	29 (5.1)
Congestive heart failure	4 (0.7)
Cerebrovascular disease	19 (3.4)
Peripheral vascular disease	6 (1.1)
Tobacco use	59 (10.5)
Antithrombotic use	96 (17.0)
<b>Preoperative history</b>	
Prior operation	244 (43.3)
Radiotherapy	57 (10.1)
Chemotherapy	124 (22.0)

Figure 1. Yearly trend of the number of surgery from 2014 to 2018 showed rapid increase of consult surgeries.

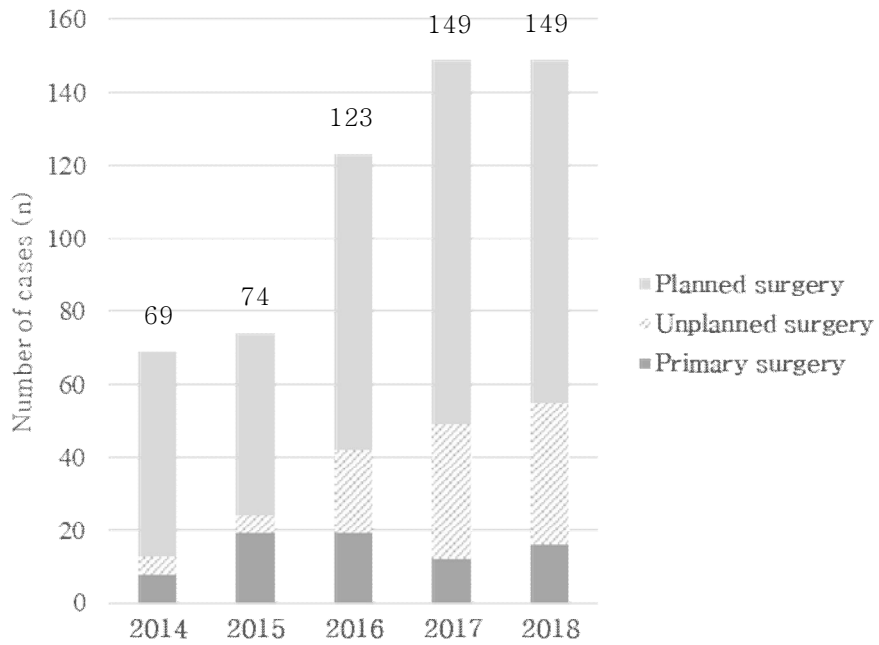
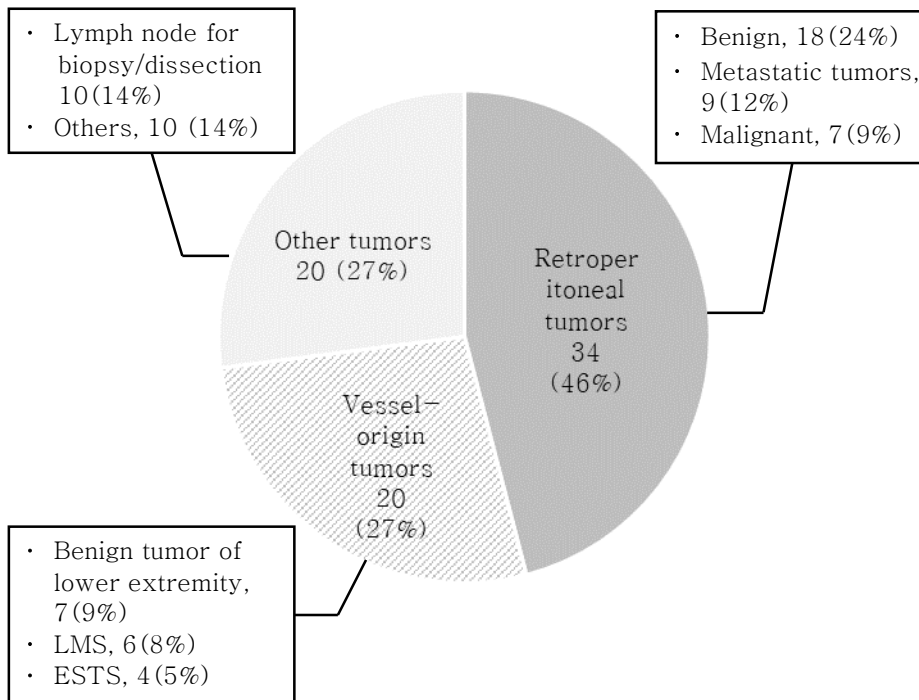


Figure 2. Distribution of primary surgery.



LMS, Leiomyosarcoma; IVLM, Intravenous leiomyomatosis; ESTS, Extremity soft tissue sarcoma.

Table 2. Distribution of the specialties requesting vascular surgery assistance

Specialty	Unplanned (n=109) n (%)	Planned (n=381) n (%)	Total (n=490) n (%)
General surgery	64 (38.8)	101 (61.2)	165 (33.7)
Plastic surgery	1 (0.8)	122 (99.2)	123 (25.1)
Urology	11 (20.4)	43 (79.6)	54 (11.0)
Orthopedics	7 (15.9)	37 (84.1)	44 (9.0)
Gynecology	20 (50.0)	20 (50.0)	40 (8.2)
Neurosurgery	0	10 (100)	10 (2.0)
Internal medicine	0	48 (100)	48 (9.8)
Intervention outside operation room	6 (100)	0	6 (1.2)

Figure 3. Yearly trend for the proportion of unplanned consult surgery

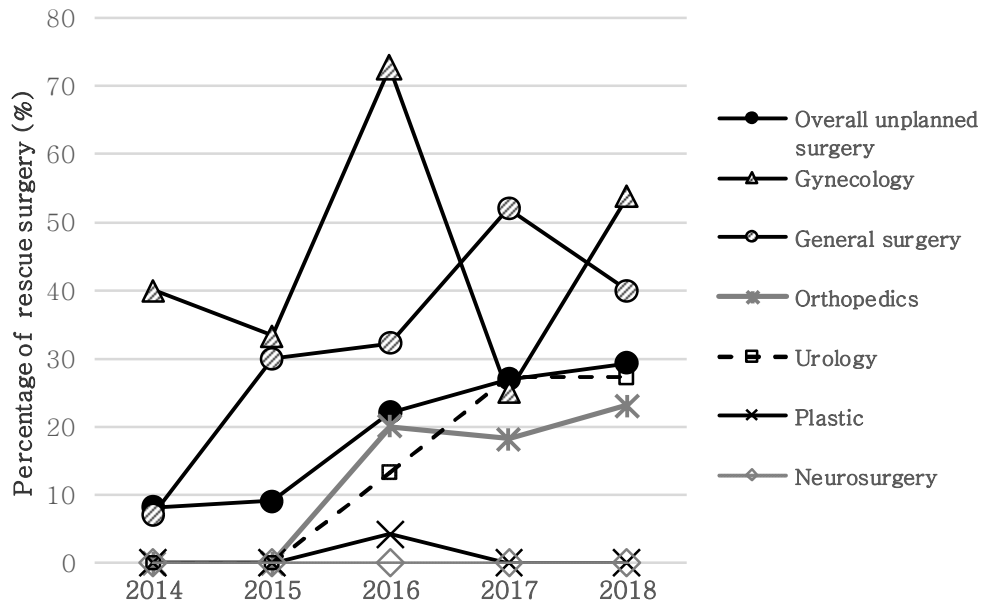


Table 3. Initial indication and number of providing procedures for consult surgeries

	Unplanned (n = 109)	Planned (n = 381)	Total (n=490)	<i>p</i> - value <sup>a</sup>
<b>Initial indication</b>				<0.001 <sup>b</sup>
Node dissection	8 (7.3)	200 (52.5)	208 (42.4)	
Vascular exposure	6 (5.5)	70 (18.4)	76 (15.5)	
Vascular invasion	37 (33.9)	91 (23.9)	128 (26.1)	
Bleeding control	44 (40.4)	14 (3.7)	58 (11.8)	
Thrombosis	2 (1.8)	4 (1.0)	6 (1.2)	
Others*	12 (11.0)	2 (0.5)	14 (2.9)	
<b>Number of providing procedures</b>				0.041 <sup>b</sup>
1	77 (70.6)	304 (79.8)	381 (77.8)	
2	29 (26.6)	60 (15.7)	89 (18.2)	
3	5 (4.6)	12 (3.1)	17 (3.7)	
4	0	3 (0.8)	3 (0.6)	

<sup>a</sup> Statistical significant when *p* - value < 0.05, <sup>b</sup> Chi-square analysis or

Fisher exact test

Table 4. Intraoperative and postoperative variables for consult surgeries

	Unplanned (n = 109)	Planned (n = 381)	Total (n = 490)	<i>p</i> - value <sup>a</sup>
<b>Intraoperative variables</b>				
Total operative time (minutes)	320.2 ± 140.8	248.2 ± 169.7	253.7 ± 170.2	<0.001 <sup>b</sup>
EBL (mL)	4241.1	1147.3	1758.9	<0.001 <sup>b</sup>
Intraoperative mortality (n, %)	1 (1.0)	0	1 (0.2)	0.061 <sup>c</sup>
<b>Postoperative variables</b>				
Length of hospital stay (days)	20.4 ± 18.6	16.3 ± 17.9	16.4 ± 17.3	0.002 <sup>b</sup>
Postoperative consult (n, %)	46 (42.2)	50 (13.1)	96 (19.6)	<0.001 <sup>c</sup>
<b>Postoperative vascular surgery related complications (n, %)</b>				
Total	9 (8.3)	11 (2.9)	20 (4.1)	0.012 <sup>c</sup>
Occlusion	6 (5.5)	4 (1.0)	10 (2.0)	0.010 <sup>c</sup>
Hemorrhage	3 (2.8)	1 (0.3)	4 (0.8)	0.036 <sup>c</sup>
Wound infection	0	4 (1.0)	4 (0.8)	0.580 <sup>c</sup>
Lymphatic leakage	0	2 (0.5)	2 (0.4)	1.000 <sup>c</sup>
Vascular reoperation (n, %)	2 (1.8)	2 (0.5)	4 (0.8)	0.216 <sup>c</sup>
30-day mortality (n, %)	3 (2.8)	2 (0.5)	5 (1.0)	0.076 <sup>c</sup>

<sup>a</sup> Statistical significant when *p* - value < 0.05, <sup>b</sup> Mann Whitney U-test, <sup>c</sup> Chi-square analysis or Fisher's exact test, EBL; Estimated blood loss



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## 요약 (국문초록)

**목적:** 혈관외과 의사들은 다양한 분야의 타과 수술 시 협진수술을 많이 하는데, 특히 완전한 절제가 중요한 종양 수술 시에 더욱 그렇다. 종양 절제 수술에서 혈관을 다루는 ‘종양혈관외과 (Oncovascular surgery)’의 개념이 최근 제기 되었다. 하지만 이러한 역할은 충분히 정량화되거나 평가되지 않았다. 본 연구의 목적은 종양혈관외과 수술과 비혈관외과 수술에서 혈관외과의사의 다양한 역할에 대해 분석하는 것이다.

**방법:** 본 연구는 서울대학교병원의 전향적 혈관외과 등록체계에서 2014년부터 2018년까지 5년 동안의 자료를 수집하여, 혈관외과 의사들이 단독 또는 협진 수술로 시행한 종양혈관외과 및 비혈관외과 수술에 대하여 분석하였다. 전자의무기록과 영상자료를 검토하여 환자정보, 임상양상, 수술기록, 혈관 관련자료, 합병증 등을 후향적으로 수집하였다. 수술은 단독수술과 협진수술로 분류하고, 협진수술은 예정수술과 응급수술로 구분하였다.

**결과:** 전체 564 건의 수술 중 혈관외과 단독으로 시행한 종양혈관외과 수술은 74 건이었으며, 후복막강 종양이 가장 많았다 (34, 45.9%). 협진수술은 총 490 건이었고, 이중 응급수술은 109 건 (22.2%) 이었다. 최근 5년간 협진수술은 115.9%가 증가하였고, 응급수술의 비율도 증가하였다. 협진수술 의뢰는 외과가 가장 많았다 (165, 33.7%).

응급수술의 가장 흔한 원인은 출혈이고, 예정수술의 가장 흔한 원인은 림프절 박리였다. 예정수술과 응급수술간 비교하면 사망률은 차이가 없었으나 전체 수술 시간, 병원 입원 기간, 수술 후 협진 의뢰, 그리고 수술 후 혈관 수술 관련 합병증이 응급수술 군에서 유의하게 많았다.

**결론:** 중앙혈관외과 수술은 근치적 암 수술에 있어 매우 중요한 개념으로, 혈관외과 의사는 접근하기 어려운 후복막강 종양 및 혈관 기원 종양 절제 수술의 일차 집도의의 역할 및 타과 분야에서 협진 수술의 조력자로서 중요한 역할을 하고 있다. 협진수술 중 예정수술이 응급수술보다 수술 후 혈관 수술 관련 합병증이 유의하게 적었다. 하지만 예상과 달리 예정수술보다 응급수술 비율이 더 증가하고 있음을 알 수 있다. 중앙혈관외과 수술은 환자의 안전을 증가시키고 합병증을 줄이기 위한 것으로 수술 전 협진을 통해서 수술을 같이 계획, 진행하고 수술 후 관리를 다학제적 접근법으로 시행하는 것이 가장 이상적이라고 하겠다. 수술 전 검사 시 혈관침범이 의심되거나 혈관손상의 우려가 있을 경우 미리 혈관외과의사와 상의하는 것이 매우 중요하다.

**주요어 :** 중앙혈관외과수술, 혈관외과, 혈관 재건, 협진 수술, 후복막강 종양, 혈관 기원 종양

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