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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии
საქართველოს სამედიცინო სიახლე

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებშიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman (Кириллица)**, для текста на грузинском языке следует использовать **AcadNusx**. Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - <http://www.spinesurgery.ru/files/publish.pdf> и http://www.nlm.nih.gov/bsd/uniform_requirements.html В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректур авторам не высылаются, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or computer-printed on a single side of standard typing paper, with the left margin of 3 centimeters width, and 1.5 spacing between the lines, typeface - **Times New Roman (Cyrillic)**, print size - 12 (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

**Articles that Fail to Meet the Aforementioned
Requirements are not Assigned to be Reviewed.**

ავტორთა საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx**. შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგების ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფხიხლებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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VIDEO-ASSISTED THORACOSCOPIC RESECTION OF THE LEFT BRACHIOCEPHALIC AND SUPERIOR VENA CAVA FOR PRIMARY AND RECURRENT THYMIC TUMORS

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Abstract.

Objective: To evaluate the technical feasibility, safety, and short-term outcomes of video-assisted thoracoscopic surgery (VATS) resections of the left brachiocephalic vein (LBCV) and superior vena cava (SVC) in patients with primary and recurrent anterior mediastinal tumors.

Material and methods: A retrospective analysis of 9 patients who underwent VATS resection of the LBCV and/or SVC for thymic tumors between 2015 and 2025 was performed. Inclusion criteria: tumor invasion into venous trunks. Exclusion criteria: need for vascular grafting, invasion of more than one-third of the SVC circumference, tumor thrombosis, distant metastases (M1b).

Results: R0 resection was achieved in all cases. Median blood loss was 110 ml, operative time – 330 min, postoperative hospital stay – 4 days. Grade I complications occurred in 3 patients; no mortality was observed. Median follow-up was 24 months. Local recurrence at the resection site occurred in 1 case (after tangential LBCV resection), regional recurrence (pleural dissemination) – in 1 patient with initial stage IVa disease, distant metastases – in 2 patients with neuroendocrine tumors.

Conclusion: In strictly selected patients with thymic tumors, VATS resection of major veins is technically feasible and associated with low morbidity. Tangential LBCV resection carries a risk of local recurrence; therefore, complete vein transection is preferable. Further studies are required to assess long-term outcomes.

Key words. VATS, thymoma, superior vena cava, brachiocephalic vein, resection, minimally invasive surgery.

Introduction.

Surgical treatment of anterior mediastinal tumors invading the major venous trunks remains a complex clinical challenge. For lesions involving of the superior vena cava (SVC) and/or left brachiocephalic vein (LBCV), median sternotomy is the gold standard, providing wide access for vascular resection and reconstruction [1-4]. However, in cases of recurrent neoplasms or following prior radiation therapy, redo sternotomy is associated with a high risk of complications and increased surgical trauma [5,6].

The introduction of video-assisted thoracoscopic surgery (VATS) in thoracic oncology has significantly reduced surgical invasiveness in the treatment of early-stage thymomas without compromising long-term oncological outcomes [7,8]. However, the application of minimally invasive technologies for locally advanced lesions involving the major veins has long been considered limited due to the technical complexity of the vascular stage and the need for radical en bloc resection (R0).

In recent years, sporadic reports have appeared regarding successful VATS resections of the SVC and LBCV for thymomas [9-11]; however, most of these contain single-case descriptions. Data on thoracoscopic interventions involving the left brachiocephalic vein, particularly in recurrent tumors, are reported in the available literature as single cases [12]. Patient selection criteria, as well as the safety and oncological efficacy of such surgeries, remain uncertain.

The study aimed to evaluate the technical feasibility, safety, and immediate outcomes of LBCV and SVC thoracoscopic resections in patients with primary and recurrent anterior mediastinal tumors.

Materials and Methods.

A retrospective analysis was conducted on a clinical case series involving patients who underwent video-assisted thoracoscopic (VATS) resection of major mediastinal veins between 2015 and 2025 at the N.N. Alexandrov National Cancer Centre of Belarus.

Inclusion criteria: patients with primary or recurrent anterior mediastinal tumors (thymoma, thymic cancer, sarcoma); tumor invasion into the superior vena cava (SVC) and/or the left brachiocephalic vein (LBCV), confirmed by CTA/MRI data; instances where R0 resection through VATS was considered viable based on preoperative imaging and additional diagnostic evaluations.

Exclusion criteria: need for prosthetic replacement or complex vascular grafting; invasion of more than one-third of the SVC circumference; SVC tumor thrombosis; presence of extrathoracic metastases (M1b).

At the outpatient stage, all patients underwent contrast-enhanced computed tomography (CECT) and/or MRI to assess the extent of invasion and collateral circulation status, as well as to plan the resection volume. In cases of suspected recurrence, PET/CT was performed.

The surgical approach was determined by tumor location (lateralization), invasion zone, number of adjacent structures subject to resection, and the patient's anatomical features. For LBCV lesions, uniportal lateral (right- or left-sided) as well as bilateral and subxiphoid approaches were applied. Marginal resection of the SVC was performed via a right-sided lateral or subxiphoid approach. Resection principles were consistent with the recommendations of the International Thymic Malignancy Interest Group [13]. The key principle was adherence to the "no-touch, tumor last" technique to preserve tumor capsule integrity.

Technical aspects of LBCV resection. The key condition for resectability was the presence of at least 10 mm of tumor-free proximal and distal venous segments, sufficient for safe application of an endostapler. The vein was mobilized after dissection of the cardiophrenic adipose tissue and thymus. To

improve visualization in patients with a high vein location, caudal traction using a vessel loop was applied (Figure 1).

The vein was transected using an endoscopic stapling device. Control of the SVC confluence and the right brachiocephalic vein was ensured to prevent iatrogenic stenosis. In cases of difficulty mobilizing the tumor upper pole or controlling the position of the endostapler on the LBCV, a combined approach (VATS + cervical suprasternal incision) was applied.

A hybrid approach combining VATS and cervical suprasternal incision was planned or adopted intraoperatively in situations with one or more of the following features: suspected dense adhesions after radiotherapy or previous surgery, recurrence located near the venous confluence, inability to safely control the proximal LBCV/SVC margins thoracoscopically, or uncertainty regarding endostapler positioning. The cervical access allowed direct palpation of the tumor superior pole, safer vascular control, and visual confirmation of stapler placement to minimize the risk of iatrogenic stenosis or incomplete resection.

After transecting the distal (or proximal) segments, the mobilized end of the vein was displaced into the contralateral pleural cavity en bloc with the tumor. Traction of the vein to the opposite side allowed for stapling and transection of the remaining segment using an endostapler under visual control.

In patients with recurrent neoplasms and a history of radiation therapy, surgery began with dissection of the proximal and distal veins from adhesions, followed by application of stapling devices (Figure 2). Final dissection of the tumor was performed only after vein resection.

One patient underwent marginal resection of the LBCV using a technique analogous to that described by Yano et al. [9].

Technical aspects of SVC resection. Invasion of no more than 30% of the vein circumference was considered the indication for marginal SVC resection. Following complete mobilization of the thymus and mediastinal adipose tissue, the aorto-caval space was dissected. The SVC was secured with vessel loops. An endostapler was applied parallel to the vein axis, capturing the invasion area so that the residual lumen remained at least 50% of the original one, according to the technique described by Xu et al. [14]. In recurrent tumors with extensive adhesions, preliminary vein dissection was minimized to reduce the risk of hemorrhage, and dissection was performed directly in the area of planned transection (Figure 3).

The following parameters were analyzed: operative time, intraoperative blood loss, conversion incidence, postoperative complications (according to the Clavien-Dindo classification),

duration of drainage and hospital stay, radicality of surgery (R0) based on morphological examination, as well as follow-up duration and status.

Statistical analysis was performed using IBM SPSS Statistics v.26 (IBM Corp., USA). Due to the limited sample size, quantitative variables are presented as median and range (minimum–maximum). Categorical variables were described as absolute and relative incidences (%).

Results.

Between 2015 and 2025, video-assisted thoracoscopic resection of major mediastinal veins was performed in 9 patients. Clinical and demographic characteristics of each case and surgical outcomes are shown in Table 1.

Median age of the patients was 56 [45; 62] years. Radical tumor resection (R0) was achieved in all 9 cases. Median intraoperative blood loss was 110 mL (range: 10-250 mL), median operative time – 330 min (range: 90-360). Median duration of pleural drainage was 2 (range: 1-3) days, median postoperative hospital stay – 4 days (range: 3-12) days. Postoperative complications corresponding to Clavien-Dindo Grade I were observed in 3 patients. No mortality was reported in the early postoperative period.

Median postoperative follow-up was 24 months. During this period, the following long-term outcomes were observed:

Local recurrence was observed in one case (Patient 1) after marginal resection of the left brachiocephalic vein (LBCV). Despite morphologically tumor-free resection margins (R0) confirmed by review of histological specimens, tumor thrombus in the LBCV and superior vena cava (SVC) was diagnosed 11 months after surgery (Figure 4). The patient died 15 months after surgery due to disease progression with brain metastases.

Locoregional progression associated with intraluminal tumor thrombus formation in the LBCV and SVC was observed in one patient (Patient 1) following marginal LBCV resection. Although histologically negative margins (R0) were achieved, it remains unclear whether this represented true local recurrence from occult residual disease or secondary tumor thrombus formation promoted by altered venous hemodynamics. This uncertainty supports caution regarding marginal LBCV resection.

Regional recurrence, manifesting as pleural dissemination, occurred in one patient with stage IVa thymoma (Patient 2) 48 months after surgery (partial pleurectomy and atypical lung resections were performed intraoperatively due to solitary metastases).

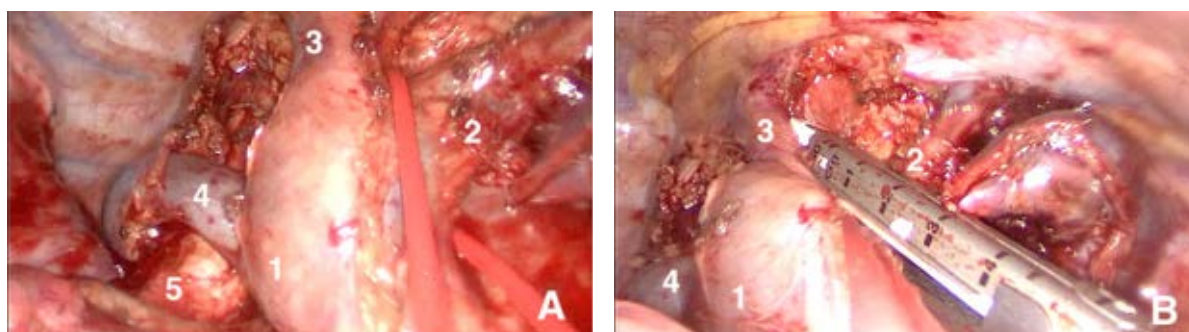


Figure 1. Mobilization of major mediastinal veins (A) and transection of distal LBCV segment (B): 1 – SVC; 2 – LBCV; 3 – right brachiocephalic vein; 4 – azygos arch; 5 – trachea.

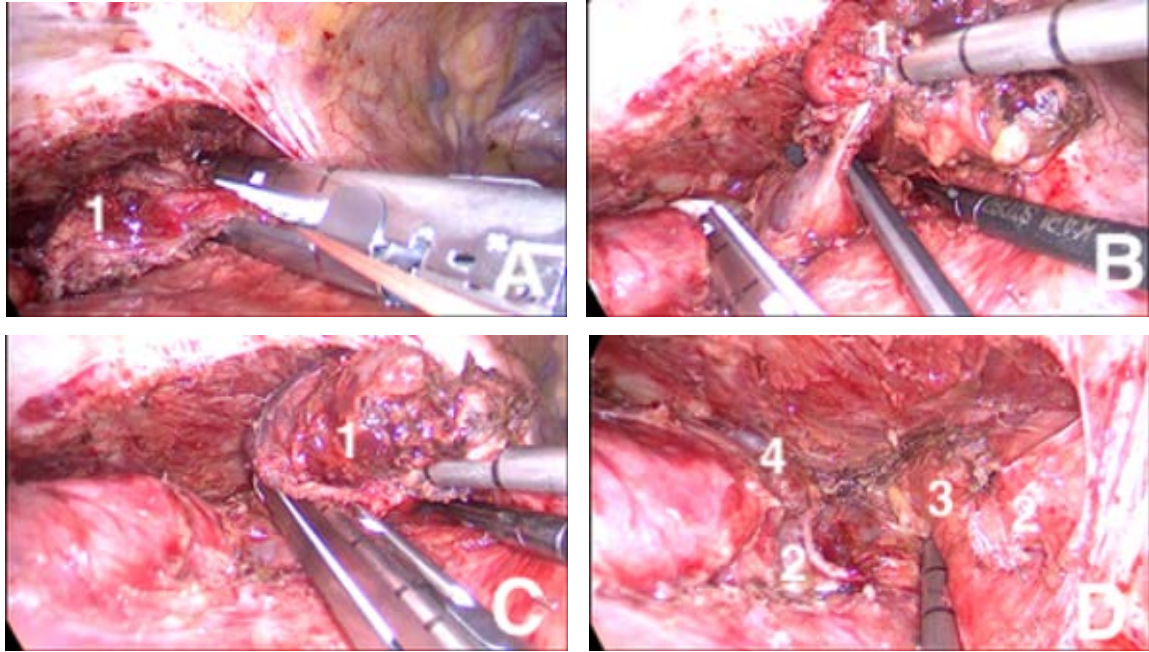


Figure 2. Video-assisted thoracoscopic resection of local thymoma recurrence with LBCV invasion: A – stapling and transection of proximal LBCV segment; B – application of endostapler to the LBCV distal segment with confluence control; C – stapling and transection of the LBCV distal segment; D – view of surgical field following LBCV resection. 1 – tumor; 2 – LBCV stumps; 3 – brachiocephalic arterial trunk; 4 – right internal thoracic vein.

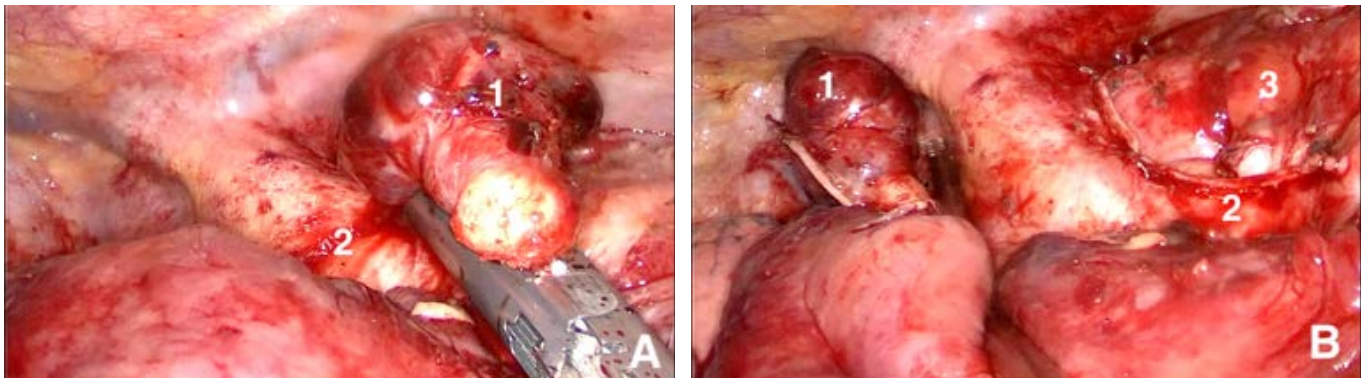


Figure 3. Video-assisted thoracoscopic resection of 2nd recurrence of undifferentiated sarcoma with SVC invasion (pericardium over the vein and right atrium had been previously resected): 1 – tumor; 2 – SVC; 3 – right atrium.

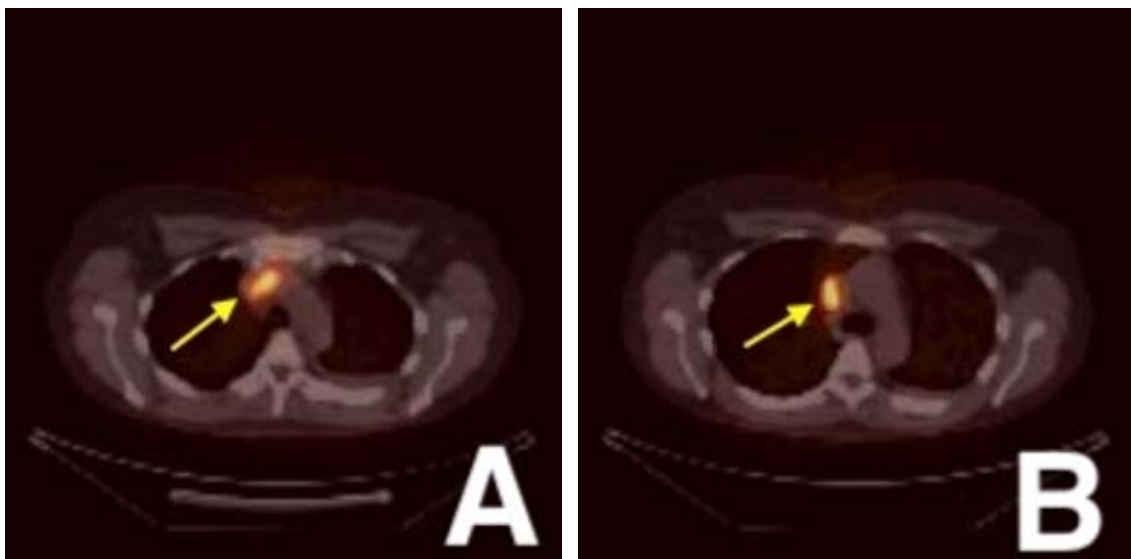


Figure 4. PET/CT of Patient 1 with intraluminal tumor thrombus in the LBCV (A) and SVC (B) (arrow indicates thrombus).

Table 1. Clinical and demographic characteristics and perioperative outcomes.

Parameter	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9
Sex	F	M	F	M	F	F	F	F	F
Age, years	45	35	46	58	45	72	56	61	64
Diagnosis, stage	NET, T3N0M0	Thymoma B1, T3N2M1	Undifferentiated sarcoma	NET, T1N2M1	NET, T3N2M0	NET, T3N0M0	Thymoma B2, T3N0M0	Undifferentiated sarcoma	Thymoma B1, T2N0M0
Tumor type	Primary	Primary	2nd recurrence	Primary	Recurrence	Recurrence	Primary	Primary	Recurrence
Tumor size, cm	6×4.5×3	13×6×4	4.5×4×2.5	11×5×4	2.9 and 1.8	3.5×2.2×2.2	3.5×2.2×2.4	8.5×8×6.5	3.8×2.5×2
VATS approach	Right-sided triportal	Bilateral uniportal	Right-sided uniportal	Right-sided uniportal + cervical	Right-sided uniportal	Subxiphoid uniportal + cervical	Left-sided uniportal	Right-sided uniportal	Subxiphoid uniportal
Resected vessel	LBCV	LBCV	SVC	SVC	LBCV	LBCV, SVC	LBCV	LBCV, SVC	LBCV
Resection of adjacent structures	None	Pericardium, lung, pleura	Pericardium, diaphragm, pleura	Phrenic nerve	Lymph node dissection	Pericardium	None	Lung, pericardium	None
Operative time, min	180	330	335	320	340	360	170	360	90
Blood loss, mL	110	100	50	180	160	250	70	230	10
Radicality (R0)	R0	R0	R0	R0	R0	R0	R0	R0	R0
Duration of drainage, days	1	3	2	4	3	3	1	2	1
Length of hospital stay, days	12	4	4	5	7	5	4	4	3
Complications (Clavien-Dindo Grade)	Dystele-tasis (I)	None	None	None	Small hydropneu-mothorax (I)	Dystele-tasis (I)	None	None	None
Follow-up, months	15	66	24	45	15	24	36	26	6
Status at last follow-up	Died of metastases	Alive with recurrence	Alive	Alive with recurrence	Alive	Alive	Alive	Alive	Alive

NET – neuroendocrine tumor.

Distant metastases developed in two patients with thymic neuroendocrine tumors. One patient developed liver metastases 42 months after surgery, while another experienced brain metastases associated with intraluminal tumor progression and died 15 months after surgery.

Thus, the incidence of locoregional recurrence at the vascular resection site was 11% (1/9). No cases of local recurrence were observed in the remaining 8 patients.

Discussion.

The presented clinical case series demonstrates that video-assisted thoracoscopic resection of the LBCV and SVC is technically feasible and safe in strictly selected patients with primary and recurrent thymic tumors. R0 resection was achieved in all 9 cases (without mortality), and postoperative complications (33%) were limited to Clavien-Dindo Grade I, which meets the criteria for an uncomplicated course. It is important to emphasize that in our study, the extent of intervention was limited to marginal resection of the SVC or complete transection of the LBCV. This allows us to consider the proposed approach a less invasive alternative designed for patients with limited invasion into major veins.

Immediate outcome (blood loss, duration of drainage and hospital stay) were predictably better than those of open surgeries, which is consistent with the general advantages of

video-assisted thoracoscopic surgery [7,8]. With regard to safety, in large series of open SVC resections performed for mediastinal malignancies, mortality ranges from 0 to 8%, and the incidence of severe complications (Grades III–V) reaches 20–30%, particularly in cases of prosthetic replacement [2–4]. In our study, despite the lack of prosthetic replacement and limited resection volume, the absence of mortality and complications above Grade II demonstrates an acceptable safety profile of the minimally invasive technique in carefully selected patients. In patients with recurrent tumors and a history of radiation therapy (n=4), the minimally invasive approach allowed for avoidance of risks associated with redo sternotomy, such as massive hemorrhage [5,6].

Our results of SVC marginal resection in 2 patients are consistent with data reported by Xu et al. [14], who first described the technique of applying an endostapler parallel to the vein axis while preserving at least 50% of the lumen. In our series, none of the patients developed clinically significant venous stenosis or superior vena cava syndrome after SVC resection, which confirms the safety of this technique in cases with invasion of no more than 30% of the vessel circumference.

Analysis of left brachiocephalic vein resections performed in 8 patients is of particular interest. In seven cases, complete vein transection was performed using an endostapler, which

represents the most radical and technically straightforward option. Literature data indicate that LBCV ligation (or resection) without reconstruction is well tolerated by patients due to the development of collateral venous outflow, and the incidence of clinically significant venous compromise does not exceed 30% [15].

We approach marginal resection of the LBCV with caution, and clinical follow-up of Patient No. 1 supports the validity of this skepticism. Despite morphologically tumor-free resection margins (confirmed by two histologists), tumor thrombosis developed in the LBCV stump and SVC 11 months after surgery (Figure 4), and the patient died due to disease progression. We hypothesize that the use of a 6-row linear stapler on a limited segment of the vein may have created conditions for turbulence and subsequent thrombosis, and the presence of micrometastases in the adventitia, undetected by standard histological examination, may have served as a basis for tumor thrombus growth. Yano et al. [9] described marginal resection of the LBCV as a technically feasible procedure; however, their report was based on a single case without assessing long-term outcomes. Our experience suggests that marginal resection of the LBCV carries a potential risk of locoregional recurrence, and preference should be given to complete vein transection using an endostapler proximally and distally to the invasion site.

In two patients (No. 4 and No. 6), we supplemented the thoroscopic stage with a cervical incision. This made it possible to palpate the superior pole of the tumor (particularly important in recurrences in the setting of cicatricial changes), safely introduce the endostapler, and visually control the venous confluence to prevent iatrogenic stenosis. This hybrid approach has not been previously described in the literature; however, we believe it may be beneficial in complex anatomical situations, particularly after radiotherapy or for redo surgeries. The subxiphoid uniportal approach, used in two patients (No. 6 and No. 9), demonstrated positive outcomes and ensured excellent visualization of both pleural cavities, which is consistent with the findings of Zhao et al. [11].

At a median follow-up of 24 months, locoregional recurrence at the vascular resection site occurred in only one case (11%), which can be considered an acceptable outcome for locally advanced and recurrent tumors. In one patient with stage IVa thymoma (No. 2), pleural dissemination developed after 48 months, which is consistent with the natural course of the disease at de novo advanced stage and is in line with data provided by international registries [13]. Two patients with thymic neuroendocrine tumors developed distant metastases (brain, liver), which reflects the aggressive biological potential of these neoplasms.

The present study is subject to several limitations. First, it has a retrospective design and a small sample size, which is typical for studies on rare pathologies. Second, the heterogeneity of tumor histological types (thymomas, neuroendocrine tumors, sarcomas) makes it challenging to ensure unambiguous interpretation of oncological outcomes. Third, the medium-term follow-up period (median 24 months) does not allow for definitive conclusions regarding long-term survival. Nevertheless, given the rarity of such interventions, the presented series contributes significantly to the understanding of

the capabilities and limitations of video-assisted thoracoscopic resections of major veins.

Our study demonstrates that with strict selection criteria (invasion involving no more than 30% of the SVC circumference, presence of at least 10 mm of tumor-free LBCV segments, absence of tumor thrombosis, and compensated collateral circulation), VATS resection of mediastinal veins can serve as a safe alternative to sternotomy. This approach is of particular value for patients with recurrent tumors and those who have undergone prior radiation therapy, where redo sternotomy carries a high risk of massive hemorrhage [5,6].

Conclusion.

Video-assisted thoracoscopic resection of major mediastinal veins (SVC, LBCV) in primary and recurrent thymic tumors is technically feasible in carefully selected patients (invasion <30% of SVC circumference, presence of tumor-free segments of LBCV) and is associated with a low postoperative complication rate and no mortality. The mid-term oncological outcomes (absence of local recurrence at the resection site in 8 of 9 patients) are encouraging. However, the case of thrombosis and local recurrence following marginal LBCV resection – despite morphologically tumor-free margins – indicates the potential risks associated with this technique. Complete LBCV transection using an endostapler should be considered the preferred approach. To definitively evaluate long-term outcomes and refine selection criteria, further multicenter studies with a larger number of cases are required.

Author contributions.

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მარცხენა მხარ-თავის და ზემო ღრუ ვენების ვიდეოთორაკოსკოპიული რეზექცია თიმუსის პირველადი და მორეციდივე სიმსივნეების დროს

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