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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

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 ВИНИТИ 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 ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

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. Корректура авторам не высылается, 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 compu-ter-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 საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ 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 შეღებვის 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 ფჩხილებში 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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LYMPHOVASCULAR AND PERINEURAL INVASION IN RELATION TO THE PRESENCE AND BURDEN OF NODAL METASTASIS IN RESECTED GASTRIC CANCER

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Abstract.

Aim: To evaluate the association of lymphovascular invasion (LVI) and perineural invasion (PNI) with the presence and burden of regional lymph node metastasis in patients undergoing gastric cancer resection.

Materials and Methods: This retrospective single-centre study included 312 patients with resected, histologically confirmed gastric adenocarcinoma at the University Clinical Center of Kosovo between January 2020 and December 2025. Lymph node metastasis (LNM) was defined as at least one positive regional lymph node, and high nodal burden as pN2-pN3 disease (at least three positive regional lymph nodes). Multivariable logistic regression included LVI, PNI, pathological tumour size, histological grade and pT category.

Results: LNM was present in 212 patients (67.9%), and high nodal burden was identified in 144 (46.2%). PNI was associated with the presence of LNM (72.6% vs 58.7%, p=0.018) but was not independently associated with high nodal burden (adjusted odds ratio [aOR], 1.25; 95% CI, 0.76-2.07; p=0.380). LVI was associated with LNM (72.1% vs 57.8%, p=0.020) and high nodal burden (50.9% vs 34.4%, p=0.012); the latter association remained after adjustment (aOR, 1.97; 95% CI, 1.16-3.33; p=0.012). Compared with pT1 disease, pT3 and pT4a were independently associated with high nodal burden (aOR, 3.61; 95% CI, 1.44-9.08; p=0.006; and aOR, 5.60; 95% CI, 1.95-16.13; p=0.001, respectively).

Conclusions: In resected gastric cancer, LVI and advanced pathological T category are independently associated with high nodal burden. PNI is associated with nodal involvement but did not independently identify extensive nodal disease in this cohort.

Key words. Gastric cancer, lymphovascular invasion, perineural invasion, lymph node metastasis, pathological stage.

Introduction.

Regional lymph node metastasis is a central determinant of pathological stage, adjuvant-treatment decisions and prognosis in gastric cancer. The AJCC eighth-edition N category is based on the number of metastatic regional lymph nodes: N1, 1–2; N2, 3–6; and N3, ≥7 positive nodes [1-17]. In addition to N category, the lymph node ratio (LNR) may capture the proportional nodal disease burden while accounting for the number of nodes examined [5,6,12,17].

Lymphovascular invasion and perineural invasion reflect invasive tumour biology and have been associated with nodal involvement and adverse outcomes in gastric cancer [2,3,9-11,14-16]. However, their relation to the extent, rather than only the presence, of nodal metastasis remains clinically relevant. We therefore assessed the relation of LVI and PNI to LNM and high nodal burden in a resected gastric cancer cohort.

Materials and Methods.

Study design and population:

This retrospective cohort study was conducted at the University Clinical Center of Kosovo (UCCK), Prishtina, Kosovo. A total of 450 consecutive patients with histologically confirmed gastric adenocarcinoma treated surgically between January 2020 and December 2025 were initially identified from institutional clinical, operative and pathology records. Of these, 138 patients were excluded because the available clinical, operative and/or pathology records were incomplete or could not be sufficiently verified to reliably ascertain the required study variables. The final analytical cohort included 312 patients with definitive pathological nodal assessment. Patient-level information on preoperative neoadjuvant therapy was not recorded consistently in the available records and could not be reliably verified for the entire cohort. Consequently, the cohort may include treatment-naïve and pretreated patients in unknown proportions, and neoadjuvant therapy could not be included as a covariate or used for stratified analyses. Pathological T and N categories were analysed as recorded in the original pathology reports; the distinction between pT/pN and ypT/ypN could not be confirmed consistently. Basic demographic and temporal variables could not be consistently retrieved and verified across the excluded records; therefore, a reliable comparison of age, sex and year of surgery between included and excluded patients was not possible.

Variables and definitions:

Recorded pathological variables included tumour location, largest pathological tumour diameter, histological grade, pT category, pN category, lymphovascular invasion (LVI), perineural invasion (PNI), number of examined lymph nodes and number of positive lymph nodes. LVI and PNI were initially assessed on routine hematoxylin and eosin-stained histological sections by experienced pathologists. In morphologically equivocal cases, immunohistochemical stains were used at the discretion of the reporting pathologist to support the diagnosis [8]. Lymphadenectomy was performed according to the extent of disease and intraoperative findings. Either D1 or D2 lymphadenectomy was undertaken at the discretion of the operating surgeon, in accordance with oncological principles and institutional practice. LNM was defined as at least one positive regional lymph node. High nodal burden was defined a priori as pN2–pN3 disease (≥3 positive nodes), whereas pN0–pN1 disease formed the reference group. The D1 or D2 extent

of lymphadenectomy was not documented in a sufficiently standardized and complete manner to support reliable stratified analysis. LNR was calculated as the number of positive lymph nodes divided by the number of examined lymph nodes and was retained solely as a descriptive secondary metric among node-positive patients.

Statistical analysis:

Categorical variables are reported as number (percentage) and compared using the chi-square test. Continuous variables are reported as median (IQR) and compared with the Mann–Whitney U test. Multivariable logistic regression was used to estimate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for high nodal burden. The prespecified covariates were LVI, PNI, pathological tumour size, histological grade and pT category; T1a and T1b were combined as pT1. Collinearity was assessed with variance inflation factors; all values were <4. All tests were two-sided, and $p<0.05$ was considered statistically significant. Analyses were performed using Python 3.12.13 with pandas 2.2.3, SciPy 1.17.0 and scikit-learn 1.8.0. Proportions displayed in Figure 1 are accompanied by two-sided 95% Wilson score confidence intervals. LNR was not entered into inferential or multivariable models.

Ethics:

The study protocol, including the retrospective use of clinical and follow-up data, was approved by the Ethics Committee of the Kosovo Medical Chamber (Approval No. 32/09.01.2025). Because of the retrospective nature of the study and the exclusive use of anonymized data obtained from existing records, the requirement for individual informed consent was formally waived by the Ethics Committee. No participants were contacted for the purposes of this study. The study was conducted in accordance with the principles of the Declaration of Helsinki and is reported in accordance with the STROBE Statement.

Results and Discussion.

Cohort and nodal assessment:

The cohort comprised 312 patients. Regional LNM was present in 212 patients (67.9%), while 100 (32.1%) had pN0 disease. High nodal burden (pN2–pN3) was observed in 144 patients (46.2%). The median number of examined lymph nodes was 25 (IQR, 19–32), and 257 patients (82.4%) had at least 16 lymph nodes examined. Among node-positive patients, the median LNR was 0.20 (IQR, 0.09–0.40).

LVI, PNI and presence of LNM:

LNM was more frequent in patients with LVI than in those without LVI (160/222 [72.1%] vs 52/90 [57.8%], p=0.020). It was also more frequent in patients with PNI than in those without PNI (151/208 [72.6%] vs 61/104 [58.7%], p=0.018). Patients with LVI had a higher median number of positive nodes than those without LVI (3 vs 1; p=0.022).

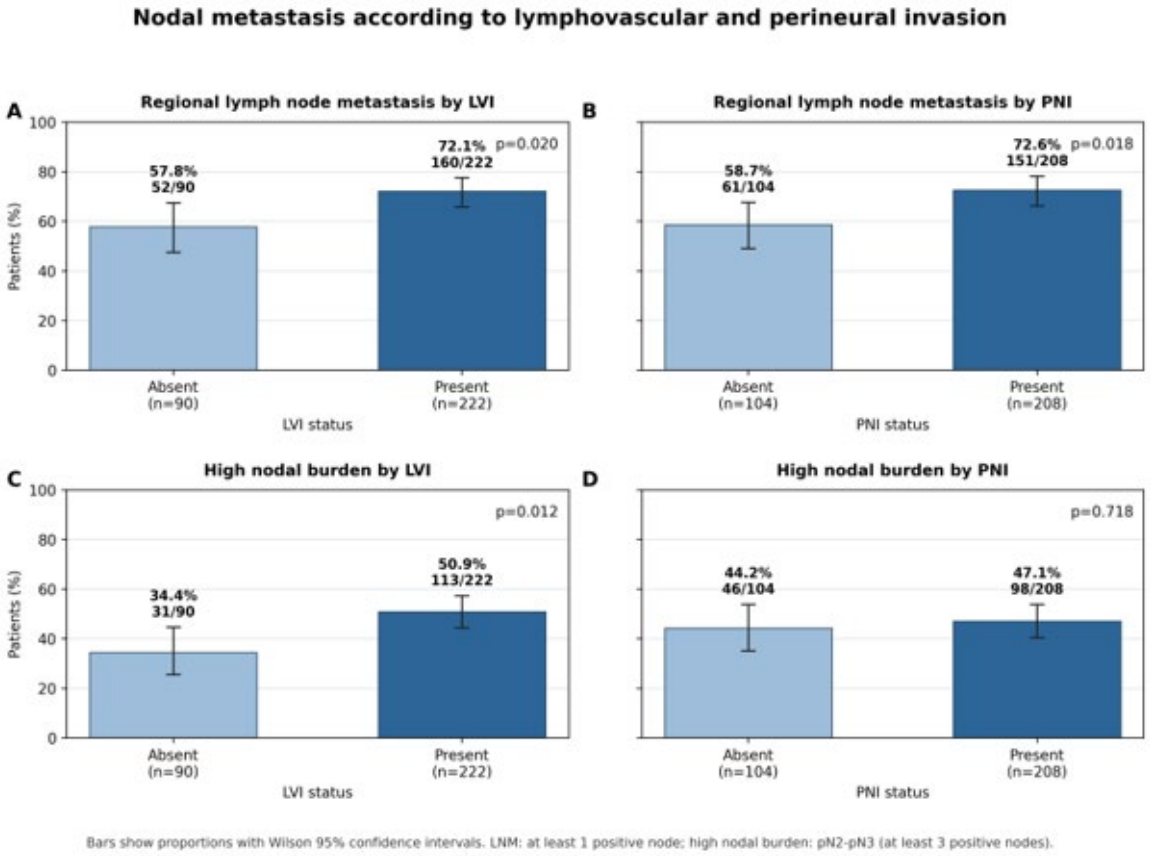


Figure 1. *Nodal metastasis according to lymphovascular invasion (LVI) and perineural invasion (PNI). (A) Presence of regional lymph node metastasis (LNM) according to LVI; (B) presence of LNM according to PNI; (C) high nodal burden according to LVI; and (D) high nodal burden according to PNI. LNM was defined as at least one positive regional node, and high nodal burden as pN2-pN3 disease (at least three positive nodes). Bars show group-specific proportions with two-sided 95% Wilson score confidence intervals. Group denominators were LVI absent, n=90; LVI present, n=222; PNI absent, n=104; and PNI present, n=208. P values were calculated with chi-square tests.*

Table 1. *Baseline demographic, operative and pathological characteristics of the study cohort (N=312).*

Characteristic	Overall (N=312)
Age, years, mean ± SD	66.6 ± 11.3
Male sex	219 (70.2%)
Total gastrectomy	178 (57.1%)
LVI positive	222 (71.2%)
PNI positive	208 (66.7%)
LNM positive	212 (67.9%)
High nodal burden (pN2–pN3)	144 (46.2%)
Examined nodes, median (IQR)	25 (19–32)
Adequate nodal harvest (≥16)	257 (82.4%)

Abbreviations: *LVI, lymphovascular invasion; PNI, perineural invasion; LNM, lymph node metastasis; IQR, interquartile range.*

Table 2. *Association of lymphovascular invasion and perineural invasion with the presence of regional lymph node metastasis.*

Variable	LNM−	LNM+	p value
LVI absent	38 (42.2%)	52 (57.8%)	0.020
LVI present	62 (27.9%)	160 (72.1%)	
PNI absent	43 (41.3%)	61 (58.7%)	0.018
PNI present	57 (27.4%)	151 (72.6%)	
Positive nodes, LVI absent vs present	median 1	median 3	0.022

LNM was defined as ≥1 positive regional lymph node. Percentages are calculated within each invasion-status group. P values are from chi-square tests; positive-node medians were compared using the Mann–Whitney U test.

Table 3. *Multivariable logistic regression analysis of factors associated with high nodal burden (pN2–pN3).*

Covariate	aOR	95% CI	p value
LVI present	1.97	1.16–3.33	0.012
PNI present	1.25	0.76–2.07	0.380
Tumour size, per cm	1.01	0.89–1.14	0.890
pT2 vs pT1	3.23	1.00–10.49	0.051
pT3 vs pT1	3.61	1.44–9.08	0.006
pT4a vs pT1	5.60	1.95–16.13	0.001

Reference groups: LVI absent, PNI absent, grade G1, and pT1. The model also included histological grade. aOR, adjusted odds ratio; CI, confidence interval.

Factors associated with high nodal burden:

High nodal burden was more frequent in patients with LVI (113/222 [50.9%]) than without LVI (31/90 [34.4%]; p=0.012). High nodal burden occurred in 98/208 patients with PNI (47.1%) and 46/104 patients without PNI (44.2%), with no evidence of an association (p=0.718). Patients with pN2-pN3 disease had a larger median pathological tumour size than those with pN0-pN1 disease (5.85 cm vs 4.90 cm; p=0.003). Advanced pT category was also associated with high nodal burden (p<0.001).

Discussion.

In this single-centre cohort of resected gastric cancers, LVI was independently associated with high nodal burden after adjustment for pathological tumour size, grade, PNI and pT category. Advanced pT category showed a graded association with extensive nodal involvement. These findings support the view that vascular/lymphatic tumour invasion identifies biologically invasive disease with a greater likelihood of regional dissemination. The pT2 estimate relative to pT1 was borderline (aOR, 3.23; 95% CI, 1.00-10.49; p=0.051). Its wide confidence interval and threshold-level p value indicate limited precision and statistical instability; it should therefore not be interpreted as a definitive independent association.

Our observation that LVI was associated with both the presence of LNM and high nodal burden is consistent with prior gastric-cancer studies linking LVI to nodal metastasis and survival [2,10,14,15]. The present analysis focused on pN2-pN3 disease as the inferential measure of extensive nodal involvement. LNR was summarized only as a descriptive secondary metric and was not evaluated as an independent exposure or outcome. The high rate of adequate nodal harvest strengthens the interpretation of pathological nodal assessment, although nodal yield alone does not remove the potential for stage migration.

PNI was associated with the presence of LNM but did not remain independently associated with high nodal burden. This distinction is clinically useful: PNI may accompany nodal dissemination, while LVI and depth of invasion more directly identify extensive nodal involvement in this dataset. Published literature similarly supports the adverse biological and prognostic significance of PNI, while its relation to nodal burden may differ by stage and treatment context [9,11,15].

The extent of lymphadenectomy may have influenced pathological nodal assessment. A more limited dissection may reduce nodal yield and fail to identify metastatic nodes, resulting in stage migration and under classification of pN category or high nodal burden. D2 lymphadenectomy generally provides more nodes for examination and may improve staging accuracy. Because dissection extent directly affects the LNR denominator

and may also influence detection of positive nodes, the direction of its effect on LNR cannot be predicted with certainty. Selection of D1 or D2 according to disease extent, operative findings or patient condition may additionally introduce confounding by indication.

The study has limitations. Its retrospective, single-centre design precludes causal inference and may limit generalisability. Survival, recurrence, adjuvant treatment and detailed histological subtype variables were not available for this analysis; therefore, this study evaluates pathological association rather than prognosis. Neoadjuvant-treatment status could not be verified reliably at the individual-patient level and was unavailable for adjustment or stratification. The cohort may therefore contain an unknown mixture of treatment-naïve and pretreated patients. The reported pathological T–N associations should not be generalized directly to patients receiving preoperative therapy, in whom tumour regression, nodal downstaging and altered detection of LVI or PNI may modify these relationships. In addition, the inability to distinguish pT/pN consistently from ypT/ypN may have introduced stage misclassification. Furthermore, 138 of 450 initially identified patients (30.7%) were excluded because required records were incomplete or unverifiable. Because age, sex and year of surgery could not be consistently recovered for the excluded group, formal comparison was not possible. If record completeness was related to calendar period, patient characteristics, disease severity, operative complexity or pathological findings, selection bias may have occurred; its direction cannot be determined, and associations may have been either overestimated or underestimated. The D1/D2 extent of lymphadenectomy was not consistently available for stratified analysis, and variation in dissection extent may have affected nodal yield, stage migration, pN distribution, high-burden classification and LNR. Finally, LVI and PNI were derived from routine pathology reports without central slide review or formal assessment of inter-observer agreement. Variation among pathologists and selective use of immunohistochemistry may therefore have caused non-differential or differential misclassification of LVI and PNI.

Conclusion.

LVI and advanced pT category were independently associated with high nodal burden in resected gastric cancer. PNI was associated with the presence of nodal metastasis but did not independently distinguish pN2–pN3 disease. These pathological features may help characterize the extent of regional dissemination after gastrectomy.

Declarations.

Conflict of Interest: The authors declare no conflict of interest.

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Author Contributions: AS: Conceptualization, data collection, statistical analysis, and manuscript drafting. FS: Methodological supervision, interpretation of results, and critical revision of the manuscript. Both authors approved the final version of the manuscript.

Ethical Approval: The study protocol, including the retrospective use of clinical and follow-up data, was approved by the Ethics Committee of the Kosovo Medical Chamber (Approval No. 32/09.01.2025). Because of the retrospective nature of the study and the exclusive use of anonymized data obtained from existing records, the requirement for individual informed consent was formally waived by the Ethics Committee. No participants were contacted for the purposes of this study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

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РЕЗЮМЕ.

Лимфоваскулярная и периневральная инвазия в связи с наличием и распространённостью метастазов в лимфатических узлах при резецированном раке желудка

Цель: Оценить связь лимфоваскулярной инвазии (LVI) и периневральной инвазии (PNI) с наличием и выраженностью регионарных метастазов в лимфатических узлах у пациентов, перенесших резекцию по поводу рака желудка.

Материал и методы: В ретроспективное одноцентровое исследование включены 312 пациентов с резецированной, гистологически подтверждённой аденокарциномой желудка, лечившихся в Университетском клиническом центре Косово в период с января 2020 по декабрь 2025 года. Метастазирование в лимфатические узлы (LNM) определяли как наличие как минимум одного положительного регионарного лимфатического узла, а высокую узловую нагрузку - как pN2-pN3 (как минимум три положительных регионарных лимфатических узла). Многофакторная логистическая регрессия включала LVI, PNI, патологический размер опухоли, гистологическую степень и категорию pT.

Результаты: LNM выявлены у 212 пациентов (67,9%), а высокая узловая нагрузка - у 144 (46,2%). PNI ассоциировалась с наличием LNM (72,6% против 58,7%; p=0,018), но не была независимо связана с высокой узловой нагрузкой (скорректированное отношение шансов [aOR] 1,25; 95% ДИ 0,76-2,07; p=0,380). LVI ассоциировалась с LNM (72,1% против 57,8%; p=0,020) и высокой узловой нагрузкой (50,9% против 34,4%; p=0,012); последняя связь сохранялась после корректировки (aOR 1,97; 95% ДИ 1,16-3,33; p=0,012). По сравнению с pT1, pT3 и pT4a независимо ассоциировались с высокой узловой нагрузкой (aOR 3,61; 95% ДИ 1,44-9,08; p=0,006 и aOR 5,60; 95% ДИ 1,95-16,13; p=0,001 соответственно).

Выводы: При резецированном раке желудка LVI и более высокая патологическая категория T независимо ассоциируются с высокой узловой нагрузкой. PNI ассоциируется с поражением лимфатических узлов, но в данной когорте не была независимым маркером распространённого узлового поражения.

Ключевые слова: рак желудка, лимфоваскулярная инвазия, периневральная инвазия, метастазы в лимфатических узлах, патологическая стадия.

რეზიუმე.

ლიმფოვასკულარული და პერინევრალური ინვაზიის კავშირი კვანძოვანი მეტასტაზების არსებობასა და სიმძიმესთან რეზეცირებულ კუჭის კიბოში

მიზანი: კუჭის კიბოს გამო რეზექციის გადატანილ პაციენტებში ლიმფოვასკულარული ინვაზიის (LVI) და პერინევრალური ინვაზიის (PNI) კავშირის შეფასება რეგიონული ლიმფური კვანძების მეტასტაზების არსებობასა და სიმძიმესთან.

მასალა და მეთოდები: რეტროსპექტულ ერთცენტრიან კვლევაში ჩართული იყო 312 პაციენტი რეზეცირებული, ჰისტოლოგიურად დადასტურებული კუჭის ადენოკარცინომით, რომლებიც მკურნალობდნენ კოსოვოს საუნივერსიტეტო კლინიკურ ცენტრში 2020 წლის იანვრიდან 2025 წლის დეკემბრამდე. ლიმფური კვანძების მეტასტაზები (LNM) განისაზღვრა, როგორც სულ მცირე ერთი დადებითი რეგიონული ლიმფური კვანძი, ხოლო მაღალი კვანძოვანი დატვირთვა - როგორც pN2-pN3 დაავადება (სულ მცირე სამი დადებითი რეგიონული ლიმფური კვანძი). მრავალცვლადიან ლოგისტიკურ რეგრესიაში შეტანილი იყო LVI, PNI, სიმსივნის პათოლოგიური ზომა, ჰისტოლოგიური ხარისხი და pT კატეგორია.

შედეგები: LNM გამოვლინდა 212 პაციენტში (67.9%), ხოლო მაღალი კვანძოვანი დატვირთვა - 144 პაციენტში (46.2%). PNI ასოცირებული იყო LNM-ის არსებობასთან (72.6% 58.7%-ის წინააღმდეგ; p=0.018), თუმცა დამოუკიდებლად არ ასოცირდებოდა მაღალ კვანძოვან დატვირთვასთან (კორექტირებული შანსების თანაფარდობა [aOR] 1.25; 95% CI 0.76-2.07; p=0.380). LVI ასოცირებული იყო LNM-თან (72.1% 57.8%-ის წინააღმდეგ; p=0.020) და მაღალ კვანძოვან დატვირთვასთან (50.9% 34.4%-ის წინააღმდეგ; p=0.012); ეს უკანასკნელი კავშირი კორექტირების შემდეგაც შენარჩუნდა (aOR 1.97; 95% CI 1.16-3.33; p=0.012). pT1-თან შედარებით, pT3 და pT4a დამოუკიდებლად ასოცირდებოდა მაღალ კვანძოვან დატვირთვასთან (aOR 3.61; 95% CI 1.44-9.08; p=0.006 და aOR 5.60; 95% CI 1.95-16.13; p=0.001, შესაბამისად).

დასკვნები: რეზეცირებულ კუჭის კიბოში LVI და უფრო მაღალი პათოლოგიური T კატეგორია დამოუკიდებლად ასოცირდება მაღალ კვანძოვან დატვირთვასთან. PNI ასოცირდება ლიმფური კვანძების ჩართვასთან, მაგრამ ამ კოჰორტაში არ იყო გავრცელებული კვანძოვანი დაავადების დამოუკიდებელი მაჩვენებელი.

საკვანძო სიტყვები: კუჭის კიბო, ლიმფოვასკულარული ინვაზია, პერინევრალური ინვაზია, ლიმფური კვანძების მეტასტაზები, პათოლოგიური სტადია.