ARAŞTIRMA MAKALESİ / *RESEARCH ARTICLE*

Sympathetic Ganglion Blocks in the Elderly: Efficacy, Safety, Analgesic Consumption, and Complications

Yaşlılarda Sempatik Ganglion Blokları: Etkinlik, Güvenlik, Analjezik Tüketimi ve Komplikasyonlar

Ahmet Basari[1], Hanzade Aybuke Unal[1], Gungor Enver Ozgencil[1], Ibrahim Asik[1]

[1]*Department of Anesthesiology and Reanimation, Division of Pain Medicine, Ankara University School of Medicine, Ankara, Türkiye*

ABSTRACT

Aim: *Chronic pain management is crucial in geriatric pain management. Sympathetic ganglion blocks are minimally invasive procedures performed in pain conditions associated with the sympathetic system, such as cancer-related, ischemic, and neuropathic pain. Data regarding the effectiveness and safety of these blocks in elderly patients are limited. This study evaluates the effects of sympathetic ganglion blocks on pain intensity, opioid consumption, and complications.*

Materials and Methods: *This retrospective cohort study included 417 patients aged ≥65 years who underwent a sympathetic ganglion block. Procedures included stellate, thoracic and lumbar sympathetic, celiac, splanchnic, hypogastric, and impar ganglion blocks. Pain intensity was assessed using the Visual Analog Scale (VAS), and opioid use was converted to morphine equivalents. Complications were classified as minor or major.*

Results: *Visual analog scale scores significantly decreased from 7.88±0.89 at baseline to 3.98±1.30 at 1 month and 5.76±1.51 at 3 months (p <0.001). Daily opioid consumption was reduced from 90.38±99.45 mg/day to 36.39±33.36 mg/day at 3 months (p <0.001), with the most pronounced decrease in malignant patients. Complications were observed in 35% of patients, primarily minor (e.g., orthostatic hypotension, Horner syndrome), while major complications were rare (e.g., pneumothorax).*

Conclusion: *Sympathetic ganglion blocks effectively reduce pain and opioid use in elderly patients with chronic pain of malignant and nonmalignant origins. Although complication rates are noteworthy, safety can be ensured with careful patient selection and follow-up.*

Key words: *analgesic agents; pain; chronic; elderly; postoperative complications; sympathetic ganglia; blocks*

ÖZET

Amaç: *Yaşlı hastalarda kronik ağrı yönetimi büyük önem taşımaktadır. Sempatik ganglion blokları, kanserle ilişkili, iskemik ve nöropatik ağrı gibi sempatik sistem ile ilişkili ağrı durumlarında uygulanan minimal invaziv girişimlerdir. Bu blokların yaşlı hastalardaki etkinliği ve güvenliği ile ilgili veriler sınırlıdır. Bu çalışma, sempatik ganglion bloklarının ağrı şiddeti, opioid tüketimi ve komplikasyonlar üzerindeki etkilerini değerlendirmektedir.*

Gereç ve Yöntem: *Bu retrospekstif kohort çalışmasına 65 yaş ve üzeri sempatik ganglion bloğu uygulanan 417 hasta dâhil edildi. Uygulanan işlemler arasında stellat, torasik sempatik, lomber sempatik, çölyak, splanknik, hipogastrik ve impar ganglion blokları yer aldı. Ağrı şiddeti Görsel Analog Skala (VAS) ile ölçüldü ve opioid tüketimi morfin eşdeğerine çevrildi. Komplikasyonlar minör ve majör olarak sınıflandırıldı*

Bulgular: *VAS skorları başlangıçta 7,88±0,89 iken, 1. ayda 3,98±1,30 ve 3. ayda 5,76±1,51'ye anlamlı şekilde azaldı (p <0,001). Günlük opioid tüketimi 90,38±99,45 mg/gün'den 3. ayda 36,39±33,36 mg/gün'e düştü (p <0,001); en belirgin azalma malign hastalarda gözlendi. Hastaların %35'inde komplikasyon görüldü; bunlar çoğunlukla minör (örneğin ortostatik hipotansiyon, Horner sendromu) iken, majör komplikasyonlar nadirdi (örneğin pnömotoraks).*

Sonuç: *Sempatik ganglion blokları, malign ve nonmalign kökenli kronik ağrısı olan yaşlı hastalarda ağrı ve opioid kullanımını etkili şekilde azaltmaktadır. Komplikasyon oranları dikkate değer olmakla birlikte, dikkatli hasta seçimi ve izlem ile güvenlik sağlanabilir.*

Anahtar kelimeler: *analjezik ajanlar; ağrı; kronik; yaşlı; postoperatif komplikasyonlar; sempatik ganglionlar; bloklar*

İletişim/Contact: *Ahmet Başarı, Department of Anesthesiology and Reanimation, Division of Pain Medicine, Ankara University School of Medicine, Ankara, Türkiye* • ***Tel:*** *0552 492 35 10* • ***E-mail:*** *dr.ahmetbasari07@hotmail.com* • ***Geliş/Received:*** *19.06.2025* • ***Kabul/Accepted:*** *10.02.2026*

ORCID: *Ahmet Başarı: 0000-0002-6870-2282* • *Hanzade Aybüke Ünal: 0000-0003-1598-1844* • *Güngör Enver Özgencil: 0000-0002-9624-9649* • *İbrahim Aşık: 0000-0002-4800-3150*

Kafkas J Med Sci 2026; 16(1):96–102
doi: 10.5505/kjms.2026.96992

Introduction

Advances in healthcare have increased life expectancy and expanded the elderly population (1). Aging is associated with multiple health problems, including pain, which is common but not a natural part of healthy aging (2,3). Musculoskeletal, vascular, neuropathic, and cancer-related pain are more prevalent in older adults (4). Pain management in this population is often challenging because of comorbidities, polypharmacy, physiological changes, drug interactions, and variable treatment responses (5). Minimally invasive interventions may improve outcomes by reducing analgesic requirements, limiting drug-related adverse effects, and improving quality of life (6). Sympathetic ganglion blocks are minimally invasive techniques used for autonomic-related conditions such as visceral and ischemic pain, cancer-related pain, and neuropathic pain (7). These techniques, including stellate, thoracic and lumbar sympathetic, splanchnic, celiac, impar, and hypogastric ganglion blocks, have been used for more than a century (8). Previous studies have shown that these blocks reduce pain scores and analgesic use, improve quality of life and function, and have acceptable safety profiles in malignant and nonmalignant conditions (8,9). However, most studies include heterogeneous age groups, and the efficacy and safety of these techniques remain less clear in elderly patients. Studies specifically focusing on older adults are limited (3–5,10–13). This study aimed to evaluate the effects of sympathetic ganglion blocks on pain intensity, opioid requirements, and complications in elderly patients and to assess the role of minimally invasive interventions in chronic pain management in this population.

Materials and Methods

This retrospective file review study was approved by the local ethics committee (approval number: 2024/154). Data from patients aged ≥65 years who underwent sympathetic ganglion block between January 1, 2010, and December 1, 2023 were evaluated. Inclusion criteria were: i) age ≥65 years, ii) stellate, thoracic sympathetic, lumbar sympathetic, celiac, splanchnic, superior hypogastric, or impar ganglion block or neurolysis, iii) complete records (pain scores, ≥3-month follow-up, opioid doses), iv) malignant or nonmalignant pain, v) pain duration ≥3 months, vi) Visual Analog Scale (VAS) ≥4, and vii) inoperable pain conditions. Patients with incomplete data or missing follow-up were excluded. Data were obtained from the hospital information system and manuscript files using procedure codes. All data were anonymized. Recorded variables included age, sex, pain etiology and character, opioid consumption (converted to morphine milligram equivalent [MME]), complications (minor or major), and VAS scores before treatment and at 1 and 3 months (14). Minor complications were defined as reversible conditions without life-threatening risk, whereas major complications included permanent or life-threatening events. A total of 417 patients were included. Informed consent was obtained from all patients. All procedures were performed in the operating room by an experienced pain specialist under sterile conditions, standard monitoring, intravenous access, and minimal sedation (midazolam 0.05–0.1 mg/kg) (15). Target levels were identified with fluoroscopy (GE OEC 9900 C-Arm), and correct needle position was confirmed with contrast material before injection. After excluding vascular spread, sympathetic blocks were performed. In nonmalignant cases, 0.5% bupivacaine (2.5 ml) + 16 mg dexamethasone + saline (total 4–15 ml) was used. In malignant cases, the same solution (3–10 ml) was applied before neurolysis. Neurolytic agents included 6% phenol (5–10 ml) or 96% alcohol for celiac blocks.

Statistical analyses were performed using IBM Statistical Package for Social Sciences (SPSS) program version 27. Normality was assessed by kurtosis–skewness and the Kolmogorov-Smirnov test. Continuous variables were presented as mean ± SD and categorical variables as percentages. Parametric tests (t-test, ANOVA with Bonferroni correction) or nonparametric tests (Mann-Whitney U, Kruskal-Wallis) were used as appropriate. Changes over time were analyzed using Two-Way Repeated Measures ANOVA and Mixed Effect Models. Categorical variables were compared using the Chi-square test. Statistical significance was set at $p < 0.05$.

Results

Demographic characteristics, including age, sex, malignancy status, pain characteristics, and location, are shown in Table 1. The most frequent etiologies were peripheral artery disease (30.2%), coccydynia (18%), pancreas (6.7%) and stomach (6%) cancers, followed by ovarian (5.3%), rectal (4.6%), bladder (3.4%), prostate (2.2%), colon (1.4%), hepatocellular and vulvar (0.2%) cancers, phantom pain (3.1%), sympathetic dystrophy (2.9%), chronic pelvic pain (1.9%), diabetic neuropathy (1.4%), ischemic heart disease (1.4%), and chronic pancreatitis (1.4%). Block distribution was

Table 1. *Demographic data are summarized.*

Variable	Description	Count (n)	Percentage (%)
Age *(years)	Mean ± SD	78.3±6.6	
Gender	Male	166	39.8%
	Female	251	60.2%
Malignancy status	Malignant	124	29.7%
	Non-malignant	293	70.3%
Pain character	Visceral	170	40.8%
	Ischemic	131	31.4%
	Mixed	63	15.1%
	Neuropathic	53	12.7%
Region	Pelvic	152	36.5%
	Lower extremity	119	28.5%
	Abdomen	70	16.8%
	Upper extremity	66	15.8%
	Thorax	10	2.4%

n: number of samples; total number of samples: 417; *: age data are presented under the count column, including the mean and standard deviation.

Table 2. *Changes in VAS scores over time by pain type*

Pain Type	Baseline (Mean ± SD)	Month 1 (Mean ± SD)	Month 3 (Mean ± SD)	p value
Visceral	8.25±1.04	3.23±1.15	4.77±1.36	<0.001
Neuropathic	7.68±0.61	4.64±0.98	6.47±1.05	<0.001
Ischemic	7.72±0.60	4.50±1.24	6.47±1.29	<0.001
Mixed	7.40±0.79	4.38±0.99	6.35±1.17	<0.001

VAS: Visual Analog Scale; SD: standard deviation.
The repeated measures ANOVA test was used to evaluate changes over time.
p values indicate the statistical significance of changes in VAS scores from Baseline to Month 1 and Month 3 within each pain type.

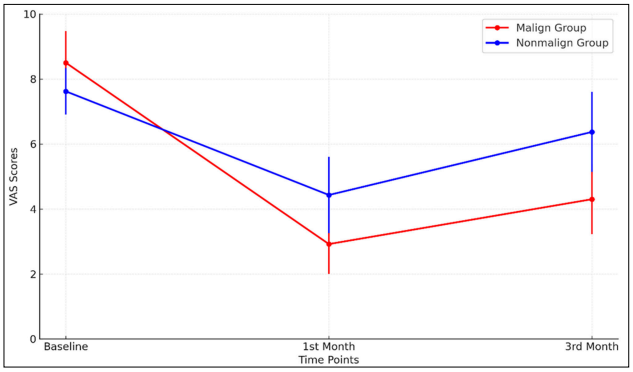

Figure 1. *Changes in Visual Analog Scale (VAS) scores over time following sympathetic blocks in non-malignant and malignant conditions are presented. Baseline VAS values before the block, as well as VAS scores at the 1st and 3rd months after the block, are shown with standard deviation error bars.*

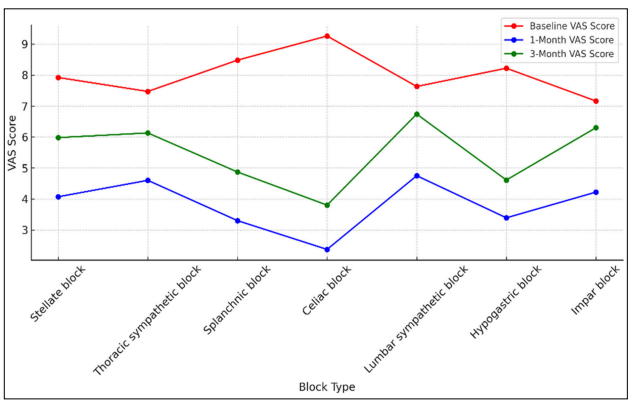

Figure 2. *Changes in Visual Analog Scale (VAS) scores over time are presented based on the type of sympathetic block.*

stellate (14.6%, n=61), thoracic sympathetic (3.6%, n=15), splanchnic (5.5%, n=23), celiac (11%, n=46), lumbar sympathetic (28.5%, n=119), superior hypogastric (15.3%, n=64), and impar (21.3%, n=89).

Visual Analog Scale Trends

Visual analog scale scores decreased significantly in both malignant and nonmalignant groups, with a greater reduction in the malignant group. Malignant patients: pretreatment 8.50±0.97, 1st month 2.92±0.92, 3rd month 4.30±1.07; nonmalignant patients: 7.62±0.71, 4.43±1.17, and 6.37±1.23 ($F=120.096$, $\eta^2=0.224$, $p<0.001$) (Fig. 1). Visual analog scale declined significantly across all block types ($p<0.05$), with the greatest decrease after celiac block ($F=20.460$, $\eta^2=0.230$, $p<0.001$) (Fig. 2). Visual analog scale decreased in all pain types, most prominently in visceral pain ($F=34.013$, $\eta^2=0.198$, $p<0.001$) (Table 2). Age ($\beta=-0.004$, $p=0.775$) and gender ($t=1.12$, $p=0.261$) showed no effect on VAS. Baseline VAS was higher in patients with complications (8.23±0.9) than those without (7.69±0.82) ($t=-6.139$, $p<0.001$), and VAS reduction was greater in these patients ($F=27.228$, $\eta^2=0.062$, $p<0.001$).

Changes in Analgesic Amount

Baseline opioid use averaged 209.51±100.99 mg/day in malignant and 40.54±36.70 mg/day in nonmalignant patients. At 3 months, doses decreased to 73.88±35.23 mg/day and 20.71±15.04 mg/day, respectively ($p<0.001$), with greater reduction in malignancy ($F=645.810$, $\eta^2=0.609$, $p<0.001$) (Fig. 3). Opioid reduction was greatest in visceral pain (Kruskal-Wallis $H=157.82$, $p<0.001$). Significant decreases were also observed in ischemic and mixed pain ($p<0.001$), but not in neuropathic pain ($p=0.052$). Opioid use decreased across all block types, with

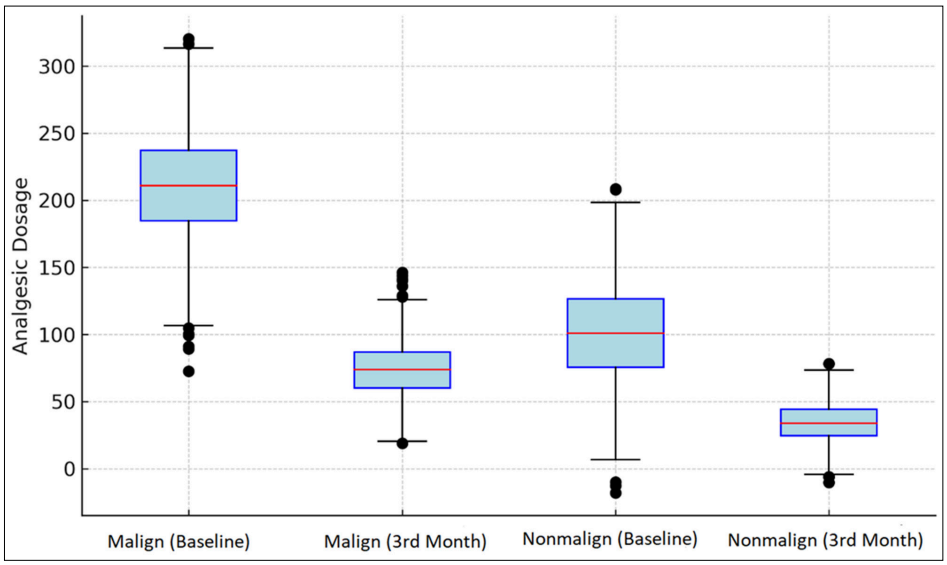

Figure 3. *Box plot illustrating the changes in analgesic dosage over time for malignant and non– malignant conditions at the 1st and 3rd months. The red lines within the boxes represent the median values, indicating the central tendency of the data. The boxes display the interquartile range (IQR), which encompasses the middle 50% of the data. The whiskers (lines extending from the boxes) represent the range of values within 1.5 times the IQR from the first and third quartiles. Black dots outside the whiskers indicate outlier values that fall beyond this range.*

Table 3. *Analgesic consumption at 1st and 3rd months across different block types and time-related effects*

Block type	Baseline analgesic consumption milligrams (Mean ± SD)	3rd month analgesic consumption milligrams (Mean ± SD)	t-test	p value
Stellate block	32.30±25.24	15.16±8.92	6.901	p <0.001
Thoracic sympathetic block	24.67±16.85	14.17±8.85	3.688	p=0.002
Splanchnic block	188.26±25.16	66.96±19.52	26.366	p <0.001
Celiac block	288.70±83.34	92.07±28.86	16.882	p <0.001
Lumbar sympathetic block	38.15±21.44	21.64±11.53	12.181	p <0.001
Hypogastric block	169.69±65.14	67.66±30.90	17.435	p <0.001
Ganglion impar block	26.29±19.00	15.25±9.63	7.755	p <0.001

The table presents the mean ± standard deviation (SD) of analgesic consumption at the 1st and 3rd months for different block types, along with statistical results. The t-values indicate the significance of reductions in analgesic consumption for each block. Celiac block showed the largest reduction compared to other blocks (Bonferroni correction, p <0.001).
SD: standard deviation; t: t-test statistic; p: probability value.

the largest reduction after celiac block (F=325.416, η^2=0.826, p<0.001) (Table 3). Age and gender showed no effect (p>0.05). Pretreatment opioid use was higher in patients with complications (133.39±113.79 mg/day) than those without (67.21±82.15 mg/day), decreasing to 49.97±39.31 mg/day and 29.08±27.04 mg/day at 3 months, with greater reduction in patients with complications (F=41.816, η^2=0.092, p<0.001).

Complications

Complications occurred in 146/417 patients (35.0%) and were classified as minor or major. Age and gender were not significant (p>0.05). Complications were more frequent in malignancy (56.91%) and in neuropathic (45.28%) and visceral pain (48.24%). Rates were highest after celiac block (82.61%) and abdominal blocks (67.14%) (Chi-square=101.19 and 68.27, p<0.001).

Minor Complications

Orthostatic hypotension was most common (n=64), mainly after celiac (n=34), splanchnic (n=7), lumbar sympathetic (n=4), superior hypogastric (n=17), and impar (n=2) blocks, resolving in 15.4 days with conservative treatment. Horner syndrome (n=27) occurred after stellate (n=25) and thoracic (n=2) blocks and resolved within 6 hours. Transient sensory-motor

deficit occurred in 25 patients (paresthesia n=17, weakness n=8) after stellate (n=1), thoracic (n=3), lumbar (n=12), hypogastric (n=2), and impar (n=7) blocks and resolved within 12 hours. Diarrhea occurred in 10 patients after celiac (n=6) and hypogastric (n=4) blocks and resolved within 6 days. Hematoma occurred in 3 patients after stellate (n=2) and impar (n=1) blocks and resolved within weeks. One abscess after impar block resolved within one week. Mild reactions (n=3) and dysphagia/hoarseness (n=4) resolved conservatively. Discitis occurred in 3 patients after transdiscal hypogastric (n=2) and celiac (n=1) blocks and was treated with antibiotics for 36.6 days.

Major Complications

Hemidiaphragmatic paralysis developed after splanchnic block in one patient and resolved within 48 hours. Three pneumothoraces occurred after stellate, thoracic sympathetic, and splanchnic blocks; one required thoracostomy and intensive care, while two were discharged after 48-hour observation. Two intercostal nerve injuries were treated with thoracic sympathetic block and managed with gabapentin and amitriptyline. No deaths occurred.

Discussion

In our study, we evaluated the effects of sympathetic blocks applied to elderly patients on pain intensity, opioid consumption, and complication profile. The most important finding was that sympathetic blocks significantly reduced pain intensity and opioid consumption in both malignant and nonmalignant pain. In addition, although the complication rate was relatively high, it was mainly minor. The number of studies evaluating sympathetic ganglion blocks in elderly patients is limited (10–13). These studies mostly focus on a few block types (impar, stellate, and celiac blocks) and on pain with specific etiologies such as pancreatic cancer, subarachnoid hemorrhage, and radiation-induced proctitis. Our study is valuable because it evaluates the effects of multiple block types across a wide range of pain etiologies in the elderly.

Another finding of our study was that pretreatment VAS values significantly decreased in the first month after treatment and remained below baseline at the third month despite a partial increase. Although this decrease was also observed in nonmalignant cases, it was more pronounced in malignant cases. This may be explained by the irreversible destructive effects of neurolytic agents applied in malignancy on neural structures involved in pain transmission and perception (16). These agents disrupt pain transmission by denaturing proteins, damaging myelin, and destroying tissue in ganglia (17). Previous studies have reported that neurolytic celiac, splanchnic, and superior hypogastric ganglion blocks applied in pelvic and abdominal malignancies reduce pain intensity (18). Our study demonstrates that similar benefits can also be achieved in elderly patients.

In our study, we observed significant pain score reductions in patients with neuropathic, ischemic, and mixed pain profiles. In ischemic, neuropathic, and mixed-type pain, these blocks may be effective due to vasodilation, increased tissue perfusion, disruption of the sympathetic reflex cycle, and suppression of a possible neuropathic sympathetic component (19). We have shown that VAS values decrease most significantly with celiac block applications, especially in visceral pain. We think that this effect may be related to the fact that visceral pain is transmitted more by sympathetic afferents, that sympathetic system-related pain has a more homogeneous innervation area, and that it has a more specific anatomical location (20). Kwon et al. (21) reported that celiac ganglion blocks are effective in their studies of patients with abdominal malignancy. Our study is consistent with this study in terms of observing this effect in elderly patients.

Our second finding was that sympathetic blocks significantly reduced opioid consumption. This effect has been reported in many studies on sympathetic ganglion block applications (22–24). However, our findings are particularly important in elderly patients by reducing drug interactions, polypharmacy-related incompatibilities, and side effects (25). Elderly patients are among the most vulnerable groups in pain palliation because of comorbidities, immunosuppression, cognitive problems, and opioid-related adverse effects (26). In our study, both opioid consumption and VAS values decreased significantly in malignant and nonmalignant groups. This reduction is especially valuable in malignant patients by lowering the risks associated with high opioid doses, including respiratory depression, immunosuppression, and metabolic side effects, and thereby improving quality of life (21,27).

In our study, the decrease in opioid consumption in neuropathic pain was borderline significant (p=0.052) and was lower than in other types of pain (visceral, ischemic, mixed pain). The reasons for this are: i) the relatively

small number of patients with neuropathic pain, reducing statistical power; ii) the short follow-up period, masking long-term effects; iii) the multidimensional nature of pain (physical, psychological, emotional, and behavioral dimensions), and the possibility that the patient or physician may not have reduced the amount of opioid "as a precaution" or "out of habit." We think that these reasons may also affect our results. Of course, the retrospective nature of the study design makes it difficult to establish a cause-and-effect relationship.

The third finding of our study is that patients who developed complications experienced more significant pain and opioid reduction posttreatment, despite higher pretreatment VAS values. Several possible mechanisms can explain this situation. The fact that patients with complications had much higher pretreatment VAS values may have increased the absolute improvement obtained from the treatment. Another reason may be that these patients are closely monitored and receive additional supportive treatments (rehydration, physical therapy, adjuvant drug support, etc.). Murphy et al. discuss the effect of this last reason on patient prognosis in their study (28,29). We believe that the measures taken in complication management indirectly strengthen pain management and lead to more effective results.

Although the complication rate was 35%, it applied to the entire patient group. Most of the complications were minor complications. The most common complications were orthostatic hypotension and Horner syndrome. This situation is related to the temporary hemodynamic and autonomic changes that the blocks cause in the sympathetic chain (21,30). However, the major complication rate is quite low. The high rate of complications, especially in celiac ganglion block, may be related to advanced-stage malignancy, comorbidities, and the need for surgery in this group (30). The absence of mortality in our study shows that these blocks are relatively safe in the elderly.

This study has some limitations. The retrospective design makes it difficult to establish a causal relationship and increases the risk of bias. Single-center data limit the generalizability of the results to the entire population. Heterogeneity in block types and small subgroups reduces statistical power. Finally, additional treatments provided to patients (physiotherapy, psychological counseling, or different pharmacological agents) could not be controlled due to the study design. Future prospective multicenter randomized clinical studies, including those involving the elderly population, and clarification of complication risk factors, follow-up protocols, and patient selection criteria will yield significant contributions.

Conclusion

Sympathetic ganglion blocks in the elderly improve quality of life, yield significant analgesic savings, and reduce pain despite the relatively high complication risk. These blocks can be safely applied with the right indication, appropriate method, and close follow-up, reducing pain and opioid requirements even in patients with complications. Our findings show the importance of minimally invasive treatments for chronic pain in the elderly and the need for more comprehensive research.

References

1. Kong F. Aging trend of the world. In: Hoshi T, Kodama S, editors. The structure of healthy life determinants. Vol 18. International perspectives on aging. Cham: Springer; 2018. p. 15-28.
2. American Geriatrics Society Panel on Pharmacological Management of Persistent Pain in Older Persons. Pharmacological management of persistent pain in older persons. J Am Geriatr Soc. 2009;57(8):1331–1346. https://doi.org/10.1111/j.1532-5415.2009.02376.x
3. Borsheski R, Johnson QL. Pain management in the geriatric population. Mo Med. 2014;111(6):508–511.
4. Helme RD, Gibson SJ. The epidemiology of pain in elderly people. Clin Geriatr Med. 2001;17(3):417–431. https://doi.org/10.1016/S0749-0690(05)70078-1
5. Abdulla A, Adams N, Bone M, Elliott AM, Gaffin J, Jones D, et al. Guidance on the management of pain in older people. Age Ageing. 2013;42 Suppl 1:i1-i57. https://doi.org/10.1093/ageing/afs200
6. Rastogi R, Meek BD. Management of chronic pain in elderly, frail patients: finding a suitable, personalized method of control. Clin Interv Aging. 2013;8:37–46. https://doi.org/10.2147/CIA.S30165
7. Tetzlaff JE. Cousins and Bridenbaugh's neural blockade in clinical anesthesia and pain medicine. Mayo Clin Proc. 2010;85(7):e51. https://doi.org/10.4065/mcp.2010.0230
8. Gunduz OH, Kenis-Coskun O. Ganglion blocks as a treatment of pain: current perspectives. J Pain Res. 2017;10:2815–2826. https://doi.org/10.2147/JPR.S134775
9. Mercadante S, Klepstad P, Kurita GP, Sjøgren P, Giarratano A; European Palliative Care Research Collaborative (EPCRC). Sympathetic blocks for visceral cancer pain management: a systematic review and EAPC recommendations. Crit Rev Oncol Hematol. 2015;96(3):577–583. https://doi.org/10.1016/j.critrevonc.2015.07.014

10. Nie Y, Song R, Chen W, Qin Z, Zhang J, Tang J. Effects of stellate ganglion block on cerebrovascular vasodilation in elderly patients and patients with subarachnoid haemorrhage. Br J Anaesth. 2016;117(1):131–132. https://doi.org/10.1093/bja/aew157
11. Chen YQ, Jin XJ, Liu ZF, Zhu MF. Effects of stellate ganglion block on cardiovascular reaction and heart rate variability in elderly patients during anesthesia induction and endotracheal intubation. J Clin Anesth. 2015;27(2):140–145. https://doi.org/10.1016/j.jclinane.2014.06.012
12. Khosla A, Adeyefa O, Nasir S. Successful treatment of radiation-induced proctitis pain by blockade of the ganglion impar in an elderly patient with prostate cancer: a case report. Pain Med. 2013;14(5):662–666. https://doi.org/10.1111/pme.12065
13. Higuera O, Ghanem I, Nasimi R, Prieto I, Koren L, Feliu J. Management of pancreatic cancer in the elderly. World J Gastroenterol. 2016;22(2):764–775. https://doi.org/10.3748/wjg.v22.i2.764
14. Souter KJ, Fitzgibbon D. Equianalgesic dose guidelines for long-term opioid use -theoretical and practical considerations. Semin Anesth. 2004;23:271–280. https://doi.org/10.1053/j.sane.2004.06.001
15. Deer TR, Pope JE, Lamer TJ, Provenzano D, editors. Deer's treatment of pain: an illustrated guide for practitioners. Cham: Springer; 2019. https://doi.org/10.1007/978-3-030-12281-2
16. Christiansen S, Erdek M. Neurolytic sympathetic blocks. In: Barash PG, Cullen BF, Stoelting RK, et al., editors. Handbook of pain management. Philadelphia: Elsevier; 2018. p. 321-335. https://doi.org/10.1016/B978-0-323-40196-8.00071-1
17. Bedran H. Neurolytic agents: mechanism and usage in pain medicine. In: Collantes Celador E, Rudiger J, Tameem A, editors. Oxford handbook of anesthesia. Oxford: Oxford University Press; 2022. p. 112-118. https://doi.org/10.1093/med/9780198799443.003.0011
18. Abd-Elsayed A, Rushmer T. Neurolytic and nonneurolytic blocks in pain management. In: Abd-Elsayed A, editor. Advanced anesthesia review. New York: Oxford University Press; 2023. p. 215-228.
19. Phuphanich ME, Convery QW, Nanda UK, Pangarkar S. Sympathetic blocks for sympathetic pain. Phys Med Rehabil Clin N Am. 2022;33(3):465–480. https://doi.org/10.1016/j.pmr.2022.02.002
20. Vorenkamp K, Yi P, Kemp A. Sympathetic blocks for visceral pain. Phys Med Rehabil Clin N Am. 2022;33(2):475–487. https://doi.org/10.1016/j.pmr.2022.01.010
21. Kwon HJ, Jang K, Leem JG, Shin JW, Kim DH, Choi SS. Factors associated with successful response to neurolytic celiac plexus block in patients with upper abdominal cancer-related pain: a retrospective study. Korean J Pain. 2021;34(4):479–486. https://doi.org/10.3344/kjp.2021.34.4.479
22. Liou H, Kong MJ, Alzubaidi S, Knuttinen MG, Patel IJ, Kriegshauser JS. Single-center review of celiac plexus/retrocrural splanchnic nerve block for non-cancer related pain. Acad Radiol. 2021;28(5):623–630. https://doi.org/10.1016/j.acra.2021.03.005
23. Aleanakian R, Chung BY, Feldmann RE, Benrath J. Effectiveness, safety, and predictive potential in ultrasound-guided stellate ganglion blockades for the treatment of sympathetically maintained pain. Pain Pract. 2020;20(5):570–578. https://doi.org/10.1111/papr.12892
24. Wi Y, Laksono RM, Asmoro AA, Isngadi I, Laksono BH, Jaya W. Pain management with ganglion impar block in adenocarcinoma recti. Solo J Anesthesiol Pain Crit Care. 2024;4(1):689–696. https://doi.org/10.20961/soja.v4i1.68927
25. Persico AL, Wegrzyn EL. Geriatric pain pharmacotherapy. In: Herndon CM, editor. Pain. Oxford: Oxford University Press; 2022. p. 399-406. https://doi.org/10.1093/med/9780197542873.003.0046
26. Smith HS, Bruckenthal P. Implications of opioid analgesia for medically complicated patients. Drugs Aging. 2010;27(5):417–433. https://doi.org/10.2165/11536540-000000000-00000
27. Dhanani NM, Almonte WA, Engle MP. Sympathetic nervous system blocks for the treatment of cancer pain. In: Handbook of cancer pain management. Cham: Springer; 2019. p. 243-260. https://doi.org/10.1007/978-3-319-99684-4_17
28. Murphy PA, Kreling B, Kathryn E, Stevens M, Lynn J, Dulac JD. Description of the SUPPORT intervention. J Am Geriatr Soc. 2000;48(5 Suppl):S120-S125. https://doi.org/10.1111/j.1532-5415.2000.tb03125.x
29. Kim E, Lim JA, Choi CH, Lee SY, Kwak S, Kim J. Assessment of the changes in cardiac sympathetic nervous activity using pupil size changes measured in seated patients whose stellate ganglion is blocked by interscalene brachial plexus block. Korean J Anesthesiol. 2023;76(2):116–127. https://doi.org/10.4097/kja.22324
30. Gupta R, Madanat L, Jindal V, Gaikazian S. Celiac plexus block complications: a case report and review of the literature. J Palliat Med. 2021;24(1):45–50. https://doi.org/10.1089/jpm.2020.0530