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TECHNICAL NOTE EMBOLISATION (ARTERIAL)

Postinterventional Patient Comfort After Uterine Artery Embolization and Superior Hypogastric Nerve Block

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Abstract
Purpose To evaluate the duration and effect of superior hypogastric nerve block (SHNB) with ropivacaine and clonidine on postinterventional pain levels and opioid requirements in patients undergoing uterine artery embolization.
Materials and Methods Postinterventional pain levels (numeric rating scale, NRS 0–10) and opioid doses were retrospectively analyzed in 53 patients undergoing transfemoral uterine artery embolization and intraprocedural superior hypogastric nerve block during 24 h. A mixture of 150 mg of ropivacaine and 150 µg of clonidine was used for the block.
Results Postinterventional pain averaged between 1.4 and 2.0 during the first 9 h, after which a small but significant increase was observed (NRS 1.7 ± 1.6 vs. NRS 2.6 ± 2.2, $p < 0.001$). 70% of patients did not exceed a tolerable pain threshold of NRS 4 during the first 9 h after the intervention. Thirty-three patients (62%) did not require any opioid medication. Mean iv morphine dose was 3.1 ± 4.7 mg, whereas 71% of opioid doses were administered after 9 h.
Conclusion Superior hypogastric nerve block using a mixture of ropivacaine and clonidine provides good pain relief for 9 h after uterine artery embolization requiring only very low amounts of additional opioids.

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Keywords Pain control · Quality of life · UFE · Regional anesthesia

Abbreviations

EDA	Epidural anesthesia
LAST	Local anesthetic systemic toxicity
NRS	Numeric rating scale
PCA	Patient-controlled anesthesia
RPC	Retained products of conception
SHNB	Superior hypogastric nerve block
UAE	Uterine artery embolization
VAS	Visual analog scale

Introduction

Uterine artery embolization (UAE) is an established minimally invasive alternative to hysterectomy for treatment of symptomatic uterine fibroids and is recommended by current guidelines for patients who desire uterine preservation [1, 2]. However, postprocedural pain related to myometrial ischemia is a major concern to eligible patients and referring physicians, limiting a more widespread use. There is consensus that pain after UAE peaks within the first 7 h [3–8]. Several strategies to improve postprocedural patient comfort have been explored without established superiority [9, 10]. Epidural anesthesia (EDA) [11, 12] is time-consuming, requires an anesthesiologist and renders same-day discharge difficult. In patient-controlled anesthesia (PCA) [3–5, 7], cumulative opioid dosages are usually high with potential dose-related adverse effects. Recently, two trials have shown a promising effect of lidocaine infused into the uterine arteries. [13, 14] However, significant pain

reduction was limited to 2–4 h after UFE. Further, there are uncertainties about the timing, dosages and a potential adverse impact of lidocaine-induced vasospasms on fibroid infarction rates, especially when lidocaine is mixed with the embolic agent rather than administered after embolization [15, 16]. Consequently, two recent meta-analyses conclude that the effect of intraarterial lidocaine administration is either limited to 4 h post-UAE or not statistically significant [17, 18]. SHNB on the other hand is safe, technically straightforward and can be performed by the interventional radiologist in the angiography suite without significant time loss [11, 19]. Additionally, SHNB allows the use of long-acting local anesthetics that cannot be administered intravascularly and allows for UAE to be performed in an outpatient setting. Existing studies on SHNB only evaluate either patient reported pain levels [12, 20] or the cumulative opioid dose as a surrogate marker for pain [11, 19, 21]. A concurrent analysis of both metrics has not been performed except in the 2020 study by Yoon et al., which covered only a short postinterventional monitoring period of four hours [22]. In this retrospective analysis, we evaluate the duration of SHNB using ropivacaine together with clonidine as well as its effect on postinterventional pain and cumulative opioid dose.

Methods

Patient Selection and Ethics

All patients who had undergone UAE between May 2017 and March 2022 at our institution received SHNB and were retrospectively screened for eligibility. Patients were excluded from the analysis if less than 5 reported pain levels within 24 h or less than 3 data points within the first 8 h after the procedure were available. Since depression and anxiety disorders are known to alter pain perception, patients with preexisting severe anxiety and/or depression disorders under antidepressant medication were excluded [23–25]. Informed consent was obtained from all patients and the study was approved by the local ethics committee (BASEC-ID 2021-02089).

Uterine Artery Embolization and Superior Hypogastric Nerve Block

The technique of uterine artery embolization and superior hypogastric nerve block has been described before in detail [11, 26]. In short, all procedures were performed from a unilateral femoral approach using a 4F sheath and catheter. A coaxial microcatheter was used in select cases where anatomy was challenging. When type Ib or type III utero-ovarian anastomoses were encountered, superselective catheter positioning past the origin of anastomosis or preventive coil-embolization was performed to reduce the risk of postinterventional reduced ovarian function [27, 28]. Trisacryl gelatine microspheres (EmboSphere®, Merit Medical Systems, South Jordan, UT, USA) were used as the embolic agent in varying sizes between 300–500 µm and 900–1200 µm. All embolization procedures were carried out bilaterally to an endpoint of near stasis in the uterine arteries. After successful embolization on the first side, SHNB was performed. In order to prolong the duration of SHNB, we added 150 µg of clonidine to 20 ml of ropivacaine 0.75%. SHNB was considered technically successful when symmetric extravascular distribution of contrast agent in front of the L5 vertebra was documented in two planes (Fig. 1).

Postinterventional Care

Postinterventional pain was assessed on a 11-point (0–10) numeric rating scale (NRS) for 24 h after intervention whenever the nurse visited the patient, at least every two hours. The medication protocol is displayed in Table 1. Morphine was administered when pain was not lowered to a tolerable level by non-opioid analgesics as subjectively assessed by the patient.

Data Collection and Analysis

Patient characteristics, patient reported pain levels and administered medication with corresponding time stamps were extracted from electronic medical records. To ensure uniformity and facilitate comparison with existing studies, the datapoints were binned to the nearest hour. If more than one datapoint was available per interval per patient, a mean was calculated for each bin. Maximum pain levels were recorded without averaging. Pain progression was modeled by nonlinear regression. All statistical analyses were performed using R 4.1.3 (R Foundation for Statistical Computing, Vienna, Austria). A two-sided p-value of less than 0.05 was considered significant. The Wilcoxon signed-rank test was used to compare pain levels during the duration of the block effect and later.

Results

Fifty-three patients were included in the final analysis. Mean patient age was 42 ± 5.9 years. Mean postinterventional pain progression is displayed in Fig. 2a. Pain levels were consistently low (average NRS 1.4–2.0) during the first 9 h. After that, pain levels started to rise with a wider variability. Nonlinear regression modeling yielded cohort-wide pain levels of NRS 1.7 (CI: 1.1–2.2) for the

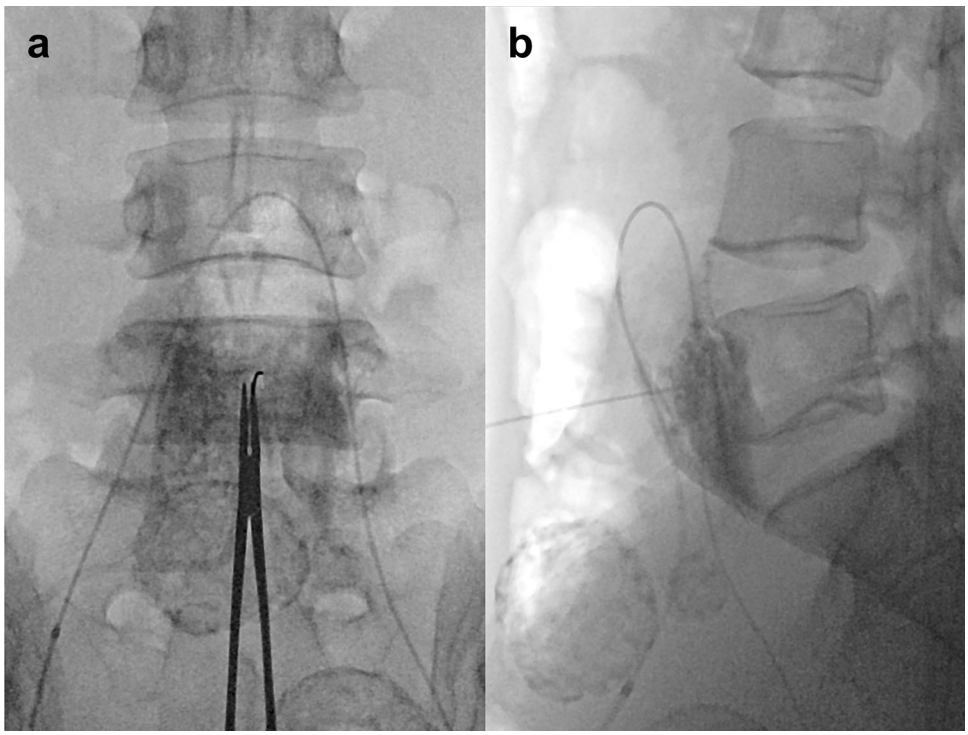

Fig. 1 Pictorial representation of SHNB procedure on ap (**a**) and lateral (**b**) views. Starting from a true ap projection of L5, a 21G Chiba needle is advanced under fluoroscopy guidance until bony resistance is reached. After confirmation of symmetric extravascular distribution of diluted contrast in two planes, 150 mg of ropivacaine mixed with 150 µg of clonidine are slowly administered while holding the needle firmly in place

Table 1 Medication protocol

	Fixed		As needed*	
Pre procedure	Amoxicilline/clavulanic Acid Or Ciprofloxacine	1000/200 mg iv 400 mg iv		
	Scopolamine	1 mg td		
Intra procedure	Ketorolac	60 mg iv	Midazolam	3 mg iv
	Methylprednisolone	40 mg iv	Fentanyl	100 mcg iv
			Propofol	When deeper sedation without mechanical ventilation was requested by the patient prior to the intervention
Post procedure	Ketorolac	30 mg iv every 8 h	Ibuprofen	600 mg every 8 h
	Acetaminophen	1 g iv every 6 h	Metamizole	1 g every 8 h
			Morphine	2.5 mg every 15 min
			Ondansetron	4 mg every 8 h
			Metoclopramide	20 mg every 12 h
			Flunitrazepam	2 mg single dose
Discharge	Ibuprofen	600 mg every 8 h	Acetaminophen	1 g every 6 h
			Metamizole	500 mg every 6 h

*Indicated as maximum doses per 24 h

first 9 h and NRS 3.4 (CI: 3.0–3.9) for post-9 h after UAE. Similarly, on a patient level, pain levels were significantly lower during the first 9 h than afterwards (Fig. 2b, NRS 1.7 ± 1.6 vs. NRS 2.6 ± 2.2, $p < 0.001$, paired Wilcoxon test). The maximum reported pain intensity per patient during the first 9 h was NRS 3.4 ± 2.6 on average. During this time, 37 patients (70%) did not exceed a maximum of NRS 4, which is considered a threshold for tolerable pain [29, 30].

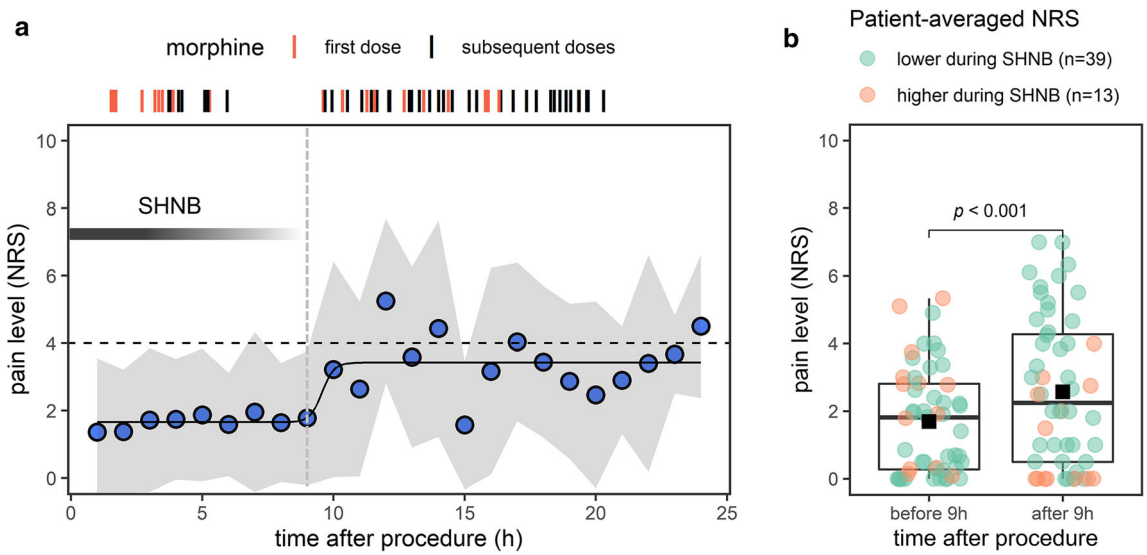

Fig. 2 **a** Cohort-averaged pain progression during 24 h showing significantly lower NRS before than after 9 h ($p < 0.001$). Values are given as mean ± SD over all patients binned to the nearest hour. Data points were fitted to a nonlinear regression model and the SHNB duration (9 h) was defined as the hour before the inflection point (vertical dashed gray line). The threshold for tolerable pain is indicated at NRS = 4 (horizontal dashed black line). Time points of first and subsequent morphine doses are provided as red and black marks. **b** Boxplot of paired patient-averaged pain levels before and after 9 h. Rectangles indicate the mean. Color-coding indicates whether the patient experienced lower or higher pain during SHNB

Thirty-three patients (62%) did not require any opioid medication. Overall mean administered iv morphine dose was therefore low at 3.1 ± 4.7 mg. In those 20 patients (38%) requiring morphine, mean dose was 8.3 ± 3.9 mg. The time of the first morphine administration followed a bimodal distribution with 10/20 (50%) patients requiring morphine for breakthrough pain within the first 5 h and the other half only after 9 h (Fig. 2a) Overall, 42/59 (71%) of morphine doses were administered after 9 h.

Discussion

Comparison of pain levels between studies is challenging due to inherent differences in population, choice of embolic agent, temporal relations between pain level registration and pain medication as well as inconsistent rating systems (10-scale or 11-scale NRS, visual analog scale VAS etc.). Pain levels observed in our population are similar to those reported by Yoon et al. for SHNB [22]. With intraarterial lidocaine, Duvnjak et al. and Noel-Lamy et al. reported slightly higher mean pain levels with VAS 42.7 ± 21.4 at 2 h post-UAE and VAS 28.6 ± 24.5 and VAS 35.8 ± 22.6 at 4 h, respectively.

SHNB likely eliminated the need for opioid medication in 62% of our patients. Out of the remaining 38%, half of the patients did not require opioids until the effect of the block had worn off. While this presumed causality cannot be definitively proven due to the retrospective, single-arm design, there is still a striking difference to the reported 99% of patients requiring opioid PCA when undergoing UAE without adjunct measures [7]. Our findings are in line with a 2020 study by Pereira et al. in which 50% of patients with SHNB did not require opioid medication [19]. Duvnjak et al. and Noel-Lamy et al. reported mean iv morphine doses of 11.1 ± 9.6, 16.3 ± 11.5 and 11.2 ± 7.3 mg, respectively, for the intervention groups, in both cases significantly lower amounts than in controls. Park et al. reported 35.9 ± 26.6 mg in patients with SHNB [21]. All of these studies cover a 24 h-monitoring period regarding cumulative opioid dose. We observed even lower mean morphine doses in our patients at 3.1 ± 4.6 mg.

Limitations

SHNB has been adopted as standard of care at our institution since 2007. Thus, the lack of a control group limits comparative statistics to intra-individual analyses. Our study examined pain in the first 24 h after UAE. No delayed pain due to post-embolization syndrome was studied. Usage of non-opioid analgesics was not controlled for, yet the medication regimen was the same for the entire hospitalization and therefore likely not a confounding factor for the pain level over time.

Conclusion

We showed that with SHNB using a mixture of ropivacaine and clonidine, mean and peak postinterventional pain was low. The effect lasted for 9 h, which is well past the reported 7 h during which pain after UAE is usually highest. In 62% of patients, no opioids were needed at all for pain control. Although no definitive superiority can be drawn from a single arm retrospective study, our results suggest that SHNB compares favorably to other pain strategies such as intraarterial lidocaine, PCA or EDA both in terms of pain level and effect duration.

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Declarations

Conflict of interest DAS has received research support from Philips Healthcare.

Consent for Publication Consent for publication was obtained for every individual person's data included in the study.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors. The study was approved by the local ethics committee (BASEC-ID 2021-02089).

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. American College of Obstetricians and Gynecologists (2021) Management of symptomatic uterine leiomyomas: ACOG practice bulletin, number 228. Obstet Gynecol 137:100–115. https://doi.org/10.1097/AOG.0000000000004401
2. Gupta JK, Sinha A, Lumsden MA et al. (2014) Uterine artery embolization for symptomatic uterine fibroids. Cochrane Database Syst Rev 2014:CD005073. https://doi.org/10.1002/14651858.CD005073.pub4
3. Han K, Kim SY, Kim HJ, et al. Nonspherical polyvinyl alcohol particles versus tris-acryl microspheres: randomized controlled trial comparing pain after uterine artery embolization for symptomatic fibroids. Radiology. 2021;298:458–65. https://doi.org/10.1148/radiol.2020201895.
4. Kim SY, Chang CH, Lee JS, et al. Comparison of the efficacy of dexmedetomidine plus fentanyl patient-controlled analgesia with fentanyl patient-controlled analgesia for pain control in uterine artery embolization for symptomatic fibroid tumors or adenomyosis: a prospective, randomized study. J Vasc Interv Radiol. 2013;24:779–86. https://doi.org/10.1016/j.jvir.2013.02.034.
5. Kim SY, Koo B-N, Shin CS, et al. The effects of single-dose dexamethasone on inflammatory response and pain after uterine artery embolisation for symptomatic fibroids or adenomyosis: a randomised controlled study. BJOG Int J Obstet Gynaecol. 2016;123:580–7. https://doi.org/10.1111/1471-0528.13785.
6. Ruuskanen A, Sipola P, Hippeläinen M, et al. Pain after uterine fibroid embolisation is associated with the severity of myometrial ischaemia on magnetic resonance imaging. Eur Radiol. 2009;19:2977–85. https://doi.org/10.1007/s00330-009-1481-8.
7. Kim HS, Czuczman GJ, Nicholson WK, et al. Pain levels within 24 hours after UFE: a comparison of morphine and fentanyl patient-controlled analgesia. Cardiovasc Interv Radiol. 2008;31:1100–7. https://doi.org/10.1007/s00270-008-9430-5.
8. Spencer EB, Stratil P, Mizones H. Clinical and periprocedural pain management for uterine artery embolization. Semin Interv Radiol. 2013;30:354–63. https://doi.org/10.1055/s-0033-1359729.
9. Saibudeen A, Makris GC, Elzein A, et al. Pain management protocols during uterine fibroid embolisation: a systematic review of the evidence. Cardiovasc Interv Radiol. 2019;42:1663–77. https://doi.org/10.1007/s00270-019-02327-1.
10. Chan P, Garcia-Reyes K, Cronan J, et al. Managing postembolization syndrome-related pain after uterine fibroid embolization. Semin Interv Radiol. 2021;38:382–7. https://doi.org/10.1055/s-0041-1731406.
11. Binkert CA, Hirzel FC, Gutzeit A, et al. Superior hypogastric nerve block to reduce pain after uterine artery embolization: advanced technique and comparison to epidural anesthesia. Cardiovasc Interv Radiol. 2015;38:1157–61. https://doi.org/10.1007/s00270-015-1118-z.
12. Malouhi A, Aschenbach R, Erbe A, et al. Effektivität und Sicherheit der Blockade des Plexus hypogastricus superior zur Schmerzkontrolle im Vergleich zur Epiduralanästhesie bei arterieller Embolisation in der Myombehandlung—eine restrospektive Evaluation. Rofo. 2021;193:289–97. https://doi.org/10.1055/a-1231-5649.
13. Duvnjak S, Andersen PE. Intra-arterial lidocaine administration during uterine fibroid embolization to reduce the immediate postoperative pain: a prospective randomized study. CVIR Endovasc. 2020;3:10. https://doi.org/10.1186/s42155-020-0099-4.
14. Noel-Lamy M, Tan KT, Simons ME, et al. Intraarterial lidocaine for pain control in uterine artery embolization: a prospective, randomized study. J Vasc Interv Radiol. 2017;28:16–22. https://doi.org/10.1016/j.jvir.2016.10.001.
15. Keyoung JA, Levy EB, Roth AR, et al. Intraarterial lidocaine for pain control after uterine artery embolization for leiomyomata. J Vasc Interv Radiol. 2001;12:1065–9. https://doi.org/10.1016/S1051-0443(07)61592-9.
16. Katsumori T, Miura H, Yoshikawa T, et al. Intra-arterial lidocaine administration for anesthesia after uterine artery embolization with trisacryl gelatin microspheres for leiomyoma. J Vasc Interv Radiol. 2020;31:114–20. https://doi.org/10.1016/j.jvir.2019.09.007.
17. Liu S, Li W. Intra-arterial lidocaine for pain control after uterine artery embolization: a meta-analysis of randomized controlled trials. J Matern Fetal Neonatal Med. 2020;2020:1–6. https://doi.org/10.1080/14767058.2020.1847079.
18. Shiwani TH. Shiwani H Intra-arterial anaesthetics for pain control in arterial embolisation procedures: a systematic review and meta-analysis. CVIR Endovasc. 2021;4:6. https://doi.org/10.1186/s42155-020-00198-z.
19. Pereira K, Morel-Ovalle LM, Wiemken TL, et al. Intraprocedural superior hypogastric nerve block allows same-day discharge following uterine artery embolization. J Vasc Interv Radiol. 2020;31:388–92. https://doi.org/10.1016/j.jvir.2019.08.017.
20. Stewart JK, Patetta MA, Burke CT. Superior hypogastric nerve block for pain control after uterine artery embolization: effect of addition of steroids on analgesia. J Vasc Interv Radiol.

2020;31:1005-1009.e1. https://doi.org/10.1016/j.jvir.2020.02.026.
21. Park PJ, Kokabi N, Nadendla P, et al. Efficacy of intraprocedural superior hypogastric nerve block in reduction of postuterine artery embolization narcotic analgesia use. Can Assoc Radiol J. 2020;71:75–80. https://doi.org/10.1177/0846537119888391.
22. Yoon J, Valenti D, Muchantef K, et al. Superior hypogastric nerve block as post-uterine artery embolization analgesia: a randomized and double-blind clinical trial. Radiology. 2018;289:248–54. https://doi.org/10.1148/radiol.2018172714.
23. Zambito Marsala S, Pistacchi M, Tocco P, et al. Pain perception in major depressive disorder: a neurophysiological case-control study. J Neurol Sci. 2015;357:19–21. https://doi.org/10.1016/j.jns.2015.06.051.
24. Hermesdorf M, Berger K, Baune BT, et al. Pain sensitivity in patients with major depression: differential effect of pain sensitivity measures, somatic cofactors, and disease characteristics. J Pain. 2016;17:606–16. https://doi.org/10.1016/j.jpain.2016.01.474.
25. Michaelides A, Zis P. Depression, anxiety and acute pain: links and management challenges. Postgrad Med. 2019;131:438–44. https://doi.org/10.1080/00325481.2019.1663705.
26. Rasuli P, Jolly EE, Hammond I, et al. Superior hypogastric nerve block for pain control in outpatient uterine artery embolization. J Vasc Interv Radiol. 2004;15:1423–9. https://doi.org/10.1097/01.RVI.0000137406.09852.A4.
27. Sheikh GT, Najafi A, Cunier M, et al. Angiographic detection of utero-ovarian anastomosis and influence on ovarian function after uterine artery embolization. Cardiovasc Interv Radiol. 2020;43:231–7. https://doi.org/10.1007/s00270-019-02305-7.
28. Razavi MK, Wolanske KA, Hwang GL, et al. Angiographic classification of ovarian artery-to-uterine artery anastomoses: initial observations in uterine fibroid embolization. Radiology. 2002;224:707–12. https://doi.org/10.1148/radiol.2243011513.
29. Woo A, Lechner B, Fu T, et al. Cut points for mild, moderate, and severe pain among cancer and non-cancer patients: a literature review. Ann Palliat Med. 2015;4:176–83. https://doi.org/10.3978/j.issn.2224-5820.2015.09.04.
30. Gerbershagen HJ, Rothaug J, Kalkman CJ, et al. Determination of moderate-to-severe postoperative pain on the numeric rating scale: a cut-off point analysis applying four different methods. Br J Anaesth. 2011;107:619–26. https://doi.org/10.1093/bja/aer195.