VDM VASCULAR DISEASE MANAGEMENT

CLINICAL REVIEW

PEER REVIEWED

The O-VAS and N-VAS: A Simple, Inexpensive, and Beneficial Adaptation of the Conventional Visual Analog Scale (VAS)

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Abstract

The visual analog scale (VAS) is a common clinical tool used for objectively assessing a variety of subjective medical parameters. In the field of interventional radiology, the VAS has been widely used to assess pre-procedure and post-procedure severity of symptoms such as pain in endovascular procedures including uterine artery embolization, genicular artery embolization, and vascular malformation sclerotherapies as well as image-guided procedures such as osteoid osteoma ablation and nerve blocks. While the VAS is useful, it has a notable limitation, particularly in procedures that may cause symptoms identical to the original disease, such as pain, making post-procedure evaluation problematic. To address this limitation, we propose the O-VAS (Old VAS)/N-VAS (New VAS) system, a straightforward and inexpensive modification to the existing VAS. This modification enables us to distinguish and analyze post-procedure improvements in symptoms of the original disease while also assisting in the assessment of any new symptoms caused by the procedure.

Introduction

The visual analog scale (VAS) is a psychometric self-administered instrument for objectively assessing numerous presenting symptoms of patients that cannot be quantified directly due to their subjective character.[1] Scott, Hayes, and Patterson initially described the scale in 1921[2,3] with the intention to assess patient well-being in the field of psychology, and it has since been widely used across various disciplines of medicine and surgery. The VAS employs an analog format to show a continuous range of values. It is conventionally depicted as a horizontal line measuring exactly 100 mm, with the patient instructed to make a mark on the line, which is then measured to determine the severity of the symptom.[4] It differs somewhat from the numeric pain scale, which uses a similar line with discontinuous whole numbers rather than a continuous range.[5]

The conventional VAS has gone through numerous modifications and adjustments throughout the years to better adapt to clinical settings. It has been presented as linear horizontal scales, linear vertical scales, curvilinear scales, graded horizontal scales, graded curvilinear scales, box scales, and Likert scales.[6] Furthermore, these scales have been represented in printed form on paper, plastic rulers (**Figure 1**), and as digital scales that may be utilized on technological devices such as smartphones.[7]

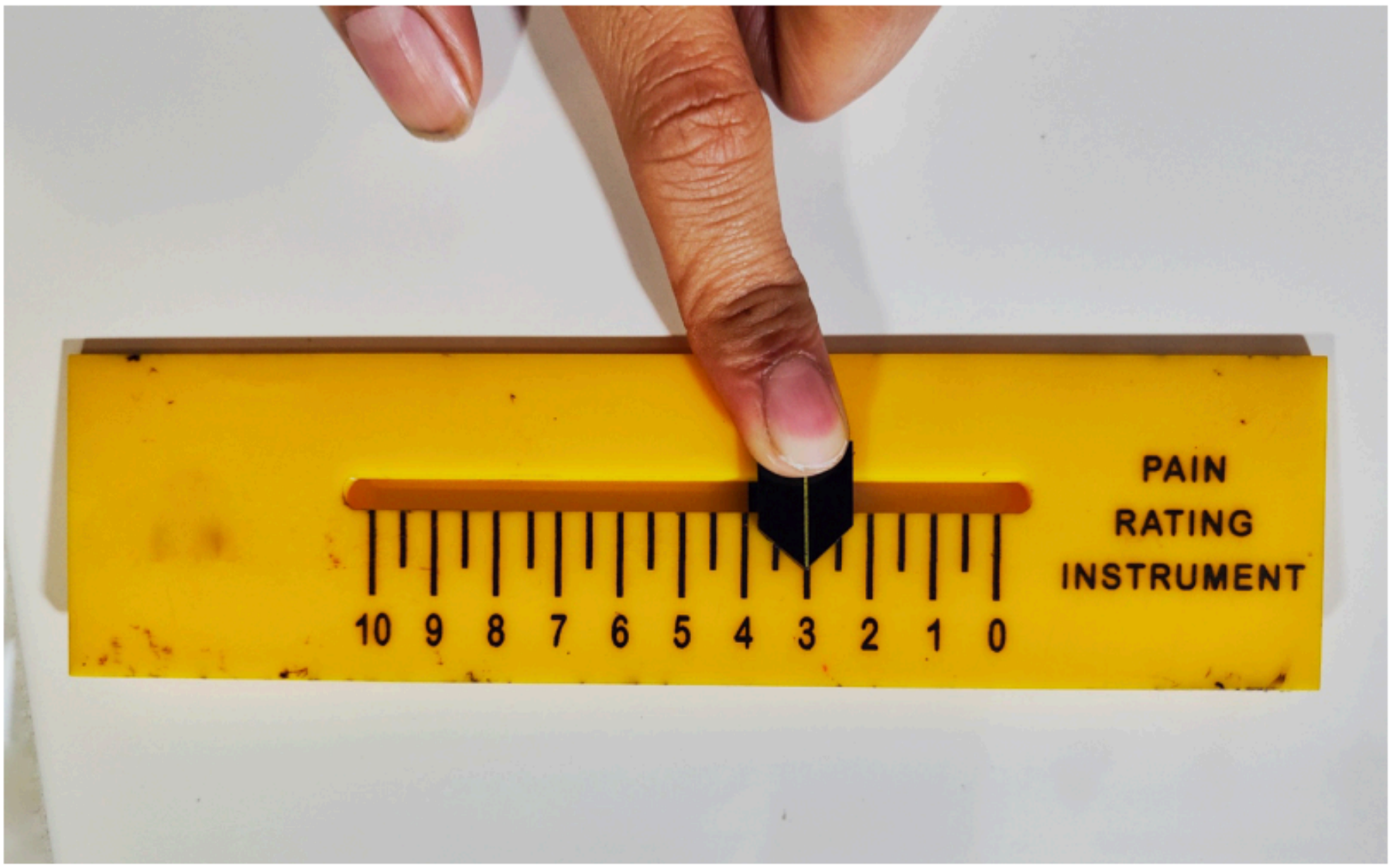


Figure 1. A picture demonstrating the use of a plastic custom designed graded pain rating visual analog scale instrument by a patient who underwent genicular artery embolization, expressing the amount of pain 2 days after the procedure.

Uses of the VAS

The VAS is helpful in both clinical and scientific contexts because of its simplicity. Its straightforward design enables health care practitioners to easily explain its purpose to patients, making it excellent for initial evaluations, tracking progress after treatment, assessing the efficacy of various therapies, and comparing different therapeutic alternatives. It is widely used in medicine and surgery, with the most common use being the assessment of acute pain,[8] labor pain,[9] surgical postoperative pain,[10] chronic pain,[11] and neuropathic pain.[12]

It is also used to evaluate various physical symptoms such as rhinitis,[13] cough,[14] pruritus,[15] tinnitus,[16] nausea,[17] fatigue,[18] and anosmia,[19] as well as psychological symptoms such as anxiety,[20] depression,[21] and stress.[22] A patient's overall quality of life may also be assessed using the VAS.[23]

VAS scales are commonly employed in interventional radiology for both vascular and non-vascular image-guided treatments. They have been used to assess post-procedure improvement of symptoms in vascular procedures such as genicular artery embolization,[24] uterine artery embolization (UAE),[25] prostatic artery embolization,[26] arterial angioplasties,[27] endovenous varicose vein ablation,[28] endovascular management of pelvic congestion syndrome,[29] and venous stenting.[30] VAS scales have been utilized in non-vascular image-guided interventional treatments such as nerve plexus blocks,[31] biopsies,[32-35] tumor ablations,[36-38] and sclerotherapies.[39]

Limitations of the VAS

While the VAS is useful, it has a significant restriction when used to quantify clinical symptoms such as pain for treatments such as osteoid osteoma ablation. The conventional VAS effectively reflects the intensity of pain that patients experience prior to the treatment; nevertheless, the ablation steps, which include traversing muscle and bone to reach the osteoid osteoma's nidus, can also lead to pain. This complicates post-procedure pain evaluation. It is critical to recognize that utilizing a single VAS may result in a higher score post-procedure, owing to the combination of pain from the underlying ailment and the intervention itself. This might cause both professionals and patients to believe that the procedure was unsuccessful.

A thorough investigation indicates that the symptoms, such as pain, that patients feel before and after such treatments might vary in nature, allowing them to distinguish between the two. To address this limitation of the conventional VAS and take advantage of the difference in nature of the primary symptom and the subsequent one following the procedure, we suggest another modification of the popular VAS that can improve its application in the assessment of patients undergoing interventional radiology procedures that can cause symptoms such as pain, which can be very similar to the symptoms caused by the primary pathology but still be differentiated by their characteristics.

The O-VAS/N-VAS Modification of the VAS

O-VAS stands for old visual analog scale, whereas N-VAS stands for new visual analog scale. It is a concept that utilizes the conventional VAS to measure symptoms such as pain, but we recommend utilizing 2 VAS scores rather than simply one. The O-VAS, which represents the primary pain or symptom related to disease, should be reported both before and after the procedure is

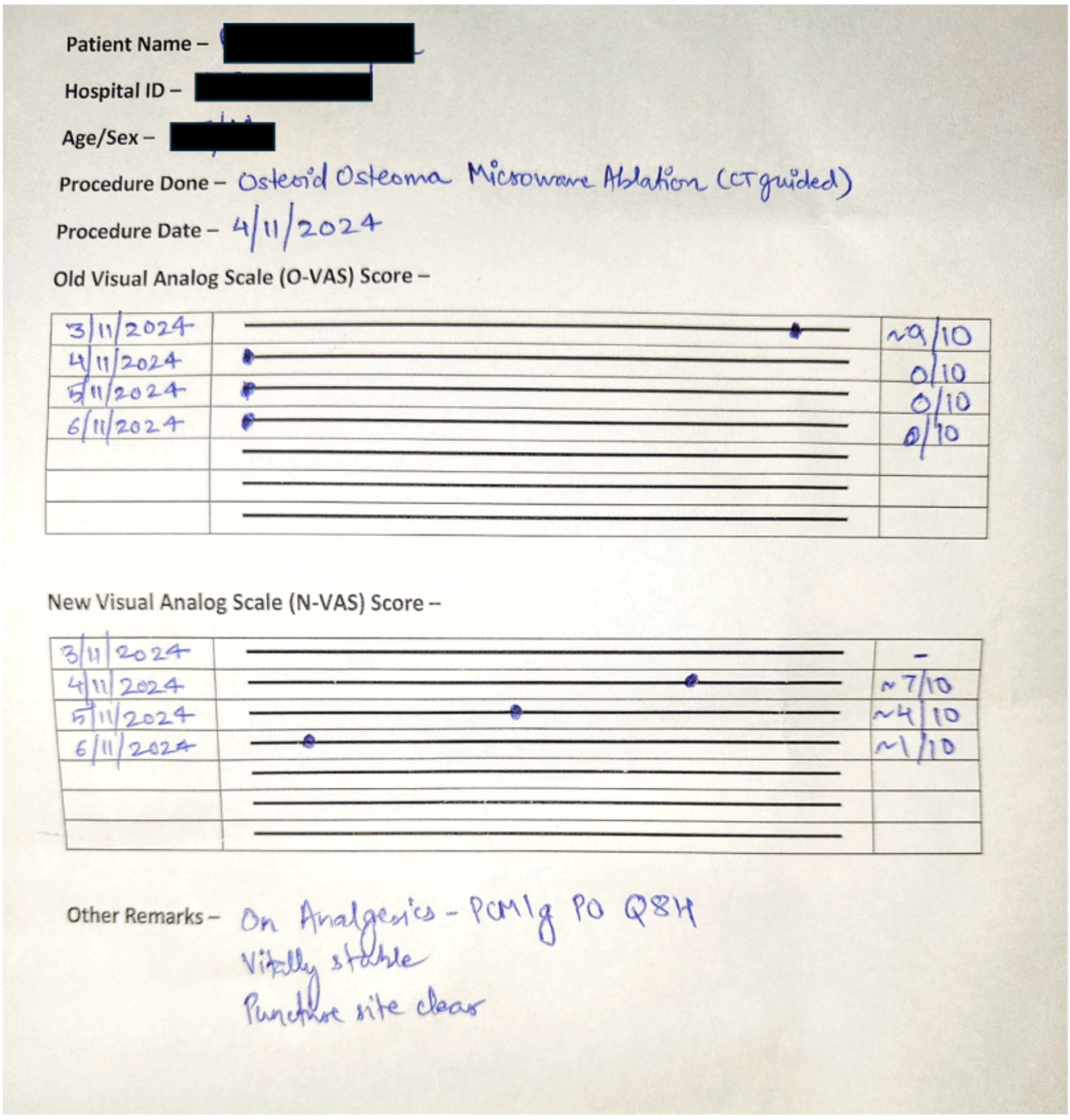
completed. The N-VAS, which reflects any new type of pain or symptom, should be noted after the procedure and considered as a different entity from the O-VAS. Educating patients ahead of time about the likelihood of additional symptoms, such as pain, and how N-VAS will distinguish them from the prior symptoms measured by O-VAS, might improve patient satisfaction and clarity.

The O-VAS and N-VAS system is a simple, inexpensive, yet highly effective adaptation of the conventional VAS that allows us to discriminate and evaluate the reduction in the primary symptom caused by the primary condition while also assessing the new symptom arising from the procedure. The dual parameters of O-VAS and N-VAS enable a deeper understanding of the therapeutic effects and outcomes. A decrease in the O-VAS score indicates success of the procedure, while a stable or increase in O-VAS score after the procedure may indicate a failure of the procedure or recurrence of the problem if the O-VAS declined prior to increasing. The primary symptom could be resolved with an O-VAS score of zero after the procedure, while an N-VAS score of more than zero allows detection of complications secondary to the procedure. Subsequent N-VAS scores can help in monitoring their progression and evaluating their resolution after appropriate management.

Moreover, N-VAS can also help in the identification and management of symptoms caused by variables not directly related to the procedure performed, such as neck pain from prolonged extended positioning during anesthesia for the ablation of a femoral osteoid osteoma.

Use of the O-VAS and N-VAS System in Interventional Radiology

O-VAS and N-VAS are useful tools for assessing discomfort in patients and assuring effective non-vascular image-guided treatments. For patients receiving computed tomography-guided microwave ablation of osteoid osteoma, O-VAS successfully records the characteristic osteoid osteoma-related pain, with a score of zero indicating successful nidus ablation. Meanwhile, N-VAS detects the new pain caused by muscle puncture or bone drilling (**Figure 2**).


Patient Name – [redacted]

Hospital ID – [redacted]

Age/Sex – [redacted]

Procedure Done – Osteoid Osteoma Microwave Ablation (CT guided)

Procedure Date – 4/11/2024

Old Visual Analog Scale (O-VAS) Score –

3/11/2024		~9/10
4/11/2024		0/10
5/11/2024		0/10
6/11/2024		0/10

New Visual Analog Scale (N-VAS) Score –

3/11/2024		-
4/11/2024		~7/10
5/11/2024		~4/10
6/11/2024		~1/10

Other Remarks – On Analgesics - PCM 1g PO Q8H
Vitally stable
Puncture site clear

Figure 2. The documentation of the old visual analog scale (O-VAS) and new visual analog scale (N-VAS) scores in the ward records of a patient who underwent computed tomography guided microwave ablation of a right femoral osteoid osteoma. The patient was asked to mark his O-VAS and N-VAS scores on a 10-cm scale every day during the ward stay, the value of which was approximated to the nearest whole number.

For patients receiving lumbar sympathectomy for peripheral arterial occlusive disease (PAOD), O-VAS is critical in quantifying rest pain associated with PAOD, whereas N-VAS addresses needle access discomfort. In treatments such as celiac plexus block for pancreatic cancer, O-VAS rates cancer-related pain whereas N-VAS analyzes access-related discomfort (**Figure 3**). For gastrostomy patients, O-VAS can be used to measure pre-procedure symptoms, whereas N-VAS analyzes procedure-related pain or discomfort.

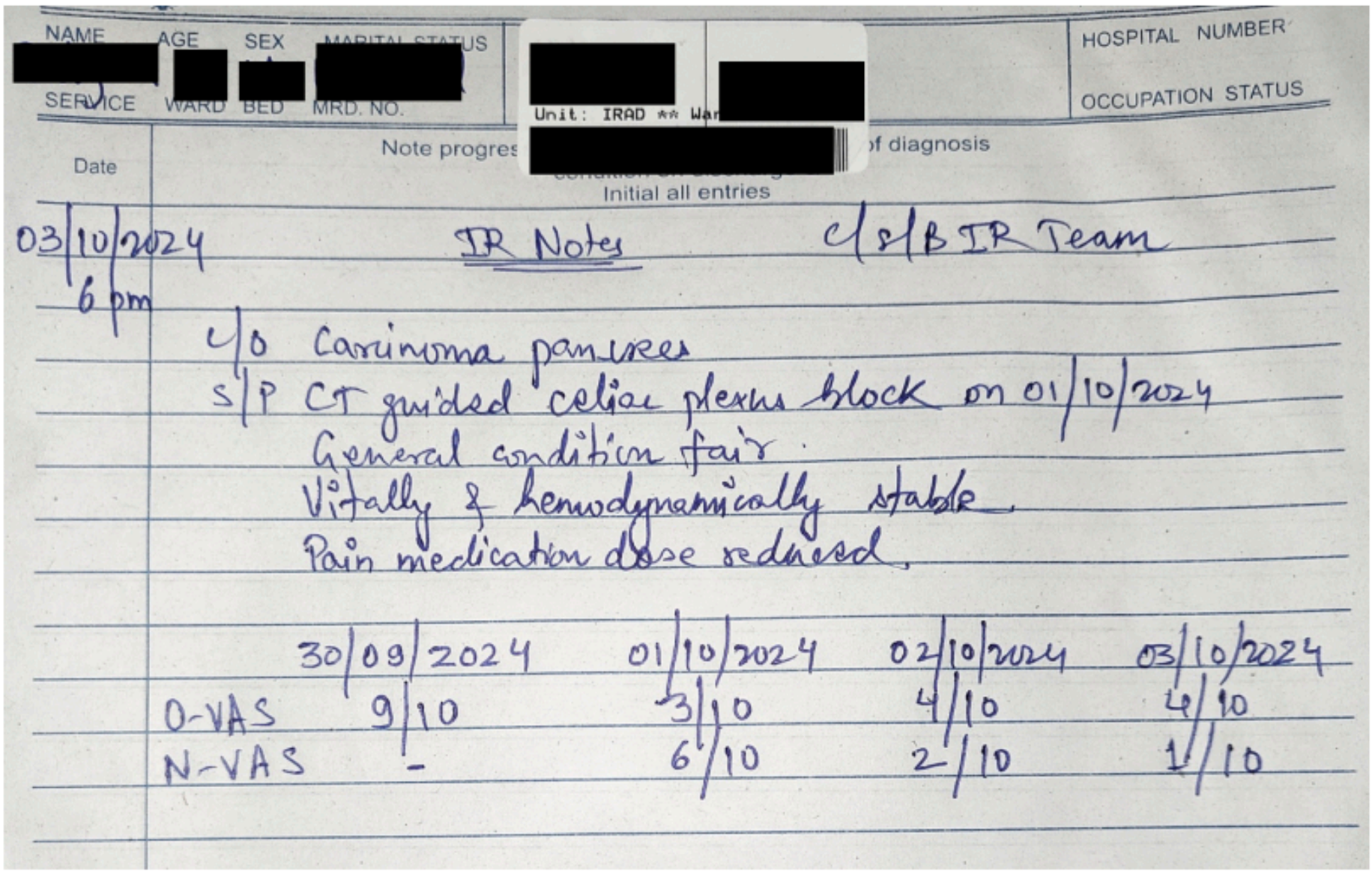


Figure 3. The documentation of the old visual analog scale (O-VAS) and new visual analog scale (N-VAS) scores in the ward progress record of a patient diagnosed with pancreatic carcinoma who underwent computed tomography guided celiac plexus block with bupivacaine and alcohol. The patient was asked to mark his O-VAS and N-VAS scores using a slider on a graded plastic VAS instrument during ward stay, with approximation of the marked values to the nearest whole number on the scale.

O-VAS and N-VAS can also be used efficiently for endovascular treatments. In UAE for fibroids or endometriosis, O-VAS provides information on the severity of menorrhagia or pain, whereas N-VAS concentrates on symptoms associated with postembolization syndrome. Transarterial embolizations benefit from the capacity of the O-VAS to evaluate the intensity of cancer-related symptoms both before and after the treatment, whereas N-VAS measures postoperative symptoms caused by embolization. In procedures involving arterial or venous stenting and plasties, O-VAS can monitor disease symptoms while N-VAS can assist in assessing procedural consequences such as pain or discomfort.

Pitfalls of the O-VAS/N-VAS System

While the O-VAS/N-VAS system presents a promising approach to pain management and symptom monitoring, it is not without its challenges. One significant pitfall arises in scenarios where the pain or symptoms triggered by a diagnostic, therapeutic, or surgical intervention closely mimic those caused by the primary pathology. This overlap can complicate the interpretation of results and hinder accurate assessments. Additionally, the system faces limitations in patients who struggle to assess, differentiate, and communicate their symptoms accurately. This group includes individuals with communication barriers, such as young children or patients with cognitive impairments, where the subjective nature of pain assessment may lead to less reliable data. Addressing these challenges requires a nuanced understanding of each patient's unique circumstances and may involve supplementary strategies to ensure comprehensive and accurate pain management.

Conclusion

The O-VAS and N-VAS system is a simple modification of the established conventional VAS, which offers a straightforward, inexpensive, yet powerful method for evaluating the effectiveness of interventions or procedures in alleviating symptoms associated with a primary pathology or disease. It also plays a crucial role in identifying and managing any new symptoms that may arise as a result of the specific intervention or procedure. The O-VAS and N-VAS system offers benefits across various medical disciplines where the VAS is employed, particularly when active medical or surgical interventions may introduce additional complications. Its incorporation offers a more nuanced understanding and a positive outlook on procedural success, enhancing both clinical insights and patient experience. To fully realize the potential of this innovative modification, further prospective studies are essential.

Affiliations and Disclosures

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References

1. Ducharme J. Acute Pain Management. In: Tintinalli JE, Ma OJ, Yealy DM, et al., eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 9th ed. McGraw-Hill Education; 2020.

2. Yeung AWK, Wong NSM. The historical roots of visual analog scale in psychology as revealed by reference publication year spectroscopy. *Front Hum Neurosci*. 2019;13:86. doi:10.3389/fnhum.2019.00086

3. Shiina K. Commentary: the historical roots of visual analog scale in psychology as revealed by reference publication year spectroscopy. *Front Hum Neurosci*. 2021;15:711691. doi:10.3389/fnhum.2021.711691

4. Breivik EK, Björnsson GA, Skovlund E. A comparison of pain rating scales by sampling from clinical trial data. *Clin J Pain.* 2000;16(1):22-28. doi:10.1097/00002508-200003000-00005

5. Johnson C. Measuring pain. Visual analog scale versus numeric pain scale: what is the difference? *J Chiropr Med.* 2005;4(1):43-44. doi:10.1016/S0899-3467(07)60112-8

6. Sriwatanakul K, Kelvie W, Lasagna L, Calimlim JF, Weis OF, Mehta G. Studies with different types of visual analog scales for measurement of pain. *Clin Pharmacol Ther*. 1983;34(2):234-239. doi:10.1038/clpt.1983.159

7. Byrom B, Elash CA, Eremenco S, et al. Measurement comparability of electronic and paper administration of visual analogue scales: a review of published studies. *Ther Innov Regul Sci.* 2022;56(3):394-404. doi:10.1007/s43441-022-00376-2

8. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. *Acad Emerg Med.* 2001;8(12):1153-1157. doi:10.1111/j.1553-2712.2001.tb01132.x

9. Wei CK, Leng CY, Siew Lin SK. The use of the visual analogue scale for the assessment of labour pain: a systematic review. *JBI Libr Syst Rev.* 2010;8(24):972-1015. doi:10.11124/01938924-201008240-00001

10. McCarthy M Jr, Chang CH, Pickard AS, et al. Visual analog scales for assessing surgical pain. *J Am Coll Surg.* 2005;201(2):245-252. doi:10.1016/j.jamcollsurg.2005.03.034

11. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain*. 1983;16(1):87-101. doi:10.1016/0304-3959(83)90088-X

12. Celik EC, Erhan B, Lakse E. The clinical characteristics of neuropathic pain in patients with spinal cord injury. *Spinal Cord.* 2012;50(8):585-589. doi:10.1038/sc.2012.26

13. Bousquet PJ, Combescure C, Klossek JM, Daurès JP, Bousquet J. Change in visual analog scale score in a pragmatic randomized cluster trial of allergic rhinitis. *J Allergy Clin Immunol.* 2009;123(6):1349-1354. doi:10.1016/j.jaci.2009.02.033

14. Martin Nguyen A, Bacci ED, Vernon M, et al. Validation of a visual analog scale for assessing cough severity in patients with chronic cough. *Ther Adv Respir Dis*. 2021;15:17534666211049743. doi:10.1177/17534666211049743

15. Reich A, Heisig M, Phan NQ, et al. Visual analogue scale: evaluation of the instrument for the assessment of pruritus. *Acta Derm Venereol.* 2012;92(5):497-501. doi:10.2340/00015555-1265

16. Adamchic I, Langguth B, Hauptmann C, Tass PA. Psychometric evaluation of visual analog scale for the assessment of chronic tinnitus. *Am J Audiol.* 2012;21(2):215-225. doi:10.1044/1059-0889(2012/12-0010)

17. Boogaerts JG, Vanacker E, Seidel L, Albert A, Bardiau FM. Assessment of postoperative nausea using a visual analogue scale. *Acta Anaesthesiol Scand*. 2000;44(4):470-474. doi:10.1034/j.1399-6576.2000.440420.x

18. Crawford BK, Piault EC, Lai C, Bennett RM. Assessing fibromyalgia-related fatigue: content validity and psychometric performance of the fatigue visual analog scale in adult patients with fibromyalgia. *Clin Exp Rheumatol.* 2011;29(6 Suppl 69):S34-43.

19. Zarachi A, Lianou AD, Pezoulas V, et al. Visual analogue scale for the evaluation of olfactory and gustatory dysfunction of COVID-19 patients in northwestern Greece. *Cureus*. 2023;15(3):e36413. doi:10.7759/cureus.36413

20. Kindler CH, Harms C, Amsler F, Ihde-Scholl T, Scheidegger D. The visual analog scale allows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. *Anesth Analg.* 2000;90(3):706-712. doi:10.1097/00000539-200003000-00036

21. Huang Z, Kohler IV, Kämpfen F. A single-item visual analogue scale (VAS) measure for assessing depression among college students. *Community Ment Health J.* 2020;56(2):355-367. doi:10.1007/s10597-019-00469-7

22. Lesage FX, Berjot S, Deschamps F. Clinical stress assessment using a visual analogue scale. *Occup Med (Lond).* 2012;62(8):600-605. doi:10.1093/occmed/kqs140

23. de Boer AGEM, van Lanschot JJB, Stalmeier PFM, et al. Is a single-item visual analogue scale as valid, reliable and responsive as multi-item scales in measuring quality of life? *Qual Life Res.* 2004;13(2):311-320. doi:10.1023/B:QURE.0000018499.64574.1f

24. Taslakian B, Miller LE, Mabud TS, et al. Genicular artery embolization for treatment of knee osteoarthritis pain: systematic review and meta-analysis. *Osteoarthr Cartil Open.* 2023;5(2):100342. doi:10.1016/j.ocarto.2023.100342

25. Saibudeen A, Makris GC, Elzein A, et al. Pain management protocols during uterine fibroid embolisation: a systematic review of the evidence. *Cardiovasc Intervent Radiol.* 2019;42(12):1663-1677. doi:10.1007/s00270-019-02327-1

26. Insausti I, Galbete A, Lucas-Cava V, et al. Prostatic artery embolization (PAE) using polyethylene glycol microspheres: safety and efficacy in 81 patients. *Cardiovasc Intervent Radiol.* 2022;45(9):1339-1348. doi:10.1007/s00270-022-03165-4

27. Cao J, Lu HT, Wei LM, Zhao JG, Zhu YQ. Rendezvous technique for recanalization of long-segmental chronic total occlusion above the knee following unsuccessful standard angioplasty. *Vascular*. 2016;24(2):157-165. doi:10.1177/1708538115589049

28. Belramman A, Bootun R, Lane TRA, Davies AH. COmpressioN following endovenous TreatmenT of Incompetent varicose veins by sclerotherapy (CONFETTI). *J Vasc Surg Venous Lymphat Disord*. 2024;12(2):101729. doi:10.1016/j.jvsv.2023.101729

29. Daniels JP, Champaneria R, Shah L, Gupta JK, Birch J, Moss JG. Effectiveness of embolization or sclerotherapy of pelvic veins for reducing chronic pelvic pain: a systematic review. *J Vasc Interv Radiol.* 2016;27(10):1478-1486.e8. doi:10.1016/j.jvir.2016.04.016

30. Rossi FH, Kambara AM, Izukawa NM, et al. Randomized double-blinded study comparing medical treatment versus iliac vein stenting in chronic venous disease. *J Vasc Surg Venous Lymphat Disord.* 2018;6(2):183-191. doi:10.1016/j.jvsv.2017.11.003

31. Nagar SD, Nagar SJ, Jordan V, Dawson J. Sympathetic nerve blocks for persistent pain in adults with inoperable abdominopelvic cancer. *Cochrane Database Syst Rev*. 2024;6(6):CD015229. doi:10.1002/14651858.CD015229.pub2

32. Pezeshki Rad M, Abbasi B, Morovatdar N, Sadeghi M, Hashemi K. Pain in percutaneous liver core-needle biopsy: a randomized trial comparing the intercostal and subcostal approaches. *Abdom Radiol (NY).* 2019;44(1):286-291. doi:10.1007/s00261-018-1704-z

33. Akın ME. Effect of music on anxiety and pain during ultrasound-guided core needle breast biopsy: a randomized controlled trial. *Diagn Interv Radiol.* 2021;27(3):360-365. doi:10.5152/dir.2021.20132

34. Giordano F, Mitrotti A, Losurdo A, et al. Effect of music therapy intervention on anxiety and pain during percutaneous renal biopsy: a randomized controlled trial. *Clin Kidney J.* 2023;16(12):2721-2727. doi:10.1093/ckj/sfad246

35. Toraman RL, Eskici Ilgin V. Effect of virtual reality glasses application on pain, anxiety, and patient satisfaction during a transrectal prostate biopsy: a randomized controlled trial. *Biol Res Nurs.* 2024;26(4):485-497. doi:10.1177/10998004241236154

36. Liu L, Wang T, Lei B. Image-guided thermal ablation in the management of symptomatic adenomyosis: a systematic review and meta-analysis. *Int J Hyperthermia*. 2021;38(1):948-962. doi:10.1080/02656736.2021.1939443

37. Li S, Yang M, Guo H, Liu M, Xu S, Peng H. Microwave ablation vs traditional thyroidectomy for benign thyroid nodules: a prospective, non-randomized cohort study. *Acad Radiol.* 2022;29(6):871-879. doi:10.1016/j.acra.2021.08.017

38. Le Corroller T, Vives T, Mattei JC, et al. Osteoid osteoma: percutaneous CT-guided cryoablation is a safe, effective, and durable treatment option in adults. *Radiology*. 2022;302(2):392-399. doi:10.1148/radiol.2021211100

39. Leal BAN, Procópio RJ, Dardik A, Navarro TP. Sclerotherapy improves symptoms in patients with small and moderate diameter low-flow vascular malformations: a prospective cohort study. *Ann Vasc Surg.* 2023;89:68-77. doi:10.1016/j.avsg.2022.09.051