BJA

British Journal of Anaesthesia, 135 (2): 382–389 (2025)

doi: 10.1016/j.bja.2025.04.045
Advance Access Publication Date: 6 June 2025
Clinical Investigation

PAIN

Chemical ablation of pericapsular nerve group with 95% ethanol for pain relief and quality of life in patients with hip osteoarthritis: a prospective, double-blinded, randomised, controlled trial

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Abstract

Background: Chronic hip pain from osteoarthritis greatly diminishes quality of life, and standard treatments often fail to provide sufficient relief. Ultrasound-guided pericapsular nerve group (PENG) neurolysis using ethanol is a minimally invasive technique that may provide extended analgesia. This study evaluated the efficacy and safety of ultrasound-guided 95% ethanol neurolysis of the PENG compared with a sham procedure in patients with chronic hip pain.

Methods: This double-blinded, single-centre, RCT included 100 patients (median age: 82 yr [IQR 74–89]; 49% male) with chronic hip pain unresponsive to conservative treatments. Participants were assigned to either ethanol neurolysis (n=50) or a sham procedure (n=50). The primary outcome was pain intensity (numeric rating scale [NRS]) assessed at 7 days, 30 days, 3 months, and 6 months. Secondary outcomes included opioid consumption (oral morphine equivalents), quality of life (EQ-5D-5L), and neurological deficits.

Results: Ethanol neurolysis significantly reduced NRS scores at all follow-ups (P<0.0001). The mean NRS scores decreased from baseline 6.0 (SD 0.9) to 3.1 (0.8) at 7 days, 2.9 (0.7) at 30 days, 2.8 (0.7) at 3 months, and 3.0 (0.7) at 6 months. Opioid consumption was lower in the neurolysis group at 7 days (median [IQR]: 1.5 [0.5–3.5] mg *vs* 11.5 [9.1–13.7] mg, P=0.002) and remained reduced through 6 months. Quality of life improved significantly (P<0.0001), and no neurological deficits were observed.

Conclusions: Ultrasound-guided ethanol neurolysis of the PENG is a safe and effective intervention for chronic hip pain, providing long-term relief and reducing opioid dependency. Further multicentre trials are needed to validate long-term outcomes.

Clinical trial registration: NCT06087588.

Keywords: chronic hip pain; ethanol neurolysis; opioid reduction; osteoarthritis; PENG block; ultrasound-guided intervention

Received: 1 February 2025; **Accepted:** 30 April 2025

Editor's key points

- Chronic hip pain owing to osteoarthritis significantly impairs quality of life, and many patients are insufficiently relieved by conventional therapy.
- Hip arthroplasty is recommended for severe cases, but it is not possible for all patients. Innovative minimally invasive approaches are therefore warranted.
- In this double-blinded, placebo-controlled, single-centre study conducted in 100 patients with chronic hip osteoarthritis, the authors evaluated the efficacy and safety of ultrasound-guided 95% ethanol neurolysis of the pericapsular nerve group compared with sham neurolysis.
- Their study shows that ethanol neurolysis provides sustained pain relief, reduces opioid consumption, and improves health-related quality of life.
- This supports the use of ethanol neurolysis as a minimally invasive and effective intervention for refractory pain from hip osteoarthrosis.

Chronic hip pain from coxarthrosis is a common and debilitating condition that greatly affects quality of life and functional independence.[1] Despite the widespread use of nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen, and co-analgesics, many patients experience insufficient pain relief, leading to reduced mobility and increased healthcare burden.[2] Regional anaesthesia provides only short-term partial analgesia. Although hip arthroplasty remains the definitive treatment for severe cases, many patients are unable to undergo surgery owing to a lack of access to specialised hospital centres or contraindications from comorbid severe conditions, which may be severe enough to impose unacceptable perioperative risks to anaesthesia.[3] These challenges underscore the need for innovative, minimally invasive approaches to effectively manage pain and improve patient outcomes.

Ultrasound-guided pericapsular nerve group (PENG) neurolysis with ethanol has emerged as a promising technique for managing refractory hip pain.[4] This approach provides sustained analgesia without the risks associated with systemic therapies or surgical interventions by targeting the articular branches of the femoral, obturator, and accessory obturator nerves.[5,6] This study used ethanol neurolysis over cryoablation owing to its well-documented effectiveness, simplicity, and efficiency.[7] Ethanol neurolysis causes chemical denervation by inducing coagulative necrosis, offering long-lasting pain relief. In contrast, although practical, cryoablation often provides pain relief for a shorter duration because of the reversible nature of axonal damage caused by freezing.[8] Additionally, ethanol neurolysis involves a more straightforward application process, requires less specialised equipment, and reduces procedural time, making it more accessible and practical in clinical settings.

The PENG ethanol neurolysis facilitates precise, ultrasound-guided delivery of the neurolytic agent to the articular branches of the targeted nerves, ensuring selective sensory blockade with minimal impact on motor function.[4,9] This targeted approach minimises risks and optimises the safety profile of ethanol neurolysis while allowing for early mobilisation and rehabilitation.

This study aimed to evaluate the efficacy and safety of ultrasound-guided 95% ethanol neurolysis compared with a sham neurolysis procedure in patients with chronic hip pain secondary to coxarthrosis. We hypothesised that ethanol neurolysis would reduce pain intensity, decrease opioid consumption, and enhance health-related quality of life compared with sham treatment intervention. By integrating the precision of the PENG block with the effectiveness of ethanol neurolysis, this study provides robust evidence of the role of this technique as part of a multimodal analgesic strategy for coxarthrosis.

Methods

Trial design

This double-blinded, single-centre, prospective, RCT (NCT06087588) was registered at ClinicalTrials.gov on October 17, 2023, before recruitment. Ethics approval was obtained on March 09, 2023. The study was conducted following the Declaration of Helsinki and regulated by standards approved by the Consolidated Standards of Reporting Trials (CONSORT) statement.

Eligibility criteria

Adult patients of the Pain Treatment Clinic of the Transfiguration of Jesus Clinical Hospital of the Poznan University of Medical Sciences with coxarthrosis who failed to achieve satisfactory pain control (numeric rating scale [NRS] >3) despite the use of NSAIDs, paracetamol, and co-analgesics were approached for participation in the study. After obtaining written informed consent, 107 patients were included. Exclusion criteria included (1) suspected or diagnosed opioid dependence syndrome, (2) active cancer disease, and (3) dementia.

Randomisation

Participants were randomly assigned in a 1:1 ratio to ultrasound-guided 95% ethanol neurolysis (n=50) or sham neurolysis (n=50) with a randomisation list generated by the nQuery Advisor programme (Statistical Solutions, Boston, MA, USA). Randomisation was performed before the diagnostic block to ensure that patients were assigned to either the control or neurolysis group before undergoing any procedural intervention.

Blinding

The double-blinding in this study was accomplished via the strict design of the work tasks for the researchers, who were unaware of each other's final scores. The first researcher, uninvolved in the study, prepared the randomisation list and masked the group assignments in closed, opaque, and serially numbered envelopes. The other Pain Clinic consultant tracked the administrators to open the envelopes before applying the 95% alcohol neurolysis or sham block to reveal the group assignments and perform the procedures as instructed. Consequently, the Pain Clinic team, nurses, and patients were blinded to the study group assignment. The patients underwent 6-month follow-up after the procedure in the Pain Clinic. An independent researcher recorded the primary and secondary outcomes during inpatient Pain Clinic visits. The group

blinding was unmasked after the statistical analysis was accomplished.

Diagnostic pericapsular nerve group block

Before the procedure, an ultrasound-guided diagnostic PENG block was performed. The PENG block was performed under sterile conditions with the patient positioned supine and the hip slightly externally rotated. No sedation was used during the procedure. A high-frequency linear ultrasound probe (or curvilinear probe for larger patients) was used to identify the relevant anatomical landmarks, including the anterior inferior iliac spine (AIIS), the iliopubic eminence (IPE), the psoas tendon, and the femoral artery.

The ultrasound probe was initially placed in a transverse orientation over the AIIS and then moved medially to visualise the IPE. The fascial plane between the psoas muscle and the IPE was identified as the target injection site. A 22-gauge, 80–100 mm peripheral nerve block needle was inserted in-plane to the ultrasound probe from lateral to medial, ensuring real-time visualisation of the needle trajectory to avoid vascular structures, particularly the femoral artery.

Hydrodissection was performed using 1–2 ml of normal saline to confirm the correct placement, ensuring spread in the fascial plane between the psoas muscle and the IPE. After confirmation, 5 ml of local anaesthetic (ropivacaine 0.2–0.5% or bupivacaine 0.25–0.5%) was injected incrementally under ultrasound guidance for the diagnostic block to ensure sufficient diffusion of the anaesthetic for accurate pain relief assessment.

Ethanol 95% neurolysis or sham neurolysis

Patients were reassessed 1 week after the diagnostic block. Patients who reported a >50% reduction in hip pain for at least 6 h were submitted to the neurolytic block. The 95% ethanol neurolysis technique, or PENG neurolysis, was similar to the diagnostic block. Firstly, a blockade was performed with lidocaine 2%, 5 ml. Five minutes after blockade with lidocaine 2% for anaesthetic purposes, neurolysis was very slowly performed with 2.5 ml of 95% ethanol or 2.5 ml of 0.9% NaCl, depending on the group allocation, to minimise the spread of ethanol to adjacent structures while ensuring precise neurolysis.

Outcome measures

Primary outcome

At all post-procedure time points, during follow-up appointments (7 days, 30 days, 3 months, and 6 months after the procedure), the pain score was assessed using the NRS score (0 indicating no pain and 10 indicating the worst pain imaginable). Two independent physicians evaluated the subject during the examination (GK and AM). The NRS scores were self-reported by patients during follow-up assessments and recorded by independent, blinded evaluators to ensure unbiased outcome collection and adherence to the double-blinding protocol (PD and GK).

Secondary outcomes

The total opioid consumption, expressed in milligrams of oral morphine per day, and neurological deficits were assessed from the patients interviewed during follow-up appointments (7 days, 30 days, 3 months, and 6 months after the procedure) by the residents and fellows who were blinded to the study. Also, the Polish version of the EQ-5D-5L health questionnaire[10] was assessed during follow-up appointments (7 days, 30 days, 3 months, and 6 months after the procedure). The EQ-5D-5L comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has five levels: no problems, slight problems, moderate problems, severe problems, and extreme problems. The patient was asked to indicate their health state by ticking the box next to the most appropriate statement of the five dimensions. This decision resulted in a one-digit number that expressed the level selected for that dimension. The digits for the five dimensions were summarised into a number that describes the patient's health state.

Sample size calculation

The sample size was calculated using an adjusted approach for repeated measures analysis based on our primary hypothesis that hip joint denervation improves pain management. The unpublished retrospective dataset used for sample size estimation was derived from a cohort of patients with hip osteoarthritis who underwent PENG block at our Pain Clinic. These data included pain intensity (NRS) assessments at multiple time points after the procedure. The inclusion criteria for this dataset were patients diagnosed with moderate to severe hip osteoarthritis (Kellgren–Lawrence grade III–IV) who received a diagnostic PENG block and had follow-up pain assessments at 7 days, 30 days, 3 months, and 6 months after the procedure. Based on this retrospective analysis, we assumed a mean NRS score of 4 (SD 3). Given the repeated measures across multiple time points, we accounted for within-subject correlations using a repeated measures analysis of variance (ANOVA) framework rather than a paired *t*-test. Assuming an α of 0.05 and power of 0.80 for a 25% difference in NRS across all post-procedure time points using a mixed-effects model, the calculated sample size was 94. To account for a possible 5% dropout rate, the sample size was increased to 50 patients per group. Although the actual dropout rate before treatment allocation was slightly higher, the final sample of 100 patients who completed all assessments remained sufficient to maintain statistical power.

Statistical analysis

All primary and secondary endpoints were analysed based on intention-to-treat approach according to a superiority design. As all 100 analysed patients completed all assessments, there were no missing data, and multiple imputation was not required. Statistical analysis was performed using GraphPad Prism 10.1.1 (270) software (GraphPad Software Inc., San Diego, CA, USA). The parametric distribution of numerical variables was evaluated using the Shapiro–Wilk normality test. The Mann–Whitney test for non-normal distribution and unpaired *t*-test for normally distributed data assessed group differences. Categorical variables were compared with the Kruskal–Wallis test, and an analysis of contingency was compared with Fisher's exact test. Given that the primary outcome (pain intensity, NRS) was assessed at multiple time points (7 days, 30 days, 3 months, and 6 months), we performed a repeated measures ANOVA to compare scores between groups, accounting for within-subject variability. When statistically significant effects were found, we conducted Tukey's Honestly Significant Difference (HSD) *post hoc* tests to identify specific group differences across time. *F*-

values, degrees of freedom (df), and adjusted *P*-values were reported accordingly. The numerical variables are presented as mean (SD), except for non-normally distributed data, which are reported as median (IQR). A *P*-value <0.05 was considered statistically significant.

Results

Summary of participation

Of the 142 patients assessed for eligibility, nine did not meet the inclusion criteria, and 10 refused to participate. The remaining 123 patients were randomly allocated to two groups. Twelve patients did not receive allocated intervention because of a <50% reduction in hip pain for at least 6 h after the diagnostic block, and thus were excluded before treatment allocation. Another 11 patients were lost to follow-up as a result of non-attendance at follow-up visits before treatment allocation. Consequently, the final analysis was conducted on 100 patients, as seen in Figure 1. Notably, there were no missing data at any assessment time point (7 days, 30 days, 3 months, and 6 months) in the final analysed cohort. The analysed groups remained comparable, and as dropouts occurred before randomisation, the study design prevented any risk of attrition bias. As our repeated measures anova framework confirmed, the final analysed sample was sufficient to maintain statistical power. No clinically relevant differences were apparent from group characteristics, as shown in Table 1.

Primary outcome

The neurolysis group demonstrated significantly lower pain intensity (NRS scores) at all assessed time points (7 days, 30 days, 3 months, and 6 months after the procedure) compared with the control group ($P<0.0001$; Fig. 2 and Table 2).

A repeated measures two-way ANOVA confirmed a significant main effect of the treatment group (56.96% of total variation, $P<0.0001$) and a main effect of time (12.18% of total variation, $P<0.0001$), indicating that pain intensity varied across time points. Furthermore, a significant interaction effect between group and time (11.57% of total variation, $P<0.0001$) suggests that the pain reduction pattern differed between the neurolysis and control groups over time. *Post hoc* analysis using Tukey's HSD revealed that patients in the neurolysis group had significantly lower NRS scores than those in the sham group at each follow-up: 7 days ($F[1,98]=231.25$, $P<0.0001$), 30 days ($F[1,98]=195.60$, $P<0.0001$), 3 months ($F[1,98]=255.45$, $P<0.0001$), and 6 months ($F[1,98]=243.10$, $P<0.0001$). These findings confirm the sustained analgesic effect of ethanol neurolysis across all evaluated time points.

Secondary outcomes

Opioid consumption

Total opioid consumption, expressed in milligrams of oral morphine per day, was lower in the neurolysis group at all time points. Seven days after the procedure, opioid

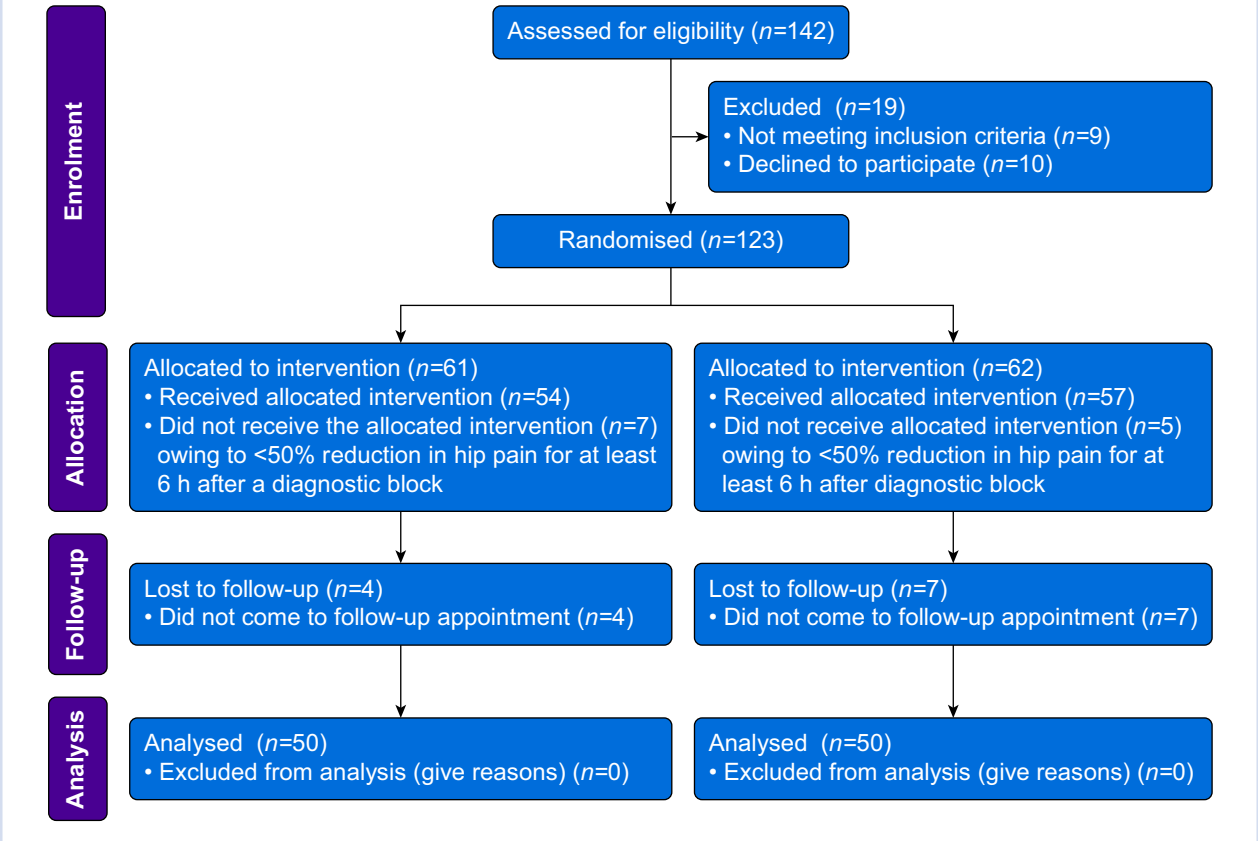

Fig 1. CONSORT flow diagram illustrating participant recruitment, randomisation, allocation, follow-up, and analysis in the clinical trial assessing ethanol neurolysis of the pericapsular nerve group for chronic hip pain.

Table 1 Baseline characteristics. Data are expressed as median and interquartile range (IQR).

	Control group (n=50)	Neurolysis (n=50)
Age	79.0 (74.0–85.0)	85.0 (77.8–89.0)
BMI	29.4 (27.2–30.2)	29.7 (27.7–31.8)
Male/Female	24/26	25/25
Duration of pain (months)	18.5 (15.0–21.3)	19.0 (17.0–22.0)
Morphine equivalent – daily dose (mg)	10.0 (8.8–15.0)	12.5 (10.0–15.0)
Kellgren–Lawrence grade	4.0 (3.0–4.0)	3.5 (3.0–4.0)
Numeric rating scale – before procedure	7.0 (6.0–8.0)	6.0 (5.8–7.0)
Neurological deficits	0	0
EQ-5D-5L mobility	2.0 (2.0–3.0)	2.0 (2.0–3.0)
EQ-5D-5L self-care	2.0 (1.0–2.0)	2.0 (1.0–2.0)
EQ-5D-5L usual activity	2.0 (1.0–3.0)	2.0 (1.0–3.0)
EQ-5D-5L pain/discomfort	4.0 (3.0–4.0)	4.0 (3.0–4.0)
EQ-5D-5L anxiety/depression	1.5 (1.0–2.0)	1.5 (1.0–2.0)
EQ-5D-5L total	11.0 (10.0–12.0)	11.0 (9.8–13.0)

consumption was 0.0 (0.0–5.0) mg in the neurolysis group compared with 10.0 (10.0–15.0) mg in the control group (P<0.0001). At 30 days, opioid consumption remained lower in the neurolysis group at 0.0 (0.0–5.0) mg, whereas the control group reported 10.0 (10.0–15.0) mg (P<0.0001). Three months after the procedure, the neurolysis group continued to show lower opioid use, with values of 0.0 (0.0–5.0) mg compared with 10.0 (10.0–15.0) mg in the control group (P<0.0001). At 6 months, opioid consumption in the neurolysis group remained at 0.0 (0.0–0.0) mg compared with 10.0 (10.0–15.0) mg in the control group (P<0.0001), as seen in Figure 3.

Neurological deficits

We did not observe neurological deficits in both groups at all time points (7 days, 30 days, 3 months, and 6 months after the procedure).

EQ-5D-5L quality of life

The total score for the EQ-5D-5L health questionnaire was lower in the neurolysis group at 7 days (11.1 [SD 1.7] *vs* 7.6 [1.1]; P<0.0001), 30 days (11.4 [1.5] *vs* 7.5 [1.6]; P<0.0001), 3 months (11.5 [1.5] *vs* 7.6 [1.0]; P<0.0001), and 6 months (10.7 [2.3] *vs* 8.3 [1.4]; P<0.0001) after the procedure, as seen in Figure 4.

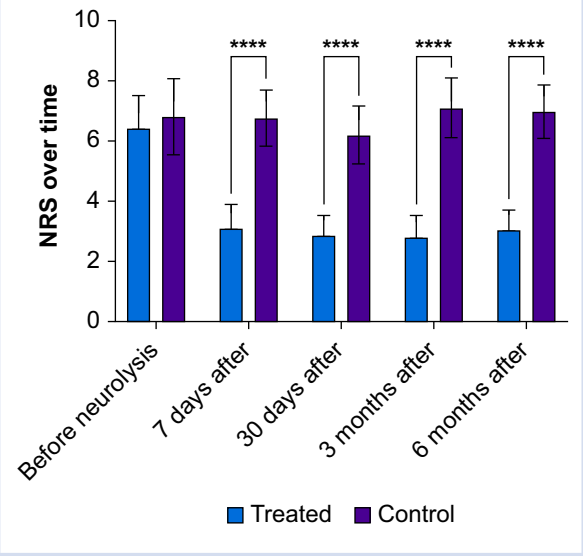

Fig 2. Pain intensity over time measured by the numeric rating scale (NRS) in treated *vs* control groups. Ethanol neurolysis significantly reduced pain scores at 7 days, 30 days, 3 months, and 6 months after treatment compared with control (****P<0.0001).

Discussion

This study demonstrates that ultrasound-guided 95% ethanol neurolysis of the PENG provides significant and sustained pain relief, reduces opioid consumption, and improves health-related quality of life in patients with chronic hip pain as a result of coxarthrosis. These findings support the utility of ethanol neurolysis as a minimally invasive and effective intervention for managing refractory pain in this population.

Although previous studies have explored the role of neurolysis in managing hip pain, many were retrospective case series or observational studies.[11,12] Our study is the first double-blinded, placebo-controlled RCT evaluating the efficacy of ethanol-based PENG neurolysis, providing the highest level of evidence in this field.

Our results align with previous research on chemical neurolysis for hip pain management. Pimenta and colleagues[13] demonstrated that phenol neurolysis of the obturator and PENG nerves effectively reduced pain and improved patient function in patients with metastatic hip cancer pain. Similarly, Dhingra and colleagues[14] reported significant pain relief after phenol neurolysis of the genicular nerves in patients with distal femoral fractures.

Our findings further support those of Ng and colleagues,[4] who explored the use of alcohol-based PENG neurolysis for non-operable hip pain, confirming its long-lasting analgesic effects. Galluccio and colelagues[15] also reported similar outcomes in their evaluation of chemical neurolysis techniques for chronic joint pain, highlighting the potential of PENG neurolysis in hip osteoarthritis pain management.

Table 2 Primary and secondary outcomes. Values are mean (SD) and interquartile range. *P-value compared all two groups. †ANOVA or Student's t-test or Mann–Whitney test. CI, confidence interval; NRS, numeric rating scale.

		Control group (*n*=50)	Neurolysis (*n*=50)	*p*-value*†	95% CI
NRS	7 days after procedure	6.8 (0.9)	3.1 (0.8)	<0.0001	4.0 (3.0–4.0)
	30 days after procedure	6.2 (1.0)	2.9 (0.7)	<0.0001	3.0 (3.0–4.0)
	3 months after procedure	7.1 (1.0)	2.8 (0.7)	<0.0001	4.5 (4.0–5.0)
	6 months after procedure	7.0 (0.9)	3.0 (0.7)	<0.0001	4.0 (4.0–4.0)
Total opioid consumption (mg of oral morphine per day)	7 days after procedure	11.8 (5.1) 10.0 (10.0–15.0)	1.6 (2.4) 0.0 (0.0–5.0)	<0.0001	−10.0 (−10.0 to −10.0)
	30 days after procedure	11.7 (4.9) 10.0 (10.0–15.0)	1.3 (2.2) 0.0 (0.0–5.0)	<0.0001	−10.0 (−10.0 to −10.0)
	3 months after procedure	12.1 (4.7) 10.0 (10.0–15.0)	1.3 (2.2) 0.0 (0.0–5.0)	<0.0001	−10.0 (−10.0 to −10.0)
	6 months after procedure	12.8 (4.8) 10.0 (10.0–15.0)	1.1 (2.1) 0.0 (0.0–0.0)	<0.0001	−10.0 (−10.0 to −10.0)
EQ-5D-5L (total score)	7 days after procedure	11.1 (1.7)	7.6 (1.1)	<0.0001	3.0 (3.0–4.0)
	30 days after procedure	11.4 (1.5)	7.5 (1.6)	<0.0001	3.0 (3.0–4.0)
	3 months after procedure	11.5 (1.5)	7.6 (1.0)	<0.0001	4.0 (3.0–4.0)
	6 months after procedure	10.7 (2.3)	8.3 (1.4)	<0.0001	3.0 (3.0–4.0)

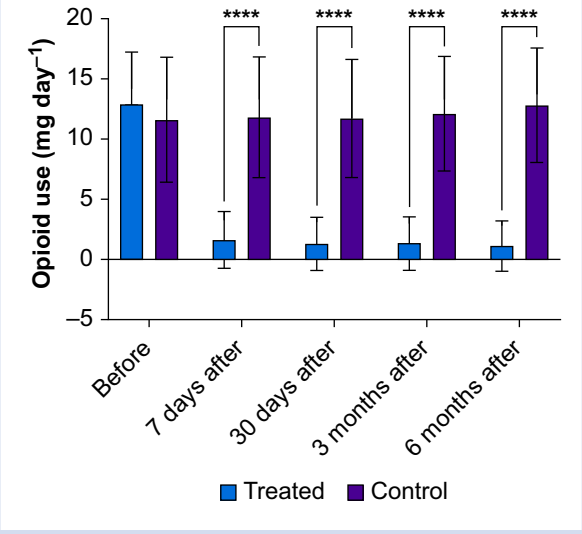

Fig 3. Daily opioid consumption (oral morphine equivalents) over time in both groups. Patients receiving ethanol neurolysis showed a sustained reduction in opioid use at all follow-up points (****P<0.0001).

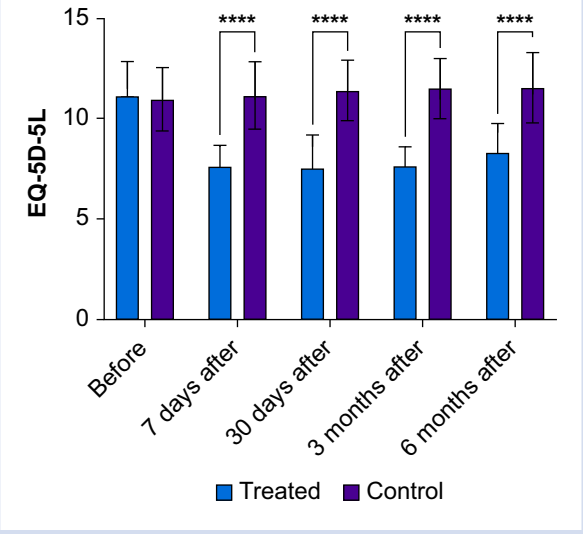

Fig 4. EQ-5D-5L quality-of-life scores over time. The neurolysis group reported significantly improved quality of life compared with controls at all post-procedure time points (****P<0.0001).

Mechanism of action and advantages of ethanol over alternative methods

Our study confirms previous findings that ethanol neurolysis works by inducing protein denaturation and coagulative necrosis, leading to long-term interruption of pain transmission.[16] Compared with radiofrequency ablation (RFA), ethanol neurolysis is a more cost-effective and accessible technique that does not require specialised equipment, making it a practical alternative in many clinical settings.[17] Furthermore, unlike cryoablation, ethanol-induced neurolysis is irreversible, ensuring a longer-lasting analgesic effect.[18]

Comparison of ethanol neurolysis with cryoablation and radiofrequency ablation

Although our study confirms the efficacy of ultrasound-guided ethanol neurolysis for chronic hip pain, it is essential to compare it with other minimally invasive techniques, such as cryoablation and RFA, which have also been utilised in pain management.

Ethanol neurolysis causes irreversible denervation by inducing coagulative necrosis, leading to long-term pain relief. In contrast, cryoablation achieves analgesia through temporary axonal damage caused by freezing, often resulting in reversible nerve regeneration and a shorter duration of pain relief. Filippiadis and colleagues[19] compared cryoablation with ethanol neurolysis for celiac plexus neurolysis in patients with

intractable abdominal pain and found that ethanol provided longer-lasting analgesic effects than cryoablation. Additionally, Chang and colleagues[20] highlighted that cryoablation may require repeat procedures because of the regrowth of nerve fibres, whereas ethanol neurolysis offers a permanent solution for neuropathic pain.

RFA relies on thermal energy to ablate nerves and disrupt pain transmission. Although RFA is an effective modality for chronic pain, it requires specialised equipment, is costly, and has a higher procedural complexity compared with ethanol neurolysis. Wu and colleagues[7] noted that RFA provides temporary pain relief, often requiring reapplications after 6–12 months, whereas ethanol neurolysis induces permanent denervation. Shah and Gulati[21] further emphasised that although RFA is helpful for selective nerve targeting, ethanol neurolysis is more effective in patients with a wider neurolytic spread, such as chronic hip pain.

Given these comparisons, ethanol neurolysis presents a cost-effective, permanent, and accessible alternative to cryoablation and RFA. Although cryoablation provides temporary relief, and RFA necessitates specialised equipment and periodic reapplications, ethanol neurolysis offers sustained analgesia without repeated interventions. This makes it a practical and efficient approach for patients with chronic hip pain who may not have access to advanced interventional pain management centres.

Impact on quality of life

Previous studies have primarily focused on pain reduction; however, our research is the first to systematically quantify opioid consumption before and after the procedure, demonstrating a significant decrease in opioid use among treated patients. Given the ongoing opioid crisis, this finding has important clinical implications by promoting safer, nonopioid-based pain management strategies. Additionally, we used the EQ-5D-5L health questionnaire, a validated quality-of-life assessment, to comprehensively evaluate patient well-being beyond pain relief, providing a holistic understanding of the intervention's impact.[22] This supports findings by Hassan and colleagues,[23] who highlighted that minimally invasive interventions enhance mobility, reduce depression, and improve overall well-being in patients with chronic hip pain. Similar observations were made by Wu and colleagues,[7] who emphasised the superiority of chemical neurolysis over traditional nerve blocks in long-term pain relief.

By incorporating these findings, our study reinforces the clinical superiority of ethanol neurolysis in achieving long-term pain relief, reducing opioid dependence, and improving the quality of life for patients with coxarthrosis-related pain.

Study limitations

Despite promising findings, this study has several limitations. Firstly, it was conducted at a single centre, which may limit the generalisability of the results. Secondly, the 6-month follow-up period, although adequate for assessing medium-term outcomes, does not provide insight into the long-term durability of the intervention. Future studies should incorporate longer follow-up periods to evaluate the persistence of pain relief. Thirdly, the exclusion of patients with active cancer, dementia, or opioid dependence limits the applicability of our findings to these populations. Fourthly, although the sham procedure was an appropriate control, the use of 0.9% saline may not have entirely replicated the procedural and psychological effects of ethanol neurolysis, introducing a potential bias. Fifthly, the observed dropout rate was slightly higher than anticipated, which did not impact the final analysis, as all patients included completed the study, eliminating the risk of missing data bias. The study design ensured that dropouts occurred before analysis, preventing attrition bias. Lastly, although outcome assessments were conducted using blinded evaluators, patient-reported measures of pain and quality of life remain subjective and can be influenced by psychological factors.

Conclusions

This study supports the efficacy and safety of ultrasound-guided 95% ethanol neurolysis of the PENG for managing chronic hip pain owing to osteoarthritis. The intervention offers sustained pain relief, reduces opioid consumption, and enhances quality of life with minimal risks. Although these findings are compelling, future research should focus on multicentre trials with extended follow-up periods to validate the long-term benefits of ethanol neurolysis. Additionally, comparative studies examining ethanol neurolysis against alternative techniques, such as RFA and cryoablation, could further clarify its role in comprehensive pain management strategies.

Authors' contributions

Study design: MR, TR
Study conception: MR
Data collection: TR
Data acquisition: MR
Supervised data acquisition: GK
Data analysis: MR,
Data interpretation: MR, AM
Methodology: GK
Provided methodological guidance: PD
Data validation: PD
Statistical analysis: TR
Provided clinical expertise in pain management: AM
Manuscript draft: MR
Reviewed the final manuscript draft: PD
Manuscript revision: AM
Critical revision of the manuscript for important intellectual content: TR, GK
Supervised the study: KWT
Scientific accuracy: KWT
Final approval of the manuscript before submission: KWT
All authors read and approved the final version of the manuscript and agree to be accountable for the accuracy and integrity of the work. All authors made substantial contributions to the study in accordance with the International Committee of Medical Journal Editors (ICMJE) recommendations.

Declaration of interest

The authors declare no conflicts of interest related to this study.

References

1. Paraliov AT, Iacov-Craitoiu MM, Mogoantă MM, Predescu OI, Mogoantă L, Crăiţoiu Ş. Management and

treatment of coxarthrosis in the orthopedic outpatient clinic. *Curr Health Sci J* 2023; **49**: 102–9
2. Tikhilov RM, Lila AM, Kochish AY, et al. Coxarthrosis. Clinic, diagnosis and treatment: clinical guidelines (abridged version). *NN Priorov J Traumatol Orthop* 2022; **29**: 87–112
3. Szwedowski D, Starczewski M, Paszke M, Jackowiak M. Scaffolds for knee chondral lesions—indications and technical tips. *Chir Narządów Ruchu Ortop Pol* 2021; **86**: 77–9
4. Ng TK, Peng P, Chan W. Posterior hip pericapsular neurolysis (PHPN) for inoperable hip fracture: an adjunct to anterior hip pericapsular neurolysis. *Reg Anesth Pain Med* 2021; **46**: 1080–4
5. Reysner T, Kowalski G, Grochowicka M, Domagalska D. The pericapsular nerve group (PENG) block for hip surgery. A narrative review. *Chir Narządów Ruchu Ortop Pol* 2023; **88**: 17–24
6. Domagalska M, Ciftci B, Reysner T, Kolasiński J, Wieczorowska-Tobis K, Kowalski G. Pain management and functional recovery after pericapsular nerve group (PENG) block for total hip arthroplasty: a prospective, randomized, double-blinded clinical trial. *J Clin Med* 2023; **12**: 4931
7. Wu R, Majdalany BS, Lilly M, Prologo JD, Kokabi N. Agents used for nerve blocks and neurolysis. *Semin Intervent Radiol* 2022; **39**: 387–93
8. Kong FL, Bie ZX, Wang Z, Peng JZ, Li XG. Nerve injury and regeneration after neurolysis: ethanol alone versus ethanol with brachytherapy in rabbits. *J Vasc Interv Radiol* 2022; **33**: 1066–72
9. Domagalska M, Wieczorowska-Tobis K, Reysner T, Geisler-Wojciechowska A, Grochowicka M, Kowalski G. Pericapsular nerves group (PENG) block in children under five years of age for analgesia in surgery for hip dysplasia: case report. *J Pers Med* 2023; **13**: 454
10. Golicki D. General population reference values for the EQ-5D-5L index in Poland: estimations using a Polish directly measured value set. *Pol Arch Intern Med* 2021; **131**: 484–6
11. Duarte CC, Galacho J, Resende A, Spranger A, Veiga M. Chemical neurolysis for the conservative treatment of hip fractures. *Pain Manag* 2024; **14**: 259–64
12. Rocha Romero A, Carvajal Valdy G, Lemus AJ. Ultrasound-guided pericapsular nerve group (PENG) hip joint phenol neurolysis for palliative pain. *Can J Anesth* 2019; **66**: 1270–1
13. Pimenta MV, Nakamura AT, Ashmawi HA, Vieira JE, Dos Santos Fernandes H. Ultrasound-guided pericapsular nerve group and obturator nerve phenol neurolysis for refractory inpatient hip cancer metastasis pain: a case report. *Braz J Anesthesiol* 2024; **74**, 744089
14. Dhingra P, McHardy PG, Jenkinson R, Meng H. Genicular nerve and fracture site chemical neurolysis for distal femoral fracture: a case report. *Reg Anesth Pain Med* 2023; **48**: 378–82
15. Galluccio F, Ng TK, Perez MF, Altinpulluk EY, Taverner M. Phenolysis for advanced shoulder osteoarthritis: a case series of a novel ultrasound-guided approach to anterior and posterior glenohumeral articular nerve branches. *Cureus* 2023; **15**, e47890
16. Arboleda MF, Girón-Arango L, Peng PWH. Can recent chronic pain techniques help with acute perioperative pain? *Curr Opin Anesthesiol* 2019; **32**: 661–7
17. Ergönenç T, Stockman J. New ultrasound-guided techniques in chronic pain management: an update. *Curr Opin Anesthesiol* 2021; **34**: 634–40
18. Kim J, Garcia RM, Prologo JD. Image-guided peripheral nerve interventions- applications and techniques. *Tech Vasc Interv Radiol* 2024; **27**, 100982
19. Filippiadis D, Efthymiou E, Tsochatzis A, Kelekis A, Prologo JD. Percutaneous cryoanalgesia for pain palliation: current status and future trends. *Diagn Interv Imaging* 2021; **102**: 273–8
20. Chang DL, Mirman B, Mehta N, Pak D. Applications of cryoneurolysis in chronic pain management: a review of the current literature. *Curr Pain Headache Rep* 2024; **28**: 403–16
21. Shah RK, Gulati A. Radiofrequency and neurolysis for the treatment of chronic visceral abdominal pain. In: Kapural L, editor. *Chronic abdominal pain: an evidence-based, comprehensive guide to clinical management*. New York, NY: Springer New York; 2015. p. 153–61
22. Łaziński M, Dziki A, Niemyjski W. A study on the quality of life of patients awaiting knee replacement in the population of central Poland. *Chir Narzadow Ruchu Ortop Pol* 2021; **86**: 39–43
23. Hassan MG, Horenberg AL, Coler-Reilly A, Grayson WL, Scheller EL. Role of the peripheral nervous system in skeletal development and regeneration: controversies and clinical implications. *Curr Osteoporos Rep* 2023; **21**: 503–18

Handling Editor: Nadine Attal