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REVIEW ARTICLE

# Ultrasound-Guided Versus Conventional Fluoroscopic-Guided Superior Hypogastric Plexus Block for Cancer-Related Pelvic Pain; a Systematic Review and Meta-Analysis

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**Background** Chronic pelvic cancer pain is a major and distressing symptom. In addition to conventional treatments such as analgesics and surgical interventions, the superior hypogastric plexus block (SHPB) serves as an alternative option for managing severe pain. This study aimed to compare the outcomes of two imaging modalities—ultrasound and fluoroscopy—for guiding SHPB.

**Methods** A systematic search was conducted in PubMed, Cochrane Library, Web of Science, Scopus, and Elsevier ScienceDirect for randomized controlled trials (RCTs) published before May 2025. The effectiveness of ultrasound-guided and fluoroscopy-guided SHPB was compared in terms of pain intensity (primary outcome), morphine consumption, quality of life (QOL), patient satisfaction, procedure duration, and post-procedural complications. Subgroup analyses were performed based on different time-points.

**Results** The analysis included four RCTs involving 246 patients. No significant differences in pain relief were observed in one week, one month, two months, or three months between the ultrasound-guided and fluoroscopy-guided groups. However, the overall effect showed significantly lower pain scores in the ultrasound-guided group (SMD= -0.39, 95% CI [-0.70, -0.07], $p$= 0.02), with substantial heterogeneity ($I^2$= 79%). No significant differences were found for morphine consumption, QOL, patient satisfaction, or procedure duration. Notably, the ultrasound-guided group had significantly fewer procedure-related complications (RR= 0.35, 95% CI [0.15, 0.81], $p$= 0.01), with moderate heterogeneity ($I^2$= 46%).

**Conclusion** Ultrasound-guided SHPB was comparable to the conventional fluoroscopy-guided approach for long-term pain control and was associated with a lower risk of adverse effects.

**Keywords** Fluoroscopy, Meta-analysis, Pain management, Pelvic cancer, Superior hypogastric plexus, Ultrasonography.
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## INTRODUCTION

Pain related to pelvic cancer can be both challenging and debilitating to manage. It may arise from a variety of pathophysiological mechanisms affecting pelvic organs, including those of the digestive, urogenital, neurological, and musculoskeletal systems[1]. Inadequately treated pain can have a profound negative impact on patients and their families. Therefore, global health organizations emphasize the importance of effective pain management as a core component of standard cancer care.

Pharmacological therapy remains a cornerstone of cancer pain management, following the World Health Organization (WHO) analgesic ladder. However, long-term opioid use is often associated with significant adverse

effects[2]. For patients who are resistant to conventional analgesics and experience intractable pain, interventional therapies offer valuable alternatives. Neurolytic blockade of sympathetic fibers at various levels may be effective in managing visceral abdominal and pelvic pain[3].

The superior hypogastric plexus (SHP), a continuation of the celiac plexus and lumbar sympathetic ganglia, is a retroperitoneal structure located between the lower border of the fifth lumbar vertebra and the top of the sacrum. It innervates several pelvic viscera, including the upper vagina, ureters, urinary bladder, sigmoid colon, and anal canal. As such, superior hypogastric plexus block (SHPB) is a promising intervention for managing pain originating from these regions[4].

Various imaging modalities and needle approaches have been utilized to guide SHPB in order to enhance safety, precision, and patient comfort. These include fluoroscopy (FL), computed tomography (CT), ultrasonography (US), and magnetic resonance imaging (MRI). SHPB can be performed via posterior approaches (paramedian, lateral, oblique, transdiscal, and transvaginal) or an anterior (transabdominal) approach[5].

Only a limited number of comparative studies have evaluated the feasibility and effectiveness of US-guided versus FL-guided SHPB in managing pelvic cancer-related pain[6–9]. However, a systematic and meta-analytic synthesis of these findings has not yet been conducted. Such a study is crucial for generating evidence that can inform and guide clinical decision-making. Therefore, the objective of this research is to systematically review and summarize evidence from randomized controlled trials comparing these two imaging modalities for SHPB.

## METHODS

**Study Protocol:**

The review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards[10] and the Cochrane's methods for conducting Systematic Reviews of Interventions[11]. This study was recorded in the PROSPERO worldwide database under a unique identifier number (CRD42024563816). No ethical approval was required, because of the study nature.

**Search Strategy:**

The research involved using the following worldwide databases; PubMed Central, Cochrane Library, Web of Science, Scopus, and Elsevier ScienceDirect. Studies of interest were searched from inception till May 2025, and the search was performed again two weeks before manuscript submission to identify newly published studies. The search keywords involved four conceptual categories: Ultrasound, fluoroscopy, SHPB, and pain. The potential keywords, used in the ultrasound group, included (ultrasound, ultrasound-guided, US, ultrasonographic, and ultrasonography). Regarding the fluoroscopy group, the potential keywords were (fluoroscopy, fluoroscopic, and *X*-Ray). The keywords for SHPB group included (superior hypogastric plexus neurolysis, and superior hypogastric block). The Boolean operator (AND) and (OR) were used to join keywords between the groups, and within each group respectively. Manual reference checks of relevant articles were also performed.

Three independent authors reviewed the search results for eligible titles, followed by an abstract review. If there were no exclusion criteria in the abstract, the entire paper was reviewed and evaluated. Cross-references from relevant papers were also evaluated for inclusion. The reviewers gathered relevant studies, and inconsistencies were resolved via discussion.

**Study eligibility:**

The inclusion criteria included: (a) patients; individuals with cancer-related pelvic pain unresponsive to pharmacological treatment; (b) intervention; SHPB guided by Ultrasound imaging; (c) comparator; SHPB guided by fluoroscopy imaging; (d) outcomes; reporting at least two of the study endpoints, (e) study design; randomized clinical trials (RCTs), and (f) English language. The exclusion criteria included: Abstracts, conference proceedings, single-arm investigations, unoriginal studies, and trials used animals or cadavers.

**Data extraction:**

Three reviewers independently extracted data using an Excel sheet. Extracted variables included: study identifiers (author, year, country), sample size, patient demographics, intervention characteristics (approach, imaging modality), and reported outcomes. When the outcome data was missing, we contacted study authors. If standard deviations (SDs) were not reported, they were calculated from standard errors, p-values, or confidence intervals using Cochrane-recommended methods. All pain scores were standardized to a common 0–10 scale.

**Risk of Bias assessment:**

To assess the methodological quality of the included trials, three independent reviewers employed the Cochrane Risk of Bias tool (RoB-2) for RCTs[12]. Trials were judged based on seven bias domains incorporating selection bias (generation of a randomized sequence and concealment of allocation), performance bias (masking of participants), detection bias (masking of outcomes assessor), attrition bias (drop-out of participants with similar characteristics), reporting bias (selective revealing or concealing of outcomes), and other possible causes of bias. For each

bias domain in each study, the reviewers gave a score of (high, low, or unclear risk). Discrepancies were resolved by discussion.

**Outcomes of Interest:**

One primary outcome and five secondary outcomes were collected and analyzed. The primary outcome was pain assessment using Visual Analogue Scale (VAS) or Numeric Rating Scale (NRS) scores in the first week, then after one, two- and three-months post-intervention. The secondary outcomes included total amount of morphine consumption, Quality of life (QOL), patient satisfaction, duration of the procedure, and related adverse events.

**Data Preparation for Synthesis:**

To ensure compatibility across studies, all outcome data were converted to a common metric where necessary. When standard errors or confidence intervals were reported instead of standard deviations, appropriate conversions were made.

**Statistical analysis:**

For continuous outcomes, the findings were reported using the mean difference (MD) or standardized mean difference (SMD), and for dichotomous outcomes, the findings were reported using the risk ratio (RR). The Study end-points were statistically analyzed using Mantel-Haenszel via Review Manager [RevMan 5.4.2, The Cochrane Collaboration, Copenhagen, Denmark]. Heterogeneity across studies was evaluated using both the $Chi^2$ test and the $I^2$ statistic. We interpreted heterogeneity following Cochrane guidance, considering the magnitude and direction of effects, the number of included studies, and clinical variability in addition to statistical indices. In general, a random-effects model was chosen when substantial heterogeneity was present, while a fixed-effect model was used when heterogeneity was judged to be low. A meta-regression analysis to detect potential sources of heterogeneity was not feasible due to the smaller number of studies included. An alpha value of less than 0.05 was used to evaluate statistical significance.

## RESULTS

**Study selection:**

After a preliminary search, 248 reference articles were identified. Out of these, 115 relevant studies were chosen and examined. Following a thorough evaluation of the remaining titles and abstracts in relation to the study selection criteria, thirteen articles were selected for further review. Four RCTs[6-9] that evaluated the method of SHPB (ultrasound-guided / Fluoroscopic-guided) for cancer pain management were utilized (Figure 1).

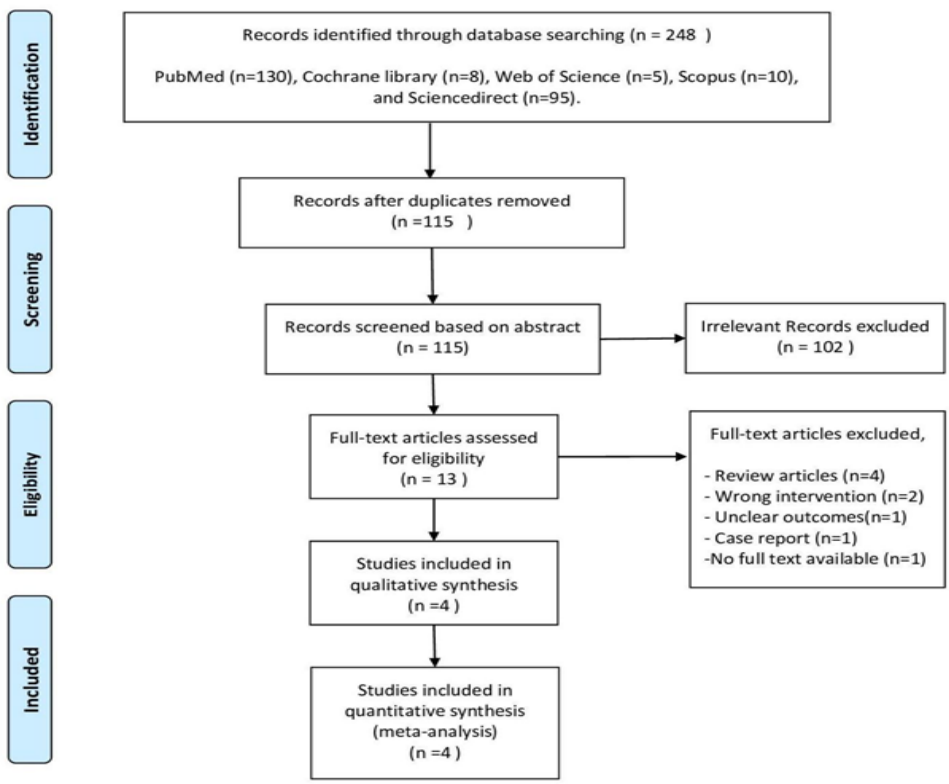


**Fig. 1:** PRISMA flow diagram for literature search.

**Study characteristics:**

The final studies chosen for the review were randomised controlled trials published in English language. All the patients were diagnosed and documented as having advanced-stage pelvic cancer. Patients were entitled if they complained sever pelvic pain resistant to current medical therapy or if they had intolerable side effects from these medications. The total number of patients was 246 of both genders and aged above eighteen years old. The included studies were published during 2016-2023 and conducted in Egypt at two different institutions: the National Cancer institute[6,7,9], and Mansoura University[8]. All studies used phenol injection diluted in saline for neurolysis, except one study[8] that added bupivacaine to the injected solution. The US-guided approach was conducted anteriorly during the supine position, while the FL-guided technique used the posterior approach (prone position) except for one trial[8] which conducted an anterior fluoroscopic approach at L5-S1 inter-discal space. In Abdelghafar *et al.,* Study[7] antero-posterior and lateral fluoroscopic imaging was following the US-guided neurolytic injections to confirm the dye distribution. The main assessed outcomes were the pain intensity based on VAS[6,7,9] and NRS[8] scores, morphine consumption amount, quality of life, patient satisfaction, duration of the procedure, and procedural adverse events. The follow-up period extended from the first week post intervention up to three months for all studies (Table 1).

**Risk of bias in the included trials:**

According to the Cochrane Handbook method, employed to evaluate the potential risk of bias, the four RCTs described their randomization methods and provided specific inclusion and exclusion criteria. However, information regarding allocation concealment using opaque, sealed envelopes was only found in one study[8]. Two RCTs reported that outcome assessors were blinded to methods[6,7]. But no patient blinding was implemented in any trial. All RCTs demonstrated low-risk bias in the attrition domain and provided clear outcome data reporting. except for one study[6] that skipped reporting duration of procedure as reported in the methods. Additionally, the same RCT[6] did not offer enough information about the sample size calculation or its primary and secondary outcomes, therefore the other bias domain was assigned as high-risk. The risk of bias items is summarized in Figure (2, 3).

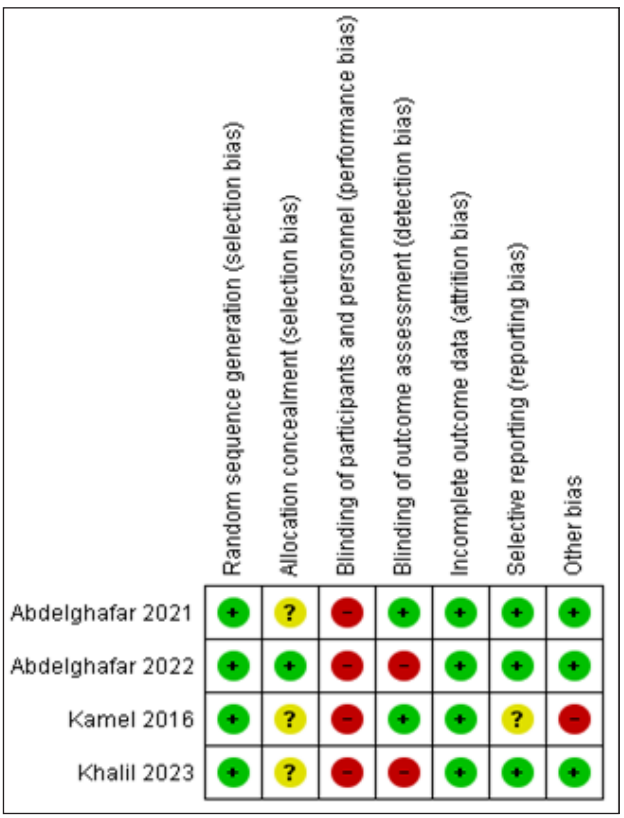


**Fig. 2:** Risk of bias summary according to the Cochrane risk of bias assessment tool.

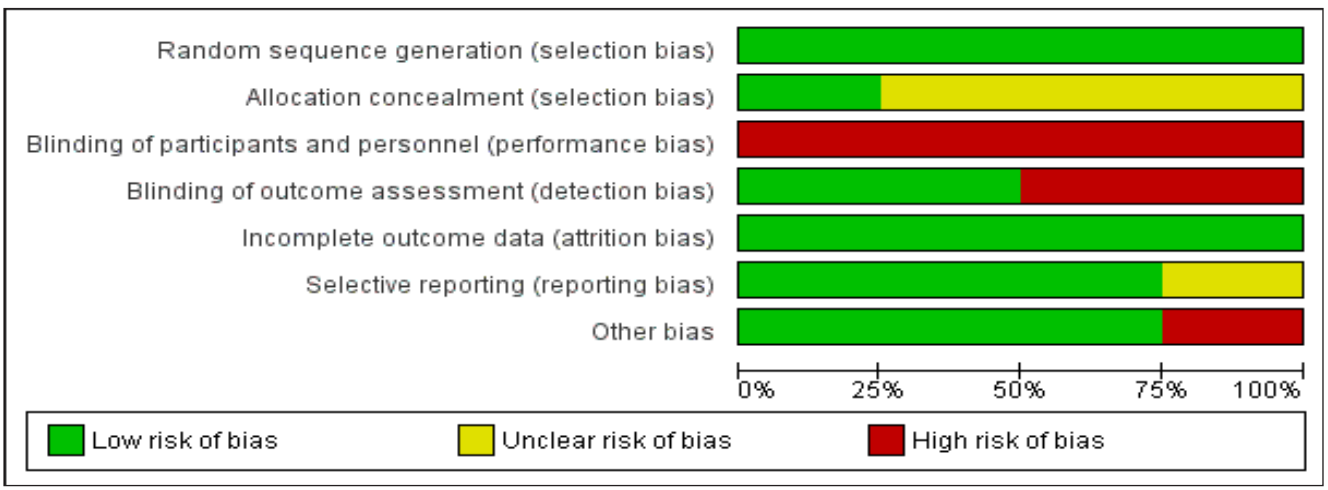


**Fig. 3:** Risk of bias graph for included studies.

**Outcomes of Meta-analysis:**

***Post-procedure Pain scores***

All included studies reported pain score assessment at variable time-points (1-week, 1-month, 2-months, 3-months) post-procedural. The overall pooled data revealed a significant reduction in pain scores favoring the US-guided compared to FL-guided groups (SMD= -0.39, 95%CI [-0.70, -0.07], $p$= 0.02). The pooled heterogeneity test indicated a high level of heterogeneity (I2= 79%, $p$<0.001), promoting the use of random-effects model. Subgroup analysis was used for pain assessment at various time-points. Pain relief was reported at first week ($n$= 3 studies, SMD= −0.32, 95%CI [−1.12, 0.47], $p$= 0.42), after one month ($n$= 4 studies, SMD= −0.59, 95%CI [−1.39, 0.22], $p$= 0.15), after two months ($n$= 2 studies, SMD= −0.39, 95%CI [−1.43, 0.64], $p$= 0.45), and after three months ($n$= 4 studies, SMD= −0.23, 95%CI [−0.64, 0.17], $p$= 0.26). The subgroup analyses at individual time-points (1-week, 1-month, 2-months, and 3-months) did not achieve statistically significant differences between the two groups. The pooled analysis was heterogeneous across all time-points ($I^2$>50%) (Figure 4).

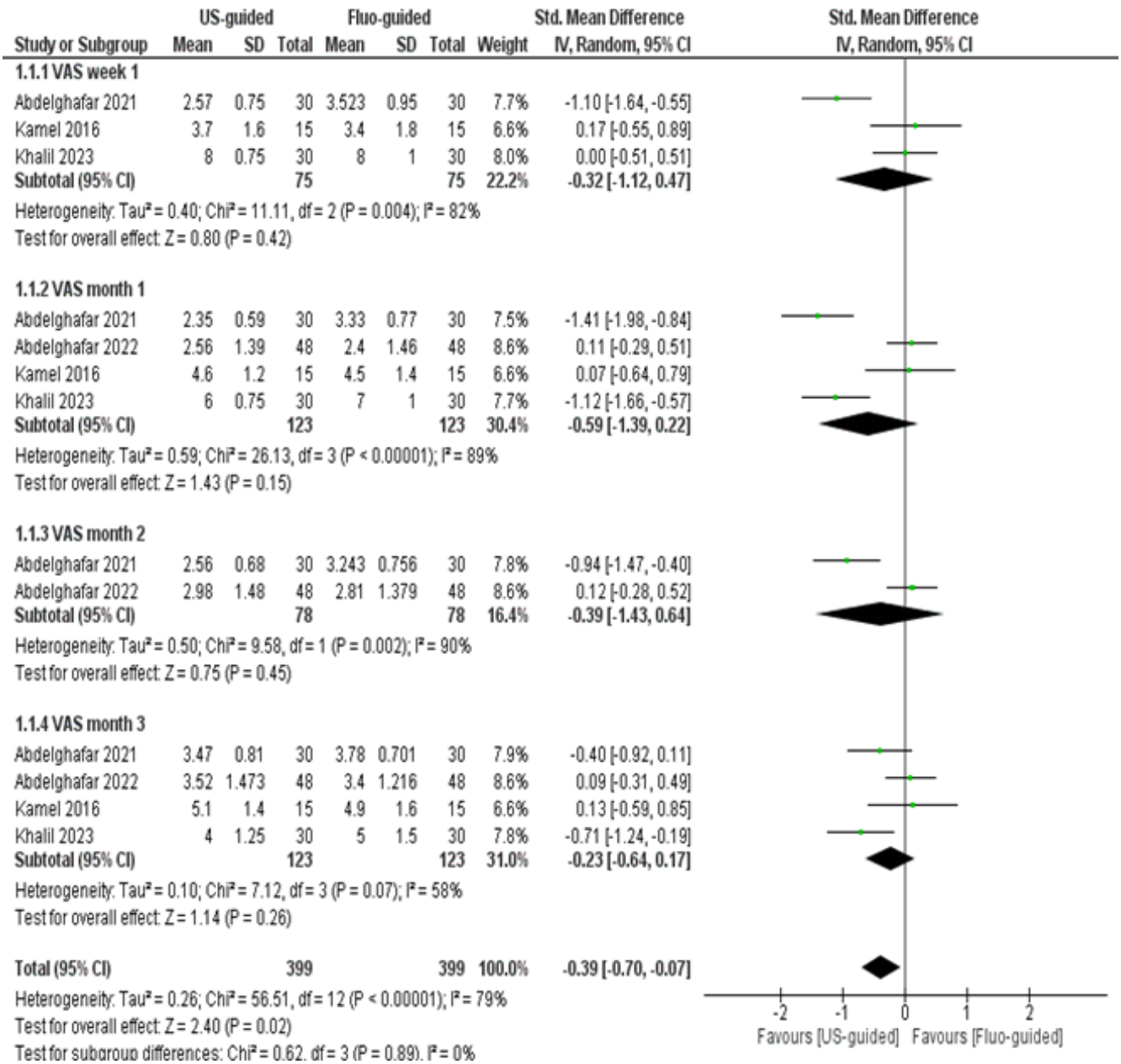


**Fig. 4:** Forest plot for post-procedure pain scores measured at different time-points based on the 10-point visual analogue scale (VAS).

### *Morphine consumption*

All included studies reported the amount of morphine consumption at variable time-points post-procedure (1-week, 1-month, 3-months), except for Abdelghaffar and Farahat study that reported the number of patients needed morphine (60mg/day), so it was eliminated from the analysis. The overall pooled result revealed insignificant difference regarding morphine consumption between the US-guided and FL-guided groups (SMD= -4.08, 95%CI [-8.42, 0.26], $p$= 0.07). The pooled heterogeneity test indicated moderate level of heterogeneity (I2= 55%, $p$= 0.02), promoting the use of random-effects model. Subgroup analysis was used for morphine consumption at various time-points. It was reported at one week ($n$= 3 studies, SMD= −4.03, 95%CI [−14.31, 6.25], $p$= 0.44), after one month ($n$= 3 studies, SMD= −4.41, 95%CI [−11.10, 2.29], $p$= 0.20), and after three months ($n$= 3 studies, SMD= −3.81, 95%CI [−12.22, 4.60], $p$= 0.37). No significant differences were observed at each time-point between both arms, and heterogeneity was moderate at one month ($I^2$= 38%, $p$= 0.20) and high at other time-points ($I^2$>50%) (Figure 5).

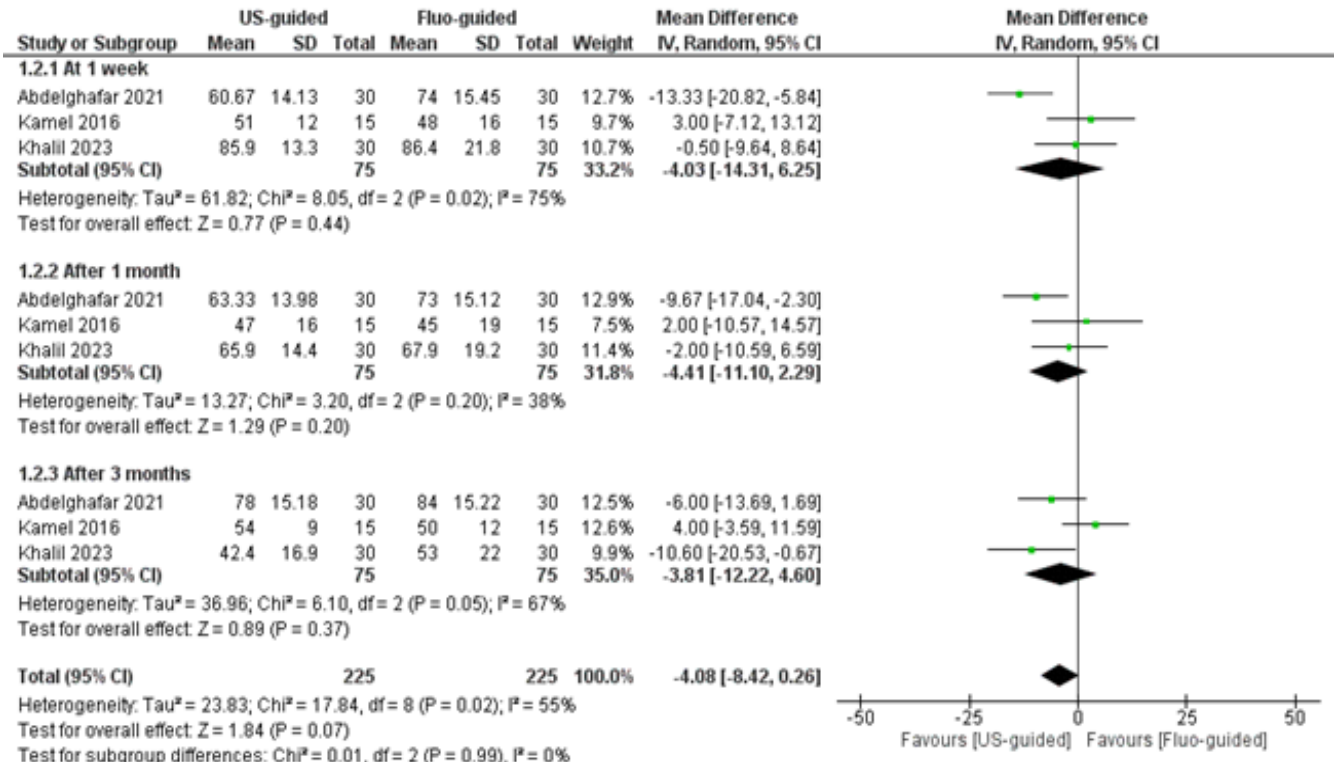


**Fig. 5:** Forest plot for post-procedure morphine consumption measured at different time-points.

### *Quality of life (QOL)*

This outcome was reported in two studies[7,9] at variable time-points (1-week, 1-month, 3-months) post-procedural. The overall pooled results revealed a non-significant difference in QOL between the US-guided and FL-guided groups (SMD= 0.05, 95%CI [-0.16, 0.26], $p$= 0.65). the pooled analysis was of low heterogeneity (I2= 16%, $p$= 0.31), promoting the use of fixed-effect model. Subgroup analysis was performed at different time-points; It was reported at one week ($n$= 2 studies, SMD= −0.14, 95%CI [−0.50, 0.22], $p$= 0.44), after one month ($n$= 2 studies, SMD= 0.00, 95%CI [−0.36, 0.36], $p$= 1.00), and after three months ($n$= 2 studies, SMD= 0.29, 95%CI [−0.07, 0.65], $p$= 0.12). No significant differences were observed between both arms at each time-point, and the pooled analysis showed substantial heterogeneity at three months ($I^2$= 61%, $p$= 0.11), while heterogeneity was absent at other time-points ($I^2$= 0%) (Figure 6).

### *Patient satisfaction*

Three studies[6-8] reported the patient satisfaction score at variable time-points (post-procedure, 1-month, 3-months). The overall pooled analysis revealed insignificant difference between the US-guided and FL-guided groups (SMD= 0.59, 95%CI [-0.47, 1.64], $p$= 0.28). The pooled heterogeneity test indicated a high heterogeneity level (I2= 95%, $p$<0.001), promoting the use of random-effects model. Subgroup analysis was performed based on different time-points; It was reported

post-procedure (*n*= 3 studies, SMD= 0.03, 95%CI [−1.92, 1.98], *p*= 0.98), after one month (*n*= 2 studies, SMD= 0.93, 95%CI [−0.10, 1.96], *p*= 0.08), and after three months (*n*= 2 studies, SMD= 1.11, 95%CI [−0.78, 2.99], *p*= 0.25). No significant differences were observed between both arms at each time-point, and high heterogeneity was detected in the overall and subgroup analyses ($I^2$>50%) (Figure 7).

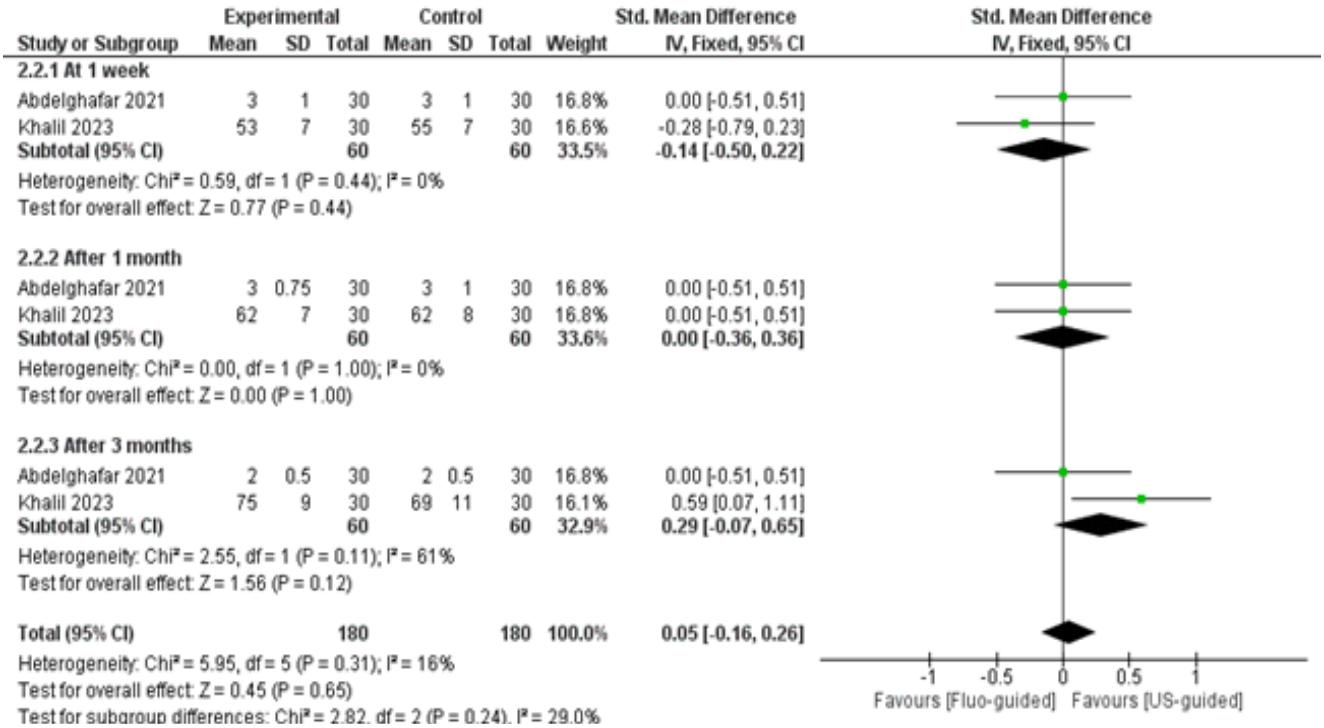


**Fig. 6:** Forest plot for post-procedure quality of life measured at different time-points.

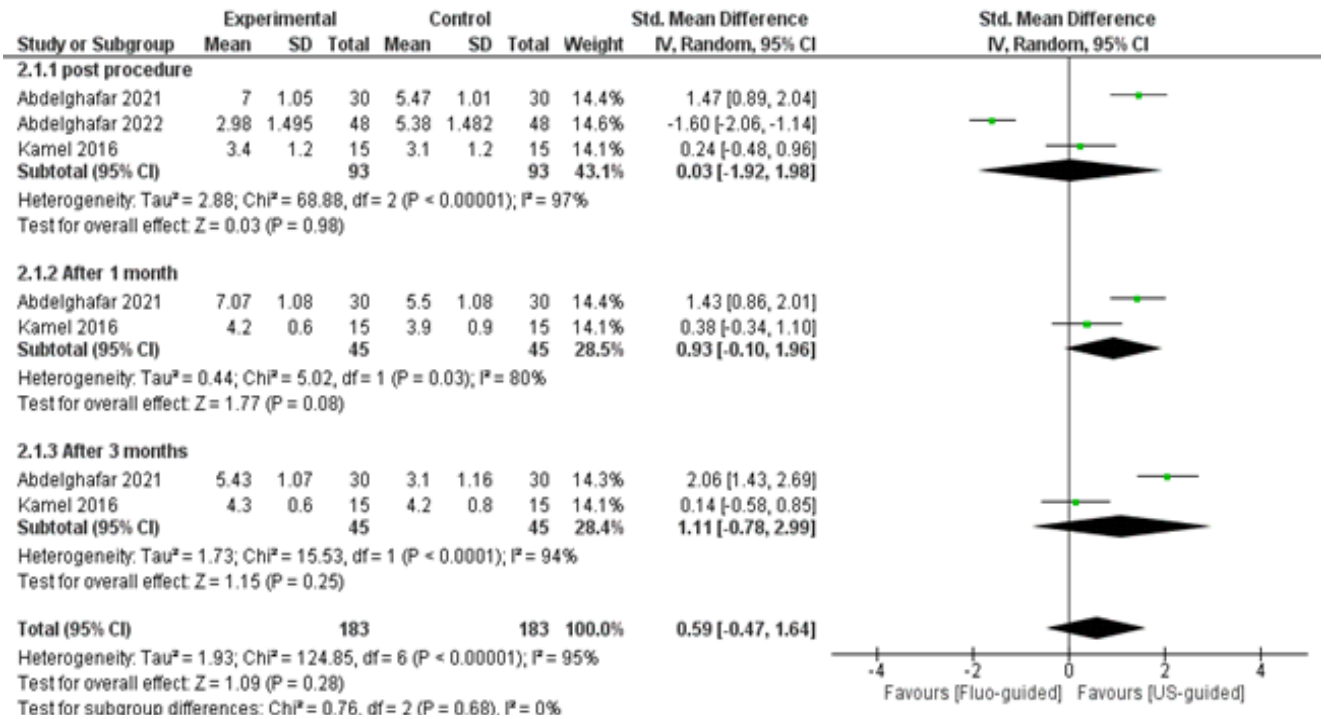


**Fig. 7:** Forest plot for patient satisfaction score measured at different time-points.

### *Procedure duration*

Three studies[7-9] reported duration of the procedure by minutes, the overall pooled analysis revealed a non-significant difference in the procedure length between the US-guided and FL-guided groups (MD= -7.95, 95%CI [-19.89, 3.99], $p$= 0.19). The pooled heterogeneity test indicated a high heterogeneity level (I2= 99%, $p$<0.001), promoting the use of random-effects model (Figure 8).

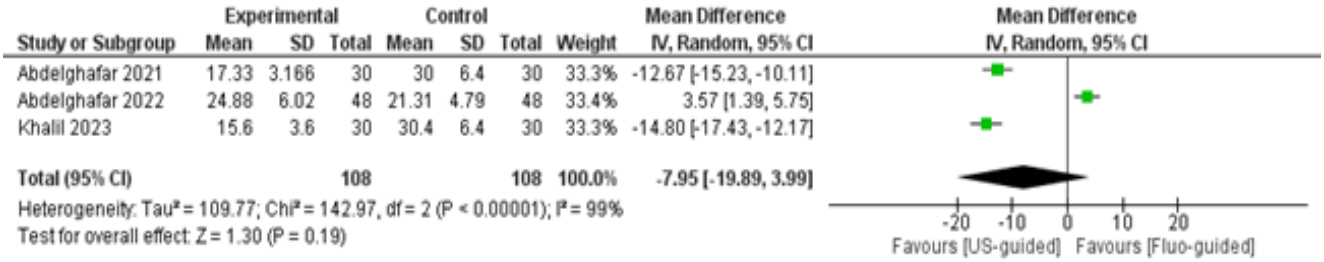


**Fig. 8:** Forest plot for the duration of the procedure.

### *Adverse events*

All included studies reported different adverse events related to the intervention such as hypotension, patient discomfort, back pain, and nerve injury. The overall pooled analysis revealed a significant reduction in adverse events favoring the US-guided compared to FL-guided groups (RR= 0.35, 95%CI [0.15, 0.81], $p$= 0.01). the pooled analysis showed moderate heterogeneity (I2= 47%, $p$= 0.05), promoting the use of random-effects model. A subgroup analysis was conducted based on the kind of adverse event; the rate of hypotension was insignificantly different between both groups. ($n$= 3 studies, RR= 0.93, 95%CI [0.43, 2.09], $p$= 0.86), the rate of patient discomfort was significantly lower in US-guided group ($n$= 2 studies, RR= 0.07, 95%CI [0.01, 0.37], $p$= 0.002), the frequency of back pain was significantly lower in US-guided group ($n$= 3 studies, RR= 0.16, 95%CI [0.04, 0.64], $p$= 0.009), while the incidence of nerve injury was insignificantly different between both arms ($n$= 3 studies, RR= 1.00, 95%CI [0.21, 4.74], $p$= 1.00). Heterogeneity was low to absent in these subgroup analyses (I2= 0%) (Figure 9).

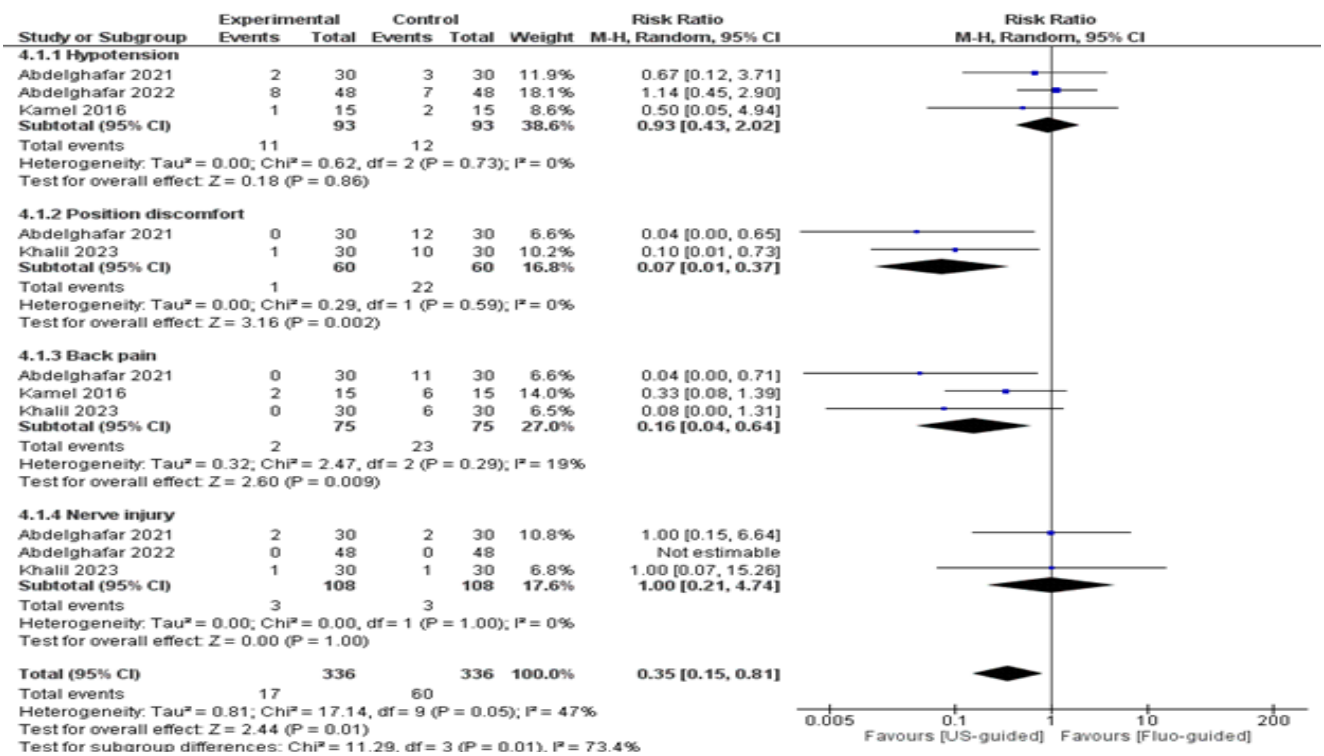


**Fig. 9:** Forest plot for the incidence of adverse events related to the procedure.

**Table 1:** Summary and characteristics of the included randomized-controlled trials:

| Study ID | Country, Institution | Sample size: Total (US/FL) | Age (US/FL) | Patient Characteristics | Injected Agents | | Fluoro-scopy approach | Main Outcomes | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | US | FL | | | |
| Kamel 2016[6] | Egypt, National Cancer Institute, Cairo University | 30(15/15) | 40.9±11.6 / 42.4±10.3 | *Inclusion criteria:* -patients with advanced-stage pelvic cancer, -age >18 y old -severe pelvic pain (VAS ≥7) -pain was refractory to medical therapy (opioids) or patient could not tolerate opioids side effects. Exclusion criteria. -local or systemic sepsis, -distorted local anatomy, -coagulopathy, -unstable cardiovascular or pulmonary conditions -history of addiction, -history of Psychiatric, or neurological disorders, -allergy to used medications. | 8ml phenol 8% diluted in saline, plus 0.5mL lidocaine. | 8ml phenol 8% diluted in saline, plus 0.5mL lidocaine. | Posterior approach (prone position) | - Visual analogue scale (VAS) - Mean daily morphine consumption after the procedure - Patient Global Impression of changes. - Patient Satisfaction Score - the duration of the procedure - intervention side effects | The US anterior approach for SHPB showed a comparable efficacy of neurolysis with the classic FL posterior technique, in patients with advanced pelvic cancer pain. |
| Abdelghafar 2021[7] | Egypt, National Cancer Institute, Cairo University | 60(30/30) | 55±9.33 / 56.17±8.8 | *Inclusion criteria:* -age >18 y old -severe pelvic cancer pain (VAS ≥7) -pain was refractory to medical therapy (opioids) or patient could not tolerate opioids side effects. *Exclusion criteria:* -Patients unwilling to participate, -local or systemic infection, -coagulopathy, -distorted local anatomy, -unstable cardiovascular or pulmonary conditions, -drug addiction, -history of neurological, or psychiatric disorders, -allergy to used medications. | 4ml phenol 8% diluted in saline, plus 0.2mL lidocaine | 4ml phenol 8% diluted in saline, plus 0.2mL lidocaine | Posterior approach (prone position) | -VAS Score -daily morphine consumption (mg/day) - patient satisfaction score, - quality of life score, - patient global impression of change, - *X*-Ray exposure time -Duration of procedure - intervention side effects | The US anterior approach for SHPB assisted by fluoroscopy was more effective than the classic FL posterior technique, in terms of pain score reduction and morphine low consumption. |

| Study ID | Country, Institution | Sample size: Total (US/FL) | Age (US/FL) | Patient Characteristics | Injected Agents | | Fluoro-scopy approach | Main Outcomes | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | US | FL | | | |
| Abdelghafar 2022[8] | Egypt, pain clinics of Mansoura University | 96(48/48) | 38.4±10.9 / 40.3±10.4 | *Inclusion criteria:* -patients with pelvic cancer staged I or II, -refractory pain to medical therapy (opioids) or poor pain control (NRS ≥4), -ASA Physical Status I or II, -BMI less than 30. *Exclusion criteria:* -patient unwilling to participate, -ascites grade 2/3 -local or systemic infection, -coagulopathy, -distorted local anatomy, -unstable cardiovascular or pulmonary conditions, -drug addiction, -allergy to used medications, -neurological or psychiatric diseases. | 3ml bupivacaine 5% plus 20ml phenol 10% | 3ml bupivacaine 5% plus 20ml phenol 10% | anterior approach at L5-S1 inter-discal space (supine position) | - *Edmonton Symptom Assessment System including:* (NRS pain score, anorexia, nausea, fatigue, drowsiness, feeling of well-being, shortness of breath, depression, anxiety, and insomnia) - The need for morphine incidence - patient satisfaction score. - The procedure duration -intervention side effects. | The anterior FL-approach for SHPB was more superior than the US-guided approach in terms of procedure duration and patient satisfaction. But, in terms of complication rates and pain reduction, both techniques were comparable. |
| Khalil 2023[9] | Egypt, National Cancer Institute, Cairo University. | 60(30/30) | 61.1±8.7 / 63.4±7.9 | *Inclusion criteria:* -patients with stages III or IV bladder cancer, -age >20y old - severe pain (VAS ≥7). *Exclusion criteria:* -Local infection at the puncture site, -coagulopathy, -unstable cardiovascular disease, -cognitive disorders, - drug addiction, - allergy to used medications. | 8ml phenol 6% diluted in saline, plus 0.5ml lidocaine. | 8ml phenol 6% diluted in saline, plus 0.5ml lidocaine. | Posterior approach (prone position) | - VAS score -amount of morphine consumption - quality of life assessed by the Short Form Health Survey-36. - Functional capacity score - procedure duration -intervention side effects. | The anterior US-approach for SHPB was superior than the FL-guided approach in terms of procedure duration, pain reduction, patient satisfaction, and functional capacity improvement with minimal side effects. |

## DISCUSSION

This meta-analysis found that the US-guided SHPB provided superior long-term pain alleviation than the FL-guided block. Also, the US-guided block was linked to a significant decrease in intervention-related adverse events. Otherwise, no significant differences were observed regarding morphine consumption, quality of life, patient satisfaction, and the procedure duration between US-guided and FL-guided approaches. These findings, however, should be interpreted cautiously because of the small number of study populations and the substantial heterogeneity.

SHPB was initially reported in 1990 by Plancarte *et al.,*[13] as a feasible substitute therapy for management of visceral pelvic pain related to malignancy. Since then, many imaging modalities have been developed to ensure the correct and safe delivery of SHPB. Plancarte *et al.,* proposed the standard method for SHP neurolysis/block, which is a FL-guided, posterior, two-needle technique that targets the anterior segment of the 5$^{th}$ lumbar vertebral body[13]. Later, novel strategies, such as a single-needle technique, anterior, and posterior trans-discal approaches utilizing fluoroscopy, computed tomography, and ultrasound guidance, were developed[14].

This is the first meta-analysis to compare ultrasonography and fluoroscopy as imaging modalities for guiding SHPB, incorporating four RCTs. Based on our analysis, all included RCTs declared equivocal efficacy between both techniques with higher safety profile in favor of Ultrasound, except for Abdelghafar and Farahat[8] study which reported that the fluoroscopic anterior approach has the upper hand regarding less procedure duration and more patient satisfaction with no difference in pain reduction and complications' incidence compared to the ultrasound technique.

Other meta-analyses comparing US- versus FL-techniques were conducted on different types of nerve blocks or procedures (spinal nerve injections[15-17], epidural injection[18], nephrolithotomy[19]) and concluded that US-guided approach is non-inferior to the classic FL-guided approach as regard pain reduction and functional enhancement, meanwhile the risk of inadvertent visceral or vascular injury seems to be less likely to occur with the US-guidance. Moreover, many research publications indicate that the use of ultrasound simplifies and secures the neurolysis process, particularly when it comes to superficially located neural structures like cervical medial branch block[20] and stellate ganglion block[21].

Gofeld and Lee[22] investigated the accuracy of the US-guided method for SHPB on eight human cadavers in the supine position through verification of the needle final position and the radiopaque contrast spread via fluoroscopy. They performed a long-axis trans-abdominal scanning of the lumbosacral region with the needle trajectory located strictly midline to target the apex of the L5/S1 disc. The pattern of the dye distribution was observed to be like that usually achieved with the posterior trans-discal approach guided by FL-imaging, which in a clinical setting would provide total blockage of the superior hypogastric plexus.

Despite being the standard image modality for the SHPB, FL-guided posterior approach encounters many challenges that can result in difficult implementation. Initially, the prone position can be extremely uncomfortable and agonizing for patients experiencing pain from abdominal or pelvic cancer. In addition, if the patient has sedation, the airway may not be secured, making it difficult to provide urgent airway management. Furthermore, the classic fluoroscopic posterior view needs anatomically intact spinal column as needle trajectory landmark, which is distorted in severe spondylo-degenerative disorders particularly at the L5-S1 level (ex, degenerative disc with marked loss of L5-S1 disc height can hinder trans-discal approach, annular disc fracture forming osteophytes, enlarged L5 transverse process, etc.), such conditions can interfere with imaging quality[6,7,23].

Thus, the proposed anterior ultrasound technique, described by Mishra and colleagues in 2008, can provide a safe alternative imaging modality in these challenging conditions that might face the posterior fluoroscopic application[23]. US-guided procedures have numerous advantages, including bedside utility, reduced procedure duration, improved tolerability in fragile cancer patients with poor health, real-time versatile imaging, and reduced exposure to radiation[24].

Moreover, intervention pain physicians using fluoroscopy are subjected to scattered ionizing radiation with variable doses, which can have significant cumulative effects throughout a lifetime[25]. Evidence connecting chronic exposures to ionizing radiation has been associated with long-term health adverse effects such as malignancy, thyroid conditions, and cardiovascular diseases[26]. Consequently, reducing the percentage of nerve injections performed under Fluoroscopy as opposed to US guidance for the treatment of chronic pain will spare both physicians and patients from radiation exposure.

In contrast, there are some major drawbacks associated with the use of ultrasound, including difficult imaging in obese patients, incorrect vertebral number calculation, uncertain ability of ultrasound to detect vascular uptake, inaccurate placement of the needle tip at the lumbar level, and injury to surrounding and overlying pelvic structures, such as the uterus, bowel, ureters, bladder, and iliac blood vessels. So, it is recommended to seek experienced sonographers to operate this procedure[27]. While it is easier to distinguish the anatomy via fluoroscopy and more accurately to confirm the needle position and contrast distribution[28].

AQ1

## LIMITATIONS

This meta-analysis involves several significant limitations. Initially, the number of the included randomized controlled trials was modest, and the total participants number utilized for metanalysis was relatively small. Also, the included RCTs were all conducted in the same country (Egypt) that might impact the feasibility and generalizability of the study findings. Second, the heterogeneity among the included literature was significant. High heterogeneity may arise from diversity in fluoroscopic approach (posterior, anterior, or trans-discal Approaches), local anesthetic type (phenol, or bupivacaine), local anesthetic dose, the number of injections (single injection or multiple injections) and so on. Additionally, some studies used an "US-assisted" strategy in which the injection site was located using ultrasound and the dye spread was validated by fluoroscopy[7]. Considering the nature of the intervention, there was a significant chance that the absence of blinding in included RCTs would introduce bias. Finally, the included RCTs had no control group to evaluate the efficacy of the SHPB injections, despite absence of significant differences between both approaches. Regardless of these limitations, no evidence stated that US-guided technique was inferior to FL-guided technique[15].

AQ2

## CONCLUSIONS

Compared to the traditional FL-guided approach, US-guided SHPB remained efficacious and minimized adverse events, as shown by this systematic review and meta-analysis. However, the effectiveness and safety of SHPB needs to be confirmed by more RCTs that are blinded to the assessor and take into consideration variations in performance and objects, as shown by the limitations of this meta-analysis.

## CONFLICT OF INTERESTS

There are no conflicts of interest.

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