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Ultrasound versus Fluoroscopic-Guided Superior Hypogastric Plexus Block in Cancer Bladder: A Randomized Controlled Trial

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Abstract

BACKGROUND: Patients with advanced bladder cancer may suffer severe pelvic pain unresponsive to standard pharmacological therapy.

AIM: This study assessed the feasibility, efficacy of ultrasoundguided (USG) versus fluoroscopy-guided (FG) superior hypogastric plexus block (SHPB) in bladder cancer pain management.

METHODS: This randomized controlled study included 60 patients undergoing SHPB to manage pain in stages 3 and 4 bladder cancer patients from December 2020 to June 2021. They were randomly divided into two groups. Group Fluoro (n = 30) underwent FG-SHPB, while Group US (n = 30) underwent US-SHPB. The patients were assessed after 1 day and 1 and 3 months regarding pain intensity using visual analog score (VAS), daily morphine consumption, functional capacity, and quality of life (QoL) using the Short Form Health Survey-36.

RESULTS: The procedure failed in 2 patients in each group. The procedure was significantly lengthier in the Fluor group than the US group ($p < 0.001$). VAS scores decreased significantly in the two groups after 1 and 3 months and were significantly in US-SHBP after 3 months. Morphine consumption decreased significantly, and functional capacity and QoL improved significantly in both groups up to 3 months. The two groups were comparable in morphine consumption, functional capacity, and QoL. Position discomfort and back pain were more common in Fluor Group.

CONCLUSION: USG SHPB is a feasible, safe, and effective analgesic procedure in patients with advanced bladder cancer suffering from severe pelvic pain. It is superior to the FG transdiscal approach regarding the duration of pain relief and improvement of functional capacity in addition to avoidance of position discomfort and back pain.

REGISTRATION: Clinical Trials.gov (ID NCT05083702).

Introduction

Bladder cancer carries an enormous public health burden, with over 430,000 newly diagnosed patients every year worldwide [1]. It is most common in the Mediterranean and in Egypt [2]. Pain is one of the most overturning symptoms in cancer patients, affecting 70–80% of patients in advanced stages [3]. A meta-analysis of epidemiological studies has shown a prevalence rate of pain of 66% in advanced, metastatic, or terminal disease, and over 38% of cancer patients experienced moderate-to-severe pain [4]. It is a devastating symptom that compromises the quality of life (QoL) of patients, families, and caregivers [5]. Experiencing pain can also influence patient outcomes.

Inadequate pain control can lead to more psychological distress and decreased social activities [6]. However, cancer pain remains undermanaged despite the advancement of modern analgesic strategies. There is substantial evidence that cancer pain management is often suboptimal [7], [8]. A systematic review revealed that approximately one-third of patients do not receive analgesia proportional to their pain intensity [7].

Pharmacological therapy remains the backbone of cancer pain management, guided by the World Health Organization (WHO) analgesic ladder [9]. However, chronic opioid use can reduce the QoL of cancer patients. Interventional therapy can benefit 10–15% of patients with intractable pain resistant to standard analgesics [10]. In patients with visceral abdominal pain, neurolytic block of sympathetic pathways at different levels can be effective [11].

Celiac plexus block is suggested for cancer pain deriving from the upper abdominal viscera, while the superior hypogastric plexus block (SHPB) is used for lower abdominal pain. The SHP is a retroperitoneal structure lying around the aortic and IVC bifurcations at the level of the L5-S1 vertebral bodies [12]. It can be done under CT or fluoroscopic guidance [13]. An ultrasound-guided (USG) approach has been suggested in a few reports [10].

The literature is scarce concerning SHPB. Therefore, this study aimed to assess the feasibility,

efficacy, and patient satisfaction of USG versus fluoroscopy-guided (FG) SHPB in bladder cancer pain management.

Patients and Methods

This randomized controlled study included 60 patients undergoing SHPB to manage bladder cancer-related pain in the National Cancer Institute, Cairo University, from December 2020 to June 2021. The study protocol was approved by the anesthesia department's scientific and ethical committees. The study was registered on Clinical Trials.gov with study ID NCT05083702. All patients were informed about the study design and objectives as well as tools and techniques. Every patient signed written informed consent before study enrollment.

Inclusion criteria were patients above 20 years of age with stages 3 and 4 bladder cancer according to the American Joint Committee on Cancer TNM system [14], suffering from severe pain measured on a visual analog score (VAS) of 70 or more. Patients with local infection at the puncture site, coagulopathy, cognitive disorders, unstable cardiovascular disease, history of drug abuse, allergy to medication used, or contraindication to the dye used were excluded from the study.

According to the guidance method, the patients were randomly allocated to two groups. Group Fluoro (n = 30) underwent the procedure under fluoroscopy guidance, while in Group US (n = 30), ultrasound was used for guiding the block.

Pre-procedure assessment

Routine pre-operative assessment was done for all patients, including clinical examination and laboratory investigations. All patients were instructed how to use the VAS score identifying 0 as no pain and 100 as the worst imaginable pain. In addition to fasting for 6 h, bowel preparation was done for the ultrasound technique. Four tablets of activated charcoal and two bisacodyl tablets were given the night before the procedure to clean the bowel of air and contents. The patients were advised before the procedure to micturate to empty the urinary bladder.

Procedure

The American Society of Anesthesiologists standard monitoring was done, including electrocardiography, pulse oximetry, non-invasive arterial blood pressure. An intravenous line was inserted, and O_2 was supplied through a nasal prong. Conscious sedation was performed using midazolam 0.05 mg/kg, IV (Midathetic; Amoun Pharmaceutical S.A.E, Cairo, Egypt), with or without fentanyl 1 µg/kg (Fentanyl 50 mg/mL 2 mL Amp, Sunny pharmaceutical, Egypt). Baseline criteria were recorded before the procedure.

Fluoroscopy guided transdiscal approach [15]

The patient lies prone, and the L5-S1 interspace was identified under fluoroscopy. The skin overlying the interspace is prepared with povidone-iodine solution, and local anesthetic infiltration with 2% lidocaine was done. A 22-gauge, 15 cm needle with a short bevel was inserted perpendicular to the skin at the center of L5-S1 space under anteroposterior fluoroscopic vision. The needle was then advanced to penetrate the thecal sac under lateral fluoroscopic control. After confirming avoidance of nerve injury by the absence of paresthesia, the tip of the needle was advanced through the intervertebral disc until it reached its anterior surface. The correct position was confirmed by administering 4 mL of soluble contrast media (Omnipaque™, Amersham Health Cork, Ireland) in both lateral and anteroposterior fluoroscopic view. Neurolysis is performed with 8 mL 6% phenol solution. After neurolysis, 0.5 mL of saline was injected to avoid the deposition of phenol within the intervertebral disc material. While withdrawing, the needle cefazoline 50 mg in 1 mL was injected into the disc.

USG approach [16]

In the supine position under aseptic conditions, a low-frequency ultrasound curved probe sound (Phillips Healthcare, Andover, Massachusetts, US) was put in the longitudinal axis to visualize the aortic bifurcation. The probe was then placed deeply transverse till the aorta end and bifurcation of iliac vessels was visualized. Local infiltration with 1% lidocaine was made 1.0–1.5 inches below the umbilicus. A 15-cm, 22-G Chiba needle was inserted (out-of-plane) and advanced to contact the L5 body while avoiding vascular structures. The needle was withdrawn 1–2 mm, and 8 mL 6% phenol in saline was injected. Finally, 0.5 mL of lidocaine was injected during Chiba needle removal.

Post-procedure management

All patients were transferred to the recovery unit, where their pain intensity and hemodynamic variables were assessed for 2 h and discharged. All patients had paracetamol *t.d.s.* for after both blocks then morphine IV was given according to VAS pain score as follows: 5 mg as a loading dose then 0.1 mL/kg to keep the VAS score <3 and then total morphine consumption was monitored as a rescue drug. Any complications and

time for each procedure from patient position till the end of injection were recorded. 1 day and 1 and 3 months after the procedure, the patients were reassessed for pain intensity, morphine consumption, functional improvement, functional capacity, and QoL.

The functional capacity was evaluated using the Eastern Cooperative Oncology Group score (Table 1) [17]. QoL was assessed using the Short-Form Health Survey (SF-36) [18]. This multidimensional instrument assesses eight health concepts: (1) Limitations in physical activities; (2) limitations in social activities; (3) limitations in usual role activities; (4) bodily pain; (5) general mental health; (6) limitations in usual role activities because of emotional problems; (7) vitality (energy and fatigue); and (8) general health perceptions [19].

Table 1: The ECOG score [17]

Grade	ECOG performance status
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light housework, office work
2	Ambulatory and capable of all self-care but unable to carry out any work activities; up and about more than 50% of waking hours
3	Capable of only limited self-care; confined to bed or chair more than 50% of waking hours
4	Completely disabled; cannot carry on any self-care; totally confined to bed or chair
5	Dead

ECOG: Eastern Cooperative Oncology Group.

The primary outcome measure was the VAS score after 1 and 3 months. Secondary outcome measures were total daily morphine consumption, functional capacity score, QoL, and adverse events.

Sample size estimation

We did not find a similar study comparing USG versus transdiscal FG approaches of SHPB. We assumed a 20% difference in VAS scores after 1 month to be of clinical significance. Based on this assumption, a minimum sample of 10 patients in each group is required to reject the null hypothesis at an alpha level of 0.05 and a power of 0.8. The sample was increased to 15 patients in each group to compensate for the loss to follow-up for patients with advanced bladder cancer included in the study. The sample size was estimated using the G*Power© software (Institut für Experimentelle Psychologie, Heinrich–Heine–Universität Düsseldorf, Germany) version 3.1.9.2 [20].

Statistical analysis

Statistical analysis was done using IBM© SPSS© Statistics version 25 (IBM© Corp., Armonk, NY, USA). Two-way ANOVA was invalid due to group-factor interaction. Therefore, repeated measures were tested in each group separately, followed by Bonferroni correction of the p-values. Comparison between two groups was made using independent sample t-test or Mann–Whitney test. Comparison of repeated measures was made using repeated measures ANOVA. A $p < 0.05$ was considered as statistically significant [21].

Results

There was no significant difference between the two groups regarding age ($p = 0.268$) and clinical characteristics. The procedure failed in 2 patients in each group. The procedure was significantly lengthier in the Fluor group (30.4 ± 6.4 min) compared to the US group (15.6 ± 3.6 min, $p < 0.001$) (Table 2).

Table 2: Baseline characteristics and procedure duration of the two studied groups

Parameters	Fluor group (n = 30)	US group (n = 30)	p-value
Age (years)	61.1 ± 8.7	63.4 ± 7.9	0.283*
VAS score	8 (7–10)	8 (7–10)	0.506**
Daily morphine consumption (mg)	91.0 ± 23.2	89.1 ± 15.6	0.679*
Functional capacity score	3 (2–4)	2 (2–3)	0.488**
SF-36 score	52 ± 7	51 ± 7	0.644*
Duration of the procedure (minutes)	30.4 ± 6.4	15.6 ± 3.6	<0.001*

VAS: Visual analog scale, SF-36: Short Form Health Survey. Data are presented as mean ± SD or median (range). *Independent sample t-test. **Mann–Whitney test.

There was no significant change of VAS score in the two groups 1 day after intervention, where both groups had comparable scores. VAS scores decreased significantly in the two groups after 1 and 3 months. The US Group had a significantly lower VAS score 3 months after intervention (Table 3). There was no significant change in morphine consumption in the Fluor group 1 day after intervention, while morphine consumption decreased significantly in the US group. Afterward, morphine consumption decreased significantly in both groups up to 3 months. The two groups were comparable in morphine consumption post-procedure (Table 4).

Table 3: Visual analog scale score before and after intervention in the two studied groups

VAS score	Fluor group (n = 30)	US group (n = 30)	p-value*
Before procedure	8 (7–10)	8 (7–10)	0.506
Day 1	8 (6–10)	8 (7–10)	0.837
p-value**	0.262	0.114	
After 1 month	7 (5–9)	6 (5–8)	0.090
p-value**	<0.001	<0.001	
After 3 months	5 (3–9)	4 (3–8)	<0.001
p-value**	<0.001	<0.001	

Data are presented as median (range). *Mann–Whitney test. **Repeated measures ANOVA.

Functional capacity improved significantly 1 day after intervention in the US group but not in the Fluor group. 1 and 3 months after the intervention,

Table 4: Morphine consumption before and after intervention in the two studied groups

Morphine consumption (mg)	Fluor group (n = 30)	US group (n = 30)	p-value*
Before procedure	91.2 ± 23.2	89.1 ± 15.6	0.665
Day 1	86.4 ± 21.8	85.9 ± 13.3	0.913
p-value**	0.204	0.048	
After 1 month	67.9 ± 19.2	65.9 ± 14.4	0.631
p-value**	<0.001	<0.001	
After 3 months	53.0 ± 22.0	42.4 ± 16.9	0.174
p-value**	<0.001	<0.001	

Data are presented as median (range). *Mann–Whitney test. **Repeated measures ANOVA.

Table 5: Functional capacity score before and after intervention in the two studied groups

Functional capacity	Fluor group (n = 30)	US group (n = 30)	p-value*
Before procedure	3 (2–4)	3 (2–3)	0.053
Day 1	3 (2–3)	2 (2–3)	0.831
p-value**	0.114	<0.001	
After 1 month	2 (1–3)	2 (1–3)	0.309
p-value**	<0.001	<0.001	
After 3 months	1 (1–3)	1 (1–3)	<0.001
p-value**	<0.001	<0.001	

Data are presented as median (range). *Mann–Whitney test. **Repeated measures ANOVA.

functional capacity improved significantly in both groups. The two groups were comparable in functional capacity after 1 day and 1 month but significantly better in the US Group (Table 5). QoL improved significantly in both groups starting from day 1 after the procedure. There was no significant difference in SF-36 score between the two groups up to 3 months (Table 6).

Table 6: Quality of life score before and after intervention in the two studied groups

SF-36 Score	Fluor group (n = 30)	US group (n = 30)	p-value*
Before procedure	52 ± 7	51 ± 7	0.852
Day 1	55 ± 7	53 ± 7	0.930
p-value**	<0.001	0.012	
After 1 month	62 ± 8	62 ± 7	0.294
p-value**	<0.001	<0.001	
After 3 months	69 ± 11	75 ± 9	0.348
p-value**	<0.001	<0.001	

Data are presented as median (range). *Mann–Whitney test. **Repeated measures ANOVA.

Position discomfort was observed in 10 patients in the Fluor group compared to only a single patient in the US Group. Furthermore, five patients of the Fluor group developed back pain, and one had discitis. A single case of nerve injury was recorded in each group.

Discussion

The SHGPB is associated with many technical and safety issues. There are potential barriers to needle passage as iliac crest and the transverse process of L5 [22]. Besides the presence of nearby important structures expose the patients to the risk of probable complications as injuries to the ureter, large vessels, and somatic nerves [23]. Therefore, an accurate technique for the approach is vital. SHGPB is commonly performed under fluoroscopy guidance. Anterior USG approach was found to be successful compared to morphine alone in patients with advanced gynecological malignancy [10]. However, few studies tested its accuracy of compared to other image-guided techniques. Therefore, this study assessed the feasibility, efficacy of USG versus FG SHPB for the management of bladder cancer pain.

This study demonstrated that US-guided SHPB is a feasible, safe, and effective procedure for pain relief in patients with advanced bladder cancer suffering from severe pelvic pain. The success rate of the procedure was 87%. Compared to the FG transdiscal approach, pain reduction was comparable after 1 month but was better after 3 months. The two approaches were comparable in morphine consumption after the procedure. The procedure was associated with improved functional capacity that was significantly better in the US Group after 3 months. Furthermore, there was a comparable significant improvement of the QoL. Position discomfort and back pain were more common in Fluor group, while only a single case of nerve injury was recorded in each group.

Most cancer patients with advanced disease have pain. Overall, 40–80% of patients with urological cancer suffer from pain in the terminal disease phase [24]. Cancer pain can be more complex than that of surgery. The WHO developed the analgesic ladder for managing cancer pain that resorted to interventional approaches as the last step for intractable pain [25]. Various interventional approaches have been developed for managing pelvic pain. These are categorized into two types: neuromodulatory and neurolytic techniques [26]. Neuromodulation involves neuraxial analgesia or spinal cord stimulation to alter pain sensation. Neurolysis implies ablating individual nerve fibers and plexuses [27].

The afferent nerve fibers innervating the pelvic organs travel with the sympathetic fibers passing through the superior and inferior hypogastric plexuses. Thus, these bundles are good potential blockade targets for the management of pelvic pain [28]. The inferior hypogastric plexus is not as easily accessible as the superior hypogastric plexus as it is located parallel to the pelvic floor and oriented in a posteroanterior manner [29]. The SHPB was successfully used for pelvic malignancies, including genitourinary, gynecological, and colorectal cancers [30]. It has also been used to treat pain associated with endometriosis, pelvic inflammatory disease, and adhesions [31], [32].

SHPB was first described by Plancarte *et al*. [33] in 1990. Their traditional technique implied a posterior approach, FG, 2-needle technique, aiming the anterior of the L5 vertebral body. Since then, many alternative techniques have been attempted. A single needle, posterior transdiscal, and anterior approaches were developed under fluoroscopy, computed tomography, or ultrasonography guidance [26], [34], [35], [36], [37], [38].

These varying approaches are mainly driven by many technical and safety issues connected with SHPB. The iliac crest and the transverse process of L5 are potential obstacles for needle passage. Thus, an alternative posteromedian transdiscal approach has been suggested [22]. The presence of many vital nearby structures as ureter and large vessels is another safety challenge, with possible complications as ureteric injury [23], hematoma or intravascular injection [39], and spread of injectate to the L5 nerve roots resulting in neurologic deficit [40].

In 2008, Mishra *et al*. [16] described an anterior USG SHPB targeting the anterior portion of the L5 vertebral body. After that, the authors compared the technique versus morphine in a randomized controlled trial in 50 patients with advanced gynecological malignancy against [10]. However, few studies are available comparing the efficacy and safety of USG-guided block with other image-guided techniques.

Kamel *et al*. [41] compared the safety and efficacy of the US-guided SHBP neurolysis with the FG posterior approach in 30 patients with advanced-stage pelvic cancer. Both approaches were comparably associated with reduction of pain and daily morphine consumption starting 1 day after the procedure and maintained up to 3 months. More recently, in 60 patients with severe visceral pelvic pain, the USG approach was compared to the posterior oblique approach guided by fluoroscopy. Pain reduction was significantly better, and morphine consumption was significantly lower in the USG approach up to 8 weeks after the procedure [42].

Other advantages have been advocated for this technique besides the possible clinical superiority of US-guided block. The spread of the medium can be clearly visualized with fluoroscopy or US guidance [43]. However, this spread is better observed and evaluated during real-time USG because the hyperechoic drug cloud expands centripetally from the echogenic tip of the Chiba needle into well-defined spaces visualized in the sagittal and longitudinal images [16]. Shorter procedure time and being a bedside facility are other advantages of the US-guided technique and avoidance of radiation exposure. The US-guided approach is a good or might be the only alternative in patients suffering from the degenerative disease at the L5/S1 level, high iliac crest, or enlarged L5 transverse process [42].

Nevertheless, this technique also has potential adverse effects. These include injury to common iliac arteries, bowel perforation, and bladder and nerve injury. Mishra *et al*. [10] did not report vascular or visceral injuries in their series. Kamel *et al*. [41] reported few cases of back pain, diarrhea, and hypotension in the 15 patients managed by US-guided block but no vascular or nerve injuries. Two cases of nerve injury were reported in the study of Abdelghafar *et al*. [42] Bowel and bladder preparation before the procedure and using the Trendelenburg position and smaller size Chiba needle are suggested precautions to avoid the visceral injury. The collapsed viscera tend to fall away from the needle path [10].

The role of interventions to manage pain in cancer patients is poorly recognized and understood. A common practice is making interventions the last choice to treat cancer-related pain after exhausting other options [27]. This is mainly due to the potential complications and the need for specific devices and specific aftercare requirements [28]. Diagnostic blocks with local anesthetics are frequently used to confirm the efficacy before proceeding to neurolytic blocks that are employed only if life expectancy is within 18 months [27].

Conclusion Section

We can conclude that in patients with advanced bladder cancer, the anterior USG approach of SHPB can effectively relieve severe visceral pain and reduce morphine consumption for 3 months with minimal adverse events. This approach is superior to the FG transdiscal approach regarding the duration of pain relief and improvement of functional capacity in addition to avoidance of position discomfort and back pain.

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