

Comparative study between computed tomography guided superior hypogastric plexus block and the classic posterior approach: A prospective randomized study

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ABSTRACT

Context: The classic posterior approach to superior hypogastric plexus block (SHPB) is sometimes hindered by the iliac crest or a prominent transverse process of L5. The computed tomography (CT) – guided anterior approach might overcome these difficulties. **Aims:** This prospective, comparative, randomized study was aimed to compare the CT guided anterior approach versus the classic posterior approach. **Settings and Design:** Controlled randomized study. **Materials and Methods:** A total of 30 patients with chronic pelvic cancer pain were randomized into either classic or CT groups where classic posterior approach or CT guided anterior approach were done, respectively. Visual analog score, daily analgesic morphine consumed and patient satisfaction were assessed just before the procedure, then, after 24 h, 1 week and monthly for 2 months after the procedure. Duration of the procedure was also recorded. Adverse effects associated with the procedure were closely observed and recorded. **Statistical Analysis Used:** Student's *t*-test was used for comparison between groups. **Results:** Visual analog scale and morphine consumption decreased significantly in both groups at the measured times after the block compared with the baseline in the same group with no significant difference between both groups. The procedure was carried out in significantly shorter duration in the CT group than that in the classic group. The mean patient satisfaction scale increased significantly in both groups at the measured times after the block compared with the baseline in the same group. The patients in the CT groups were significantly more satisfied than those in classic group from day one after the procedure until the end of the study. **Conclusions:** The CT guided approach for SHPB is easier, faster, safer and more effective, with less side-effects than the classic approach.

Key words: Anterior approach, computed tomography guided approach, superior hypogastric plexus block

INTRODUCTION

Patients with advanced pelvic cancer may suffer from intractable chronic cancer pain that might affect their life quality as well as their families. Different options had been practiced to control such incapacitating pain. These options

vary from the pharmacological treatment in accordance to the World Health Organization (WHO) guide and end with interventional interruption of the sympathetic nerves close to the hypogastric plexus.

The superior hypogastric plexus is a retroperitoneal structure that extends bilaterally, below the aortic bifurcation, on the anterior aspect of L5-S1, in association with the common and internal iliac vessels on either side.^[1] It is formed by pelvic visceral afferents and efferent sympathetic nerves from branches of the aortic plexus and fibers from the splanchnic nerves.^[2] It innervates the vast majority of pelvic viscera (including the bladder, urethra, uterus, vagina, vulva, perineum, prostate, penis, testes, rectum and descending colon) and hence block of this

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plexus can potentially alleviate pain originating from the above mentioned regions.

Percutaneous neurolysis of the superior hypogastric plexus is an efficient, relatively simple method of control of pain caused by advanced pelvic cancer which is resistant to the pharmacological treatment. Plancarte *et al.*^[3] are the first who described the classic posterior approach to the superior hypogastric plexus block (SHPB). However, this approach is sometimes hindered by the iliac crest or a prominent transverse process of L5 which make the correct needle placement difficult. The transdiscal approaches appeared to be alternative routes either through the paramedian transdiscal as described by Erdine *et al.*^[4] or through the posteromedian transdiscal approach which was reported by Turker *et al.*^[5]

In an article in 2005 Michalek and Dutka^[6] in their study reported two cases of a computed tomography (CT) — guided anterior approach for non-cancer pelvic pain. This approach might overcome many of the technical difficulties that hamper the needle placement in the classic approach.

The aim of this prospective, comparative, randomized and controlled study was to compare the CT guided anterior approach versus the classic posterior approach of SHPB regarding side-effects and duration of the procedure.

MATERIALS AND METHODS

After approval of the local Ethical Committee, 30 patients diagnosed with pelvic cancer and complained from chronic pain were recruited from the National Cancer Institute.

All patients included in the study were informed about the steps of the procedure and its possible complications and then a written informed consent was obtained from them. All patients had been treated with analgesic medications prescribed according to the WHO guidelines for cancer pain. However, they still had significant pain on the visual analog scale (VAS ≥ 5) (VAS is a 10 cm length graded from 0 to 10 where 0 indicates no pain meanwhile, 10 represents the worst pain imaginable). Patients included in the study did not have any contraindication to both regional blockade (coagulation disorders, local infection, sepsis and mental disorders) and sympathetic blockade (decompensated cardiac and hemodynamic disorders). Using an envelope technique, patients were randomly allocated to one of either group (15 patients each):

1. The classic group in which patients had the SHPB via the classic posterior approach guided by the fluoroscope
2. The CT group in which patients had the SHPB through the anterior approach guided by the CT.

The pain intensity at rest (VAS), daily analgesic morphine intake and the patient satisfaction scale (PSS)^[7] were recorded on the morning before beginning the procedure as baseline control. Patient satisfaction score (described later) was assessed to indicate the patient's quality of life (QOL). Midazolam 0.05 mg/kg and fentanyl 1 ug/kg were administered before the procedure for anxiolysis. Standard American Society of Anesthesiologists recommended monitors were applied (electrocardiogram, blood pressure and pulse oximetry). A prophylactic antibiotic ceftriaxone (Rocephin) 1 g infusion over 30 min and 1000 mL of lactated Ringer solution were administered via a secured intravenous catheter before the intervention.

Classic posterior approach

Patients in the classic group were laid in the prone position with a pillow under their iliac crest and the L4-5 spinous processes were identified by the fluoroscope in the posteroanterior position. After proper sterilization of the skin and draping, the entry points were marked 5-7 cm lateral from the midline bilaterally and infiltrated with local anesthetics (lidocaine 2%). The entry points were punctured by 20 G Chiba needles, 15 cm long which were directed medially and caudally in 45° to avoid the transverse process of L5 and the sacral alae. We considered the following precautions: The needle tip must be within 1 cm from the bony outline of L5/S1 in the anteroposterior view and should be at the anterior junction of L5-S1 in the lateral view. On feeling loss of resistance which implied that the needle had reached the retroperitoneal space after passing the psoas muscle, a slight aspiration was applied to exclude intravascular penetration, then, 1-2 mL/kg of non-ionic contrast media (Omnipaque 300 mg/mL) was injected through the needle. The presence of the dye within the lateral bony edge, above the sacral nerve roots confirmed proper position of the needle. Then, 8 mL of phenol in saline 10% was injected on both sides followed by injection of 2 mL of air then needle withdrawal.

CT guided anterior approach

We used a Multislice CT device of 16-slice CT scanner (Bright Speed 16, General Electric Medical Systems Co., USA). The protocol of scanning was as follows: 16 slices scanning parameters of 1 mm X-ray beam collimation, rotation time of 0.75 s. and reconstruction interval of 0.5 mm.

The patients were asked to urinate before the procedure to empty the urinary bladder in order to minimize the incidence of bladder injury. In contrary to the classic approach, the patients were laid supine. They were asked to co-operate and to lie motionless. Then a series of contiguous scans in the transverse orientation were obtained starting from L4 to L5 interspace up to the body of S2. The optimal

level and the appropriate route were determined. The large intestine should be at least 2-3 cm from the selected needle route. After proper sterilization of the skin and draping, the entry points were marked usually midway between the umbilicus and the symphysis, in the midline or 1-3 cm lateral to the midline. After subcutaneous infiltration with local anesthetics (lidocaine 2%), 20 G Chiba needle, 15 cm long was introduced. For accurate placement of the needle, guide system and biopsy calculation software integrated in the CT scanner to calculate the required needle angulation was used. The tip of the needle was inserted in between the iliac vessels and directed to the intervertebral disc of L5-S1. After needle advancement, a negative aspiration was made to exclude intravascular penetration. Proper needle positioning was verified by injection of 2 mL of contrast (Omnipaque 300 mg/mL) as a test dose followed by another scan to check the contrast spreading. A volume of 10 mL of phenol in saline 10% were injected followed by 2 mL of air to prevent the spread of the neurolytic agent within the surrounding tissue during withdrawal of the needle. The patients were observed for 24 h after the procedure before their discharge to home [Figure 1].

The patient's QOL was evaluated through the PSS which is a linear analog scale, 10 cm length graded from 0 to 10 where 0 indicated very "dissatisfied" and 10 "very satisfied". Such estimation was subjectively determined by the patient himself.

The measured parameters including VAS, daily analgesic (morphine) consumed and PSS were assessed just before the procedure (base line), then, after 24 h, 1 week and monthly for 2 months after the procedure. Duration of the procedure was also recorded. Adverse effects associated with the procedure including pain associated with needle penetration, intravascular injection, visceral or urinary bladder injury and neural injury were closely observed and recorded.

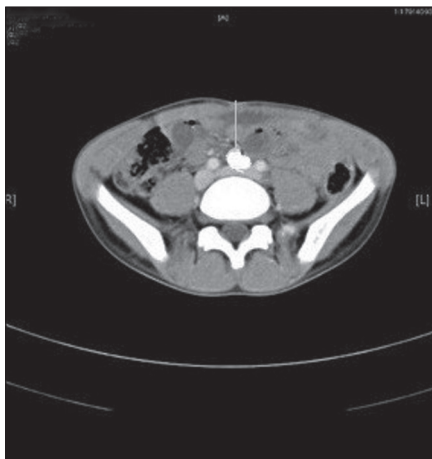


Figure 1: Computed tomography cut section showing the needle and the contrast dye between the iliac vessels

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences for windows (SPSS 13.0.1; SPSS Inc.; Chicago, II, USA).

The normality of the distribution was assessed using the Shapiro-Wilk test. Descriptive statistics were expressed as mean and standard deviation unless otherwise stated. Student's *t*-test was used for comparison of the means of continuous variables and normally distributed data between groups. Meanwhile repeated measures analysis of variance was used for comparison of the means of continuous variables and normally distributed data in the same group followed by the *post hoc* Bonferroni test to detect the least significant difference in the same group. Categorical data were analyzed using χ^2 test analysis or Fisher's exact test, as appropriate. Differences were considered to be statistically significant at $P < 0.05$.

RESULTS

Patients were enrolled in this study at the National Cancer Institute during the period from December 2012 to September 2013. No significant differences between both groups were observed regarding age, sex, clinical diagnosis and pain duration [Table 1].

The visual analog score lowered significantly immediately after injection than the base line in both groups and remained so lower throughout the 2 months period after the block. There was no significant difference between groups at any of the measured time [Figure 2].

There was statistically significant decrease in the daily morphine consumption in both groups at the measured times after the block when compared with the base line in the same group. Meanwhile, there was no statistically significant difference between both groups at any measurement times [Table 2].

Table 1: Patients characteristics and clinical data

Item	Classic group <i>n</i> = 15	CT group <i>n</i> = 15
Age (year)	59.7±6.3	60.1±1.3
Sex (M/F)	8/7	9/6
Body weight (kg)	60.2±7.9	58±9.5
Height (m)	1.67±11.2	1.7±3.6
Pain duration (months)	6.4±1.43	5.6±2.5
Cancer diagnosis		
Rectum	3 (20)	4 (26.7)
Prostate	3 (20)	2 (13)
Bladder	5 (33)	6 (40)
Cervix	4 (26.7)	3 (20)

Data are represented as mean ± SD except for sex as ratio and for cancer diagnosis as number (%), * $P < 0.05$ in comparison to classic group, SD = Standard deviation

The procedure was done in significantly shorter duration in the CT group than that in the classic group (29.6 ± 6.3 and 56.4 ± 7.9 min, respectively [$P < 0.05$]).

The mean PSS increased significantly ($P < 0.05$) from 3.4 ± 0.80 to 3 ± 0.82 (before the block) and 4.13 ± 0.72 and 5.07 ± 0.77 in classic and CT groups respectively in day 1 after the block and maintained higher throughout the study. The patients in the CT groups were significantly more satisfied than those in classic group from day 1 after the procedure until the end of the study [Figure 3].

Three patients (20%) in the classic group only and no one in the CT group did not feel change in pain intensity from the before block score. Meanwhile, five patients from classic group and only one patient from CT group had severe pain while introducing the needle during the procedure [Table 3].

The ureter was punctured accidentally in 4 patients in classic group that required withdrawal of the needle and readjusting the needle direction.

In the CT group, the advancement of the needle to its target in the midline between the iliac vessels and anterior to L5-S1 intervertebral disc was achieved from the first trial in all patients; meanwhile it was done after three and two trials in four and six patients, respectively, in classic group. There was no evidence of hypotension, in any group. Table 3 summarizes these side-effects.

DISCUSSION

The pain suffered by patients with pelvic cancer is often vague and poorly localized and so it is difficult to manage. Patients with cancer affecting any pelvic organ may complain of severe pain that is resistant to strong opioids (the third step in WHO step ladder). Moreover, severe

adverse effects may limit the use of oral or parenteral opioids therapy. Therefore, we may be directed to invasive technique such as SHPB in order to control their pain and improve their QOL.

Plancarte *et al.*^[3] are the first who described the classic technique of SHPB in which the patients were laid in prone position. The needle tips targeted the superior hypogastric plexus bilaterally at the level of L5 to S1 vertebrae. They did not use the fluoroscopy in their procedure. On an average 70-90% of patients in their study developed pain relief significantly.

Table 2: Total daily morphine consumption

Time	Classic group (n = 15)	CT group (n = 15)
Before block	167.67±18.92	169.67±19.2
24 h	90±12.65*	83.33±9.42*
1 week	67±8.7*	65.8±5.8*
1 month	70±4.6*	69±3.44*
2 months	80±10.43*	75.4±8.7*

Data are represented as mean ± SD, * $P < 0.05$ in comparison to before block in same group, † $P < 0.05$ in comparison to classic group in same period, SD = Standard deviation

Table 3: Frequency of side effects and number of trials

Variable	Classic group number (%)	CT group number (%)
Pain at puncture site	5 (33)	1 (6)
Puncture of viscera	4 (27)	0 (0)
Neural injury	0 (0)	0 (0)
Diarrhea	2 (13)	3 (20)
Headache	0 (0)	0 (0)
Failure to relieve pain	3 (20)	0 (0)
Hypotension	0 (0)	0 (0)
Number of trials		
One trial	5 (33)	15 (100)
Two trials	6 (40)	0 (0)
Three trials	4 (27)	0 (0)

Data are represented as number (%), CT = Computed tomography

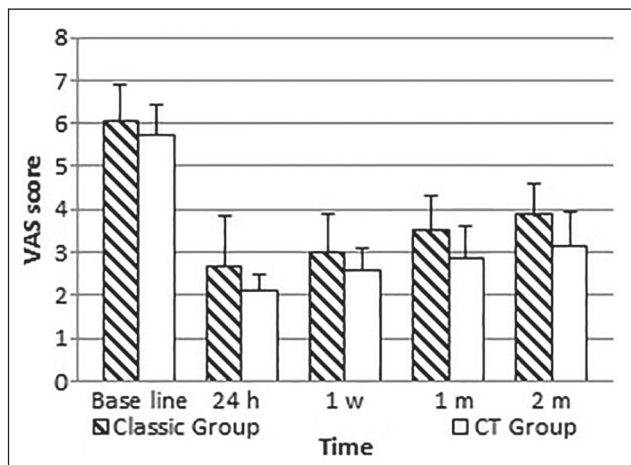


Figure 2: Mean visual analog scale in groups under study

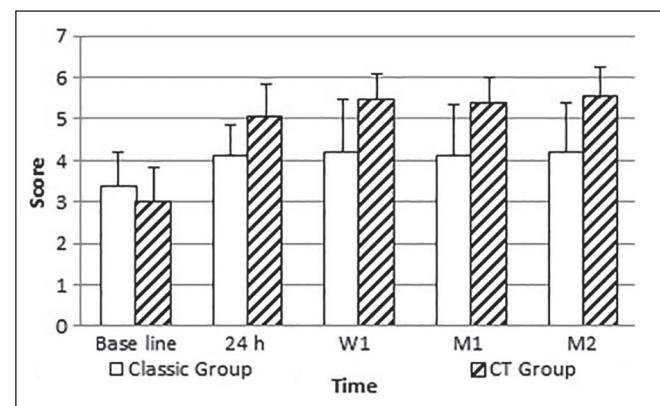


Figure 3: Mean patients satisfaction scores in groups under study

de Leon-Casasola *et al.*^[1] tried the classic approach of the SHPB but with the aid of fluoroscopy. Their study was carried out on patients complained of advanced cancer pain not responding to strong opioids. The block provided satisfactory pain relief in 69% of the patients with the result of 56% reduction in the mean opioid consumption.

The anatomic position of the superior hypogastric plexus at the ventral aspect of lower third of L5 to upper third of S1 vertebrae together with some anatomic barriers such as the large transverse process of L5 vertebra and the high arch of the iliac crest may impede the needle passage and increase the technical difficulties during the classic approach. So different modifications of the procedure had been studied in order to facilitate an easier approach such as a transvascular approach,^[8] transvaginal approach,^[9] CT-guided posterior placement of the needle,^[10] transdiscal approach^[11] and anterior approach.^[12]

Although the anterior approach risks injury to the structures that overlie the plexus such as the common iliac artery, bladder and the bowel, fruitful results have been reported with this technique.

CT guided anterior approaches have been applied for pain control through sympathetic blocks mainly in celiac plexus blocks.^[13,14]

Cariati *et al.* are the first to describe the CT guided anterior approach for cancer related pelvic pain.^[14,15] They noted, in a non-comparative study, an improvement in pain in 8 out of 10 patients with no serious complications elicited.

In our comparative study, we reached to similar results as the pain significantly lowered than the base line in both groups. We could not notice any statistically significant difference between both groups regarding pain relief and daily analgesic requirements; however, the CT guided approach in our study was carried out in a statistically shorter duration than the classic approach (25.4 ± 5.6 min for CT vs. 57.9 ± 9.8 min for the classic group [$P < 0.05$]). No intravascular puncture has been detected in the CT group versus 2 patients with intravascular puncture in the classic group. No urinary injury has been reported in the CT group versus 4 patients with urinary injury in the classic group. We used one single needle technique in the CT group which may led to decrease the incidence of inadvertent puncture of the viscera, meanwhile two needles — one needle on each side — were used in the classic technique. And a proper positioning of the needle was confirmed in the CT group, causing effective block in all patients who did not show any failure of the block, meanwhile, two cases of failure of pain relief in the classic group had been reported.

The use of CT in our study allowed us to accomplish the neurolytic SHPB with a wide range of safety. Moreover, the patients remained in supine position during the procedure; besides being comfortable, this position offers many advantages, especially in emergency situations.

The anterior approach used in our study was very simple, fast and safe. It minimized the risk of damaging the vessels, or lumbar nerves; the only crossed peritoneal structure was the intestine which can be seen by the CT and minimized the risk of its injury. Although the use of a fluoroscopic guide is favored by others, it is less convenient, to our view, because little information is obtained during the course of the procedure as the bony structures and their relation to the needle are the only visualized structures during the procedure which raises the risk of puncture of the vessels or organs around the plexus. In addition, the narrow space between the superior hypogastric plexus and the aortic bifurcation needs accurate detection of these structures by using the CT guidance.

This come in agreement with Kanazi *et al.*^[12] who reported the easiness, safety and accurate needle placement in addition to good pain relief during the anterior approach for SHPB in three patients.

Furthermore, Waldman *et al.*^[10] in 1991 used the CT scan to modify the SHPB in order to accurately apply the needle in place and they achieved the same conclusion.

It is important to mention the potential of increased risks of injury to structures overlying the plexus such as the bladder, bowel and common iliac artery. This technique also has the risk of infection when going through the bowel. However, in this study, there were no reported cases of these complications as evidenced absence of fever, abdominal rigidity, peritonism or increased leukocytic count 1 week after the procedure. Moreover, prophylactic antibiotics were given 30 min before the procedure.

Our results showed that patients in both groups were more satisfied after than before the block from the 1st day after the procedure and throughout the 1st month only and patients in the CT group were more satisfied than those in the classic group during the same period. Improvement in patient satisfaction may be explained by better pain control and increased ambulation after reduction of pain. Moreover, the shorter duration of the procedure and the decreased number of trials of the block in patients in the CT group reflected the significant more patient satisfaction in this group.

CONCLUSION

The CT guided approach for SHPB in pelvic cancer pain is easier, faster, safer and more effective, with less side-effects

than the classic approach. Moreover, it can be performed, in particular, in patients in whom the classic approach cannot be carried out. However, larger well-controlled studies are required to establish the safety and efficacy of this approach compared with the classic one.

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