Transhepatic Hilar Nerve Block as Pain Management in Hepatic Interventions

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ABSTRACT

Background: One of the issues that is not adequately addressed, particularly in the postoperative phase, is pain, which directly affects survival and quality of life as well as the course of the disease. For the majority of interventional liver procedures, most centers use either conscious sedation or general anesthesia (GA). For such procedures, the use of a regional anesthetic technique that targets the liver's nerve supply specifically may prove beneficial.

Objective: to achieve a simple, safe, effective &minimally invasive way for hepatic specific nerve block by US guidance for reducing &alleviating the pain produced by the image guided hepatic interventional procedures as Trans-arterial chemoembolization resulting in improved post-procedural comfort, faster recovery& discharge, decreased post-operative analgesics used.

Patients and Methods: This randomized controlled trial was conducted on 20 patients subjected to image guided hepatic interventions; they were divided into interventional group (10 patients who subjected to hepatic hilar nerve blocks) and control group (10 patients) at Interventional radiology unit, Radiology department, Ain-Shams University hospitals.

Results: In the current study, the mean age was 53.4 ± 5.1 years in interventional group versus 55.7 ± 5.7 years in Control group with no significant difference. Most of patients were males in interventional group (80%) and Control group (90%). In our study, the patients in interventional group showed highly statistical significant (p-value < 0.001) decreased VAS in (3.8 ± 1.5) when compared with Control group (7.3 ± 1.05). Concerning consumption of analgesia, there was a highly statistical significant (p-value < 0.001) decreased dose of paracetamol needed in interventional group (1450 ± 724.5) when compared with Control group (3200 ± 632.4). In the present study, there was no statistical significant decrease of complication in interventional group as there were only 3 patients (30%) with complications in interventional group versus 6 patients (60%) in control group. Among our patients, there was statistically significant (p-value = 0.006) decreased recovery time in interventional group (1.56 ± 0.4 weeks) when compared with Control group (2.48 ± 0.83 weeks).

Conclusion: Hepatic hilar nerve block is promising intervention for different liver procedures due to the following findings: Patients subjected to hepatic hilar nerve block showed low pain. Reduced analgesic consumption. Shorten recovery time. Low incidence of complications.

KEYWORDS: Transhepatic Hilar Nerve Block, Hepatic Interventions..

How to Cite: Khaled Fikry Tawfik Shehab ElDin, Mohamed Shaker Ghazy, Mohamed Gamal AbdelMoteleb, Ahmed Mohamed Ashraf Okba, (2025) Transhepatic Hilar Nerve Block as Pain Management in Hepatic Interventions, Vascular and Endovascular Review, Vol.8, No.2, 86-93. **DOI**: *https://doi.org/10.15420/ver.2025.08.02.86-93*

INTRODUCTION

Interventional radiology is now the mainstay of treatment for liver disease ***(Molla et al., 2014).*** Percutaneous tumoral thermal ablation is currently a primary therapy option due to technological developments. But it can result in excruciating procedure pain ***(Shamim et al., 2017).***

Pain management techniques include both conscious sedation and general anesthesia. Avoiding general anesthesia can also have certain benefits, such as preventing aerosol-generating intubation and lowering the risk of complications in patients with cardiopulmonary comorbidities. Unfortunately, anesthetic support has often not increased in tandem with the expansion of interventional radiology-based therapies ***(Locke et al., 2018).***

Celiac plexus and paravertebral blocks are commonly used for liver procedures, but they have not been fully adopted by radiologists. This may be due to a lack of familiarity and concerns about potential side effects, including diarrhea, postural hypotension, and in rare cases, more severe complications such as paraplegia or pneumothorax. Along the hepatic artery, portal vein, and biliary tree, the hepatic plexus—which provides nerve fibers to the liver—enters the liver at the hilum via the Glisson sheath. Although these nerve fibers may be separated into anterior and posterior divisions, they frequently interact with one another in real life. Effective nerve blocks and pain management during liver-related surgeries depend on this intricate network of nerve fibers ***(Ren et al., 2020).***

The main portal vein was located using Doppler imaging, and a 22-gauge Chiba needle was gently inserted through the liver toward the major portal vein's anterior surface, preferably within 2 cm of the portal bifurcation. An intercostal trans-right hepatic route was utilized in place of the typically recommended trans-left hepatic subcostal technique when anatomical constraints such intestinal gas made it difficult to see the left lobe and hepatic hilum. Following the needle's placement, a three-step safety procedure was put in place to ensure extravascular placement and guard against unintentional puncture of the hepatic artery or portal vein. This involved administering 3 mL of iodinated contrast under CT or fluoroscopic supervision to ensure that there was no intravascular contrast spread, aspirating to rule out blood return, and injecting 3 mL of lidocaine 1% with epinephrine to check for epinephrine-induced tachycardia. After placement was confirmed to be correct, 15 mL of 0.25% bupivacaine was administered ***(Kevin et al., 2021).***

The needle tip for a hepatic hilar block needs to be precisely placed in the periportal fat close to where the main portal vein splits into its left and right branches. Although a trans-right hepatic lobe procedure may be used when necessary, a trans-hepatic ultrasound-guided approach is recommended. The left lobe provides a simpler path since it is closer to the target and does not interfere with the ribs. Seeing the needle tip inside the periportal fat confirms that the extravascular placement was done correctly. Ten to fifteen milliliters of either 0.5% ropivacaine or 0.25% bupivacaine are injected after proper positioning has been established. Although there haven't been any serious side effects from the treatment yet, there is always a chance that the liver might sustain vascular damage ***(Liu et al., 2020).***

AIM OF THE WORK

To achieve a simple, safe, effective &minimally invasive way for hepatic specific nerve block by US guidance for reducing &alleviating the pain produced by the image guided hepatic interventional procedures as Trans-arterial chemoembolization resulting in improved post-procedural comfort, faster recovery& discharge, decreased post-operative analgesics used.

PATIENTS AND METHODS

Study Setting: Interventional Radiology Unit, Radiology department, Ain Shams University Hospitals
Study Period: 2023-2025
Study Population: ***Inclusion Criteria:*** *All Patients listed to undergo image guided hepatic interventions as TACE.* ***Exclusion***

Criteria: *Only patients not doing image guided interventions are excluded*
Sampling Method: Convenience sampling
Ethical Considerations: Before the research begins, all patients will provide their informed oral permission, outlining the specifics of the operation.

Following their permission, the study will be carried out in accordance with the guidelines set forth by the ASU ethical and scientific committee.

Throughout the course of the study, participant privacy and data confidentiality will be ensured.

Study Tools: ultrasound machine, 21 or 22 gauge Chiba needle /spinal needle, mix of short acting (1-2 hrs) &long acting (6-8 hrs) local anaesthetics can be used (lidocaine &bupivacaine/ropivacaine), vital data &EKG monitoring, IV access by cannula and intra-venous lipid emulsion for possible reversible in case of anaesthetic toxicity.

Study Procedures: Informed oral consent should be obtained before the procedure, with the patient positioned supine. A 21- or 22-gauge spinal or Chiba needle, ideally with an echogenic tip, is recommended for better visualization during ultrasound-guided blocks. Continuous monitoring of vital signs and EKG is essential to detect autonomic disturbances. Ultrasound is the preferred imaging technique due to its real-time, safe, and precise guidance, though CT or fluoroscopy may be needed for deeper blocks.
To confirm the needle's extravascular placement, several techniques can be used: a) ensuring no blood is aspirated, b) checking for the absence of tachycardia after injecting lidocaine with epinephrine, c) injecting contrast to confirm proper spread without vascular uptake, or d) using ultrasound to visualize saline or D5W injections, confirming correct compartmentalization.

Various nerve block agents can be selected based on their duration of action, from shorter-acting lidocaine (1–2 hours) to longer-lasting bupivacaine or ropivacaine (6–8 hours). It's important to stay within the recommended weight-based dose limits for these agents: lidocaine (5 mg/kg), bupivacaine (2 mg/kg), and ropivacaine (3 mg/kg). In case of intravascular toxicity, access to intravenous lipid infusion for the "lipid rescue" technique should be ready.

Post-procedural monitoring is essential for 1–2 hours in the recovery room to ensure the patient does not exhibit signs of delayed nerve block toxicity, such as perioral numbness, dizziness, auditory/visual disturbances, or seizures.

For a hepatic hilar block, the needle should target the periportal fat near the junction of the right and left portal veins. Once confirmed, 10–15 ml of a 0.25% bupivacaine or 0.5% ropivacaine solution is injected. Afterward, oral analgesics are typically introduced 1–2 hours post-procedure, and if needed, a low-dose opioid or analgesic combination can be given for up to 48 hours post-discharge. The patient's pain management needs should be carefully documented.

Statistical analysis: Data analysis was performed using SPSS software version 24. Qualitative variables were summarized as frequencies and percentages, while quantitative variables were presented as means ± standard deviation (SD), with the mean representing the average of a dataset. For statistical comparisons, the independent sample t-test was applied to normally distributed quantitative data, and the chi-square test was used for non-parametric data. A p-value less than 0.05 was considered statistically significant, with values below 0.001 indicating high significance, whereas p-values above 0.05 were regarded as not significant.

RESULTS

Table (1): Comparison of age between studied group.

		Interventional group (N = 10)	Control group (N = 10)	Stat. test	P-value
Age (years)	Mean	53.4	55.7	T = 0.94	0.358 NS
	±SD	5.1	5.7		

T: independent sample T test.

NS: p-value > 0.05 considered non-significant.

This table shows no statistical significant difference **(p-value = 0.358)** between studied groups (interventional and control groups) as regard age. It was 53.4 ± 5.1 years in interventional group versus 55.7 ± 5.7 years in Control group.

Table (2): Comparison of sex between studied group.

		Interventional group (N = 10)		Control group (N = 10)		Stat. test	P-value
Sex	Male	8	80%	9	90%	$X^2 = 0.39$	0.531 NS
	Female	2	20%	1	10%		

X2: Chi-square test.

NS: p-value > 0.05 considered non-significant.

There is no statistically significant difference (p-value = 0.531) between the interventional and control groups in this table with respect to sex. In interventional group, there were 8 males (80%) and 2 females (20%) while in control group, there were 9 males (90%) and 1 female (10%).

Table (3): Comparison of VAS between studied group.

		Interventional group (N = 10)	Control group (N = 10)	Stat. test	P-value
VAS	Mean	3.8	7.3	**T = 5.8**	**< 0.001 HS**
	±SD	1.5	1.05		

T: independent sample T test.

HS: p-value < 0.001 considered highly significant.

This table shows highly statistical significant **(p-value < 0.001)** decreased VAS in interventional group (3.8 ± 1.5) when compared with Control group (7.3 ± 1.05).

Table (4): Comparison of dose of paracetamol needed between studied group.

		Interventional group (N = 10)	Control group (N = 10)	Stat. test	P-value
Dose of paracetamol	Mean	1450	3200	**T = 5.7**	**< 0.001 HS**
	±SD	724.5	632.4		

T: independent sample T test.

HS: p-value < 0.001 considered highly significant.

This table shows highly statistical significant **(p-value < 0.001)** decreased dose of paracetamol needed in interventional group (1450 ± 724.5) when compared with Control group (3200 ± 632.4).

Table (5): Comparison of intervention between studied group.

		Interventional group (N = 10)		Control group (N = 10)		Stat. test	P-value
Intervention	PTC	3	30%	3	30%	$X^2 = 0.0$	1.0 NS
	TACE	7	70%	7	70%		

X2: Chi-square test.

NS: p-value > 0.05 considered non-significant.

The table demonstrates that there was no statistically significant difference between the interventional and control groups in terms of the intervention, as indicated by a p-value of 1.0. In interventional group and control group there were 3 patients (30%) subjected to PTC and 7 patients (70%) subjected to TACE.

Table (6): Comparison of complications (GIT upset) between studied group.

		Interventional group (N = 10)		Control group (N = 10)		Stat. test	P-value
Complications (GIT upset)	No	7	70%	4	40%	$X^2 = 1.81$	0.178 NS
	Yes	3	30%	6	60%		

X2: Chi-square test.
NS: p-value > 0.05 considered non-significant.
Regarding the complication (GIT upset), this table demonstrates no statistically significant difference (p-value = 0.178) between the interventional and control groups. There were 3 patients (30%) with complications in interventional group versus 6 patients (60%) in control group.

Table (7): Comparison of recovery time between studied group.

		Interventional group (N = 10)	Control group (N = 10)	Stat. test	P-value
Recovery time (weeks)	Mean	1.56	2.48	**T = 3.11**	**0.006 S**
	±SD	0.4	0.83		

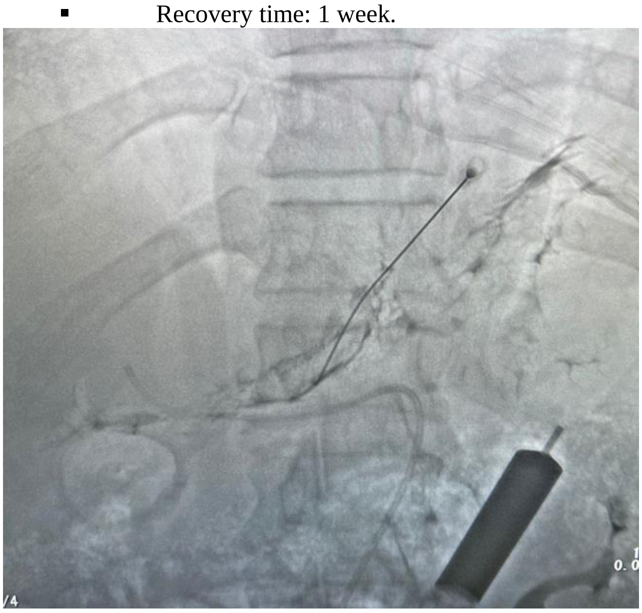
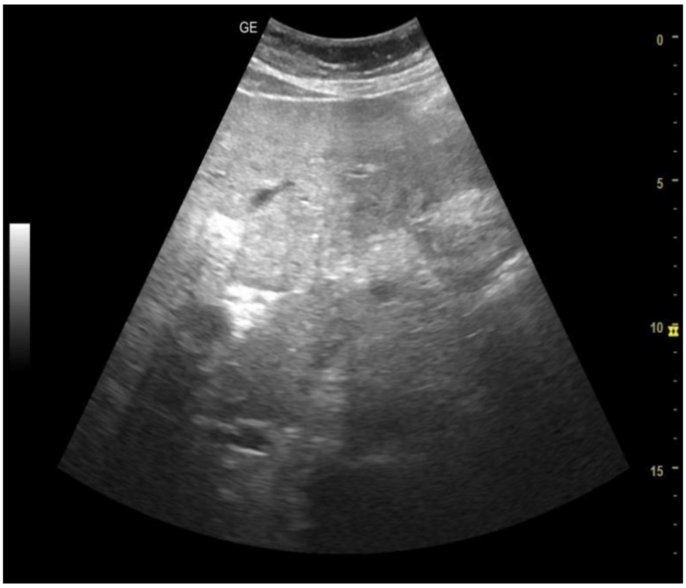
T: independent sample T test.
S: p-value < 0.05 considered significant.
This table shows statistically significant **(p-value = 0.006)** decreased recovery time in interventional group (1.56 ± 0.4 weeks) when compared with Control group (2.48 ± 0.83 weeks).

ILLUSTRATIVE CASES

In the following cases, each case underwent transhepatic hilar nerve block with target position of the needle tip being the periportal fat near the bifurcation of the main portal vein into right &left portal branches, using a mix of nerve block agents including the short acting lidocaine (max dose 4.5 mg/kg during the whole procedure, not to exceed 300 mg per dose) &the longer acting Bupivacaine (max dose 2.5 mg/kg, not to exceed 175 mg per dose) using a chiba needle 21G after confirmation of the extravascular position of the needle tip (lack of blood aspiration &contrast injection showing correct spread of contrast) & switching to oral paracetamol afterwards.

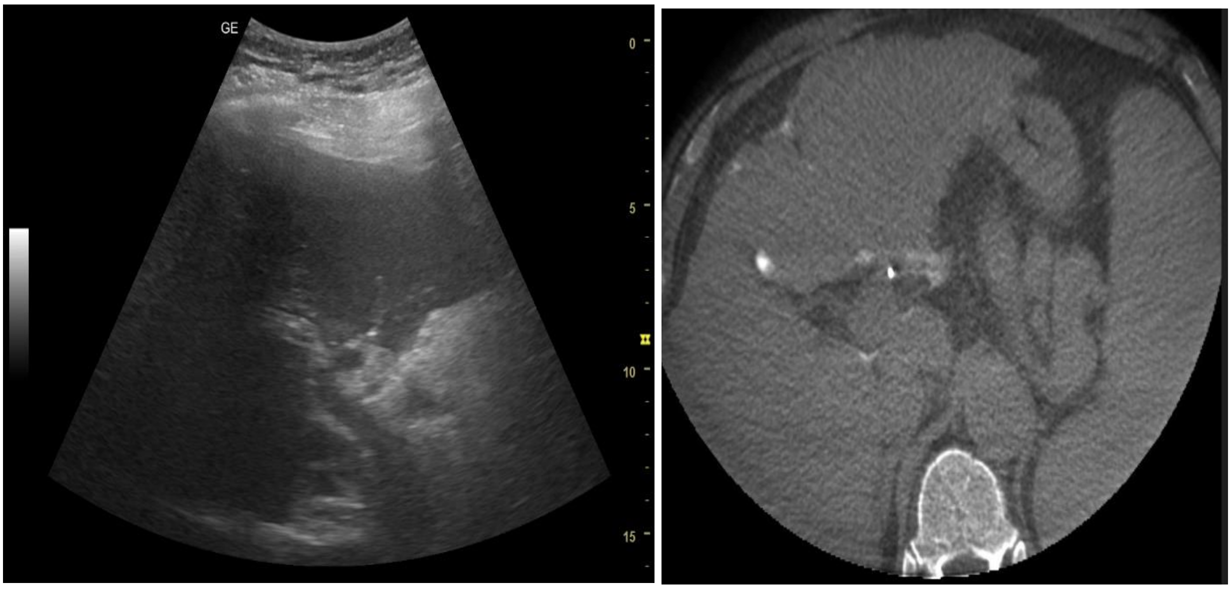
Case 1: A 50-year-old male patient undergoing TACE procedure underwent transhepatic hilar nerve block for alleviating the pain with the following outcome;

- Visual analogue score recorded: 2 (being the best recorded number).
- Dose of paracetamol needed (the day of the operation &48 hrs post): 1000 mg.
- No complications occurred as regards the procedure.
- No recorded GI upset which can occur due to excessive analgesics.
- Recovery time: 1 week.

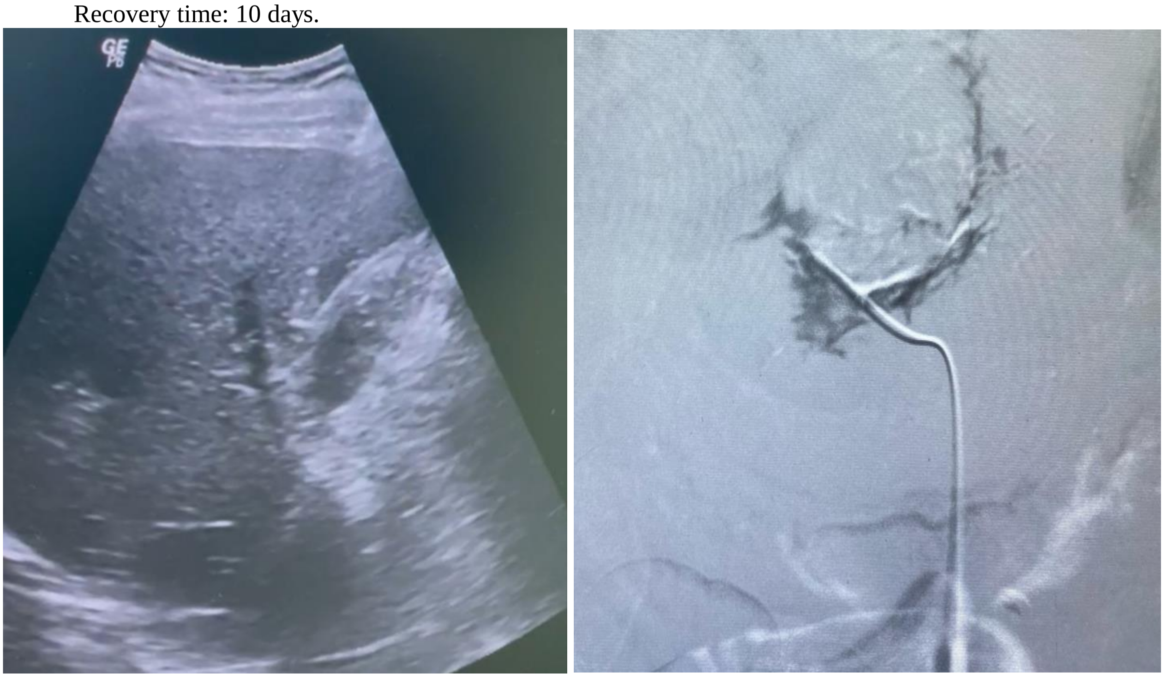
Case 2: A 53-year-old female patient undergoing TACE procedure underwent transhepatic hilar nerve block for alleviating the pain with the following outcome;

- Visual analogue score recorded: 5
- Dose of paracetamol needed (the day of the operation &48 hrs post): 1500 mg.
- No complications occurred as regards the procedure.
- No recorded GI upset which can occur due to excessive analgesics.
- Recovery time: 10 days.



Case 3: A 56-year-old male patient undergoing PTC procedure underwent transhepatic hilar nerve block for alleviating the pain with the following outcome:

- Visual analogue score recorded: 3
- Dose of paracetamol needed (the day of the operation &48 hrs post): 1000 mg.
- No complications occurred as regards the procedure.
- No recorded GI upset which can occur due to excessive analgesics.
- Recovery time: 10 days.



DISCUSSION

Liver intervention irrespective of the approach can be associated with significant postoperative pain. Effective pain control can facilitate early mobilization and reduce postoperative complications ***(Yip et al., 2016)***. The success of an improved recovery after surgery (ERAS) has been highlighted as being dependent on effective pain management ***(Joshi & Kehlet, 2019; Kim & Aloia, 2022)***.

There are several significant disadvantages to using general anesthetic, such as longer procedure durations, more resource requirements, a higher chance of problems, and occasionally more challenging intervention ***(Chao & Park, 2023)***. Opioid drugs, which are linked to a number of problems and adverse effects, such as cardiopulmonary depression, addiction or dependence, nausea or vomiting, altered mental status, and gastrointestinal issues, are widely used in current practice for post-procedural pain management ***(Gregorian Jr et al., 2010)***.

One quick, affordable, and efficient non-opioid analgesic option is peripheral nerve blocks. A shorter hospital stay, lower maximum pain scores, and less opioid use have all been linked to receiving periprocedural peripheral nerve blocks ***(Bingham et al., 2012)***. Celiac plexus and paravertebral blocks are the most often utilized nerve blocks during liver surgeries ***(Beck et al.,***

2005; Elyazed & Abdullah, 2018). However, radiologists have only partially embraced them, perhaps due to unfamiliarity and potential side effects such diarrhea, postural hypotension, and even paraplegia and pneumothorax ***(Batra et al., 2011; Yousefshahi & Tahmasebi, 2018)***. During hepatic interventions, pain can be managed by targeting the hepatic nerve plexus, which is made up of sympathetic, para-sympathetic, and afferent somatic fibers and is located near the portal vein and biliary system ***(Hao et al., 2022)***. The precise application of hepatic hilar nerve blocks in liver intervention, however, is not well documented.

This randomized controlled trial was conducted on 20 patients subjected to image guided hepatic interventions; they were divided into interventional group (10 patients who subjected to hepatic hilar nerve blocks) and control group (10 patients) at Interventional radiology unit, Radiology department, Ain-Shams University hospitals.

In the current study, the mean age was 53.4 ± 5.1 years in interventional group versus 55.7 ± 5.7 years in Control group with no significant difference. Most of patients were males in interventional group (80%) and Control group (90%).

In a single-center retrospective cohort study involving 177 individuals (median age 67 years; range 33–86), all of whom underwent percutaneous image-guided thermal ablation for liver tumors, 114 patients (64%) received a hilar nerve block alongside procedural sedation, while the remaining 63 patients (36%) were managed with procedural sedation alone. Baseline demographic characteristics were largely comparable between the two groups ***(Parhar et al., 2023)***. The mean age of the 12 patients who underwent hepatic hilar nerve block was 66 years ± 13 years, while the control group's mean age was 63 years ± 15 years, according to a prospective pilot study by ***He et al***. There was no significant distinction between the two groups in terms of demographic data, and the majority of patients in both groups were men ***(He et al., 2021)***.

In our study, the patients in interventional group showed highly statistical significant **(p-value < 0.001)** decreased VAS in (3.8 ± 1.5) when compared with Control group (7.3 ± 1.05).

Similarly, Nakamura et al.'s study, which involved local anesthetic block of the hepatic plexus prior to RFA for nearby HCC, demonstrated that pain was decreased in all eight instances who had intractable pain during ablation, enabling the RFA to be completed ***(Nakamura et al., 2014)***. According to the same findings, ***He et al.*** found that during percutaneous thermal ablation, the nerve block group felt less pain (the maximum visual analog scale score) than the control group (mean score, 3.9 ± 2.4 vs. 7.0 ± 2.8, respectively; P =.01) ***(He et al., 2021)***.

Additionally, a non-blinded randomized clinical trial involving 92 patients undergoing DEE-TACE for hepatocellular carcinoma found that those in the nerve block group experienced significantly less pain during the procedure and on postoperative days 1 and 7 (P < .001) compared to the control group, which received only standard intraprocedural local anesthesia.

Compared to previous nerve block procedures like celiac plexus or splanchnic nerve blocks, the hepatic hilar nerve block was developed lately to deliver more focused analgesia to the liver. In addition, the block has the advantage of being comparatively easier and perhaps safer than other block techniques ***(Parhar et al., 2023)***. With the exception of one patient, every patent interventional group in our study demonstrated a decrease in VAS. Numerous factors, including age, gender, psychological factors, nerve damage (which can cause patients to develop a falsely low pain tolerance), and accidental intravascular injection of anesthetic (the right phrenic artery bypassing the hepatic hilum into the liver) could account for this ***(Nobre et al., 2020)***.

For a variety of surgical procedures including thermal ablations, neuroaxial and regional blocks are linked to lower costs, less postoperative resource utilization, and shorter hospital stays ***(Gazzera et al., 2014; Song et al., 2000)***. In carefully chosen individuals, a hepatic plexus nerve block may provide comparable advantages, however this needs further research. In terms of analgesic consumption, the interventional group required a significantly lower dose of paracetamol (1450 ± 724.5) than the control group (3200 ± 632.4) (p-value < 0.001).

He et al. found that the nerve block group required less fentanyl throughout the ablation operations (mean dosage, 152 mg 6 78.0 vs. 235.4 mg 6 58.2, respectively; P =.01), which is consistent with our findings ***(He et al., 2021)***. Similarly, Parhar et al. showed that decreased fentanyl was related to hilar nerve blocks (−18.4%, P =.0045) ***(Parhar et al., 2023)***.

Hepatic plexus nerve blocks may reduce postoperative opioid use in patients receiving liver-directed treatment, according to the comparable clinical results in the two trials that were cited.

On the other hand, a study by Jain et al. that looked at hepatic hilar nerve blocks (HHNB) in patients with neuroendocrine tumors (NET) treated with transarterial embolization (TAE) found that although there was no discernible decrease in post-procedure opioid analgesic use, patients used analgesic patches more frequently after an HHNB (25% vs. 5.88%, p = 0.014) ***(Jain et al., 2023)***. These variations could be because a higher proportion of patients in the HHNB group had tumor volumes that were greater than 50% of the liver volume in their research. This could have led to severe post-procedure discomfort because of the bigger volume of tumors treated and the larger tissue ischemia that followed. Despite the increased analgesic benefit provided by the nerve block, this may have led to identical post-procedure analgesic usage between the two groups under study, however this is mostly conjectural.

As regard type of intervention, in interventional group and control group, there were 3 patients (30%) subjected to PTC and 7 patients (70%) subjected to TACE with no significant difference between the studied groups.

While the previously published patients studied hepatic hilar nerve block in certain intervention as percutaneous thermal ablation ***(Hao et al., 2022; Parhar et al., 2023),*** Radiofrequency ablation ***(Chandrashekhara et al., 2023; Nakamura et al., 2014),*** Microwave Ablation ***(Chao & Park, 2023)*** and doxorubicin-eluting embolics transarterial chemoembolization (DEE-TACE) ***(Bessar et al., 2021)***.

In current study, there was no statistical significant decrease of complication in interventional group as there were only 3 patients (30%) with complications in interventional group versus 6 patients (60%) in control group.

Likely, ***Bessar et al.*** showed no significant difference between hepatic hilar nerve block and control group as regard complication with the lack of serious immediate adverse events ***(Bessar et al., 2021)***. Also, ***Parhar et al.*** demonstrated that adverse event rate (11% vs 3%, P =.14) were not significantly different between the cohorts ***(Parhar et al., 2023)***. Similar to our work, ***Hao et al.*** found that there were no significant complications with hepatic hilar nerve block, with the exception of one patient who had a little perihepatic hematoma brought on by the placement of the microwave probe and another who had brief bradycardia and hypotension ***(Hao et al., 2022)***. Also, in ***Nakamura et al.*** no complications were observed ***(Nakamura et al., 2014)***.

More liver specificity and separation from vital structures like the spine and lungs are two benefits of hepatic hilar nerve blocks over celiac and paravertebral nerve blocks ***(Yang et al., 2016)***. Furthermore, HHNBs may be carried out using ultrasonography and a supine patient posture, and they have a lower chance of reaching the colon than celiac plexus blocks ***(He et al., 2021)***.

Intravenous sedation and a technically simple liver-specific hepatic hilar nerve block are used to reduce discomfort in patients undergoing hepatic ablations. Among our patients, there was statistically significant **(p-value = 0.006)** decreased recovery time in interventional group (1.56 ± 0.4 weeks) when compared with Control group (2.48 ± 0.83 weeks). Similarly, **Parhar et al**. study detected that hilar block allowed for quicker recovery and discharge times than other cohort ***(Parhar et al., 2023)***.

Study Limitations: First, our study was single center study based on small sample size. Secondly, we didn't mention any data about size and site of the tumors that may affect the outcomes. Finally, we didn't define the spectrum of patients included.

CONCLUSION

From the current study, it was concluded that: Hepatic hilar nerve block is promising intervention for different liver procedures due to the following findings: Patients subjected to hepatic hilar nerve block showed low pain. Reduced analgesic consumption. Shorten recovery time. Low incidence of complications.

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