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Research Article

Effect of Glisson's Capsule Infiltration with 2% Lignocaine on Anaesthetic Drug Requirements During Monitored Anaesthesia Care for Percutaneous Radiofrequency Ablation of Liver Tumors

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Abstract

Background and Aims: Percutaneous radiofrequency ablation (PRFA) is a minimally invasive approach that employs needle targeted heat therapy for necrosis of hepatic tumour lesions. Despite of its advantages, patients often experience pain and anxiety during PRFA, necessitating the use of monitored anaesthesia care (MAC) with sedation to alleviate pain and ensure comfort during the procedure.

This study aims to evaluate the effectiveness of infiltration of Glisson's Capsule with 2% Lignocaine in reducing intravenous anaesthetic requirements and ensuring patient's comfort during MAC sedation for PRFA of hepatic tumours.

Methods: After approval from the ethical committee with the clinical trials registry, this prospective, randomized, controlled study was conducted. Fourteen patients fulfilling the inclusion criteria, randomly allocated into Group L (10 ml of 2% lignocaine infiltrated over Glisson's capsule) or Group C (no infiltration) were included in this study. Intraoperative anaesthetic requirements (Ketamine boluses) along with intraoperative and postoperative VAS scores, sedation levels and haemodynamic parameters were recorded.

Results: The total dose of ketamine administered was lower in Group L (21.43 ± 6.90) as compared to Group C (58.57 ± 8.99) with statistical significance ($P = 0.001$) with duration of procedure comparable between the groups. Intraoperative and postoperative VAS scores and sedation levels were significantly lower in Group L with steady haemodynamic compared to Group C ($P < 0.05$).

Conclusion: Infiltration of Glisson's capsule was found to be a promising approach for reducing anaesthetic requirements, ensuring patient's comfort with hemodynamic stability during PRFA of sub-capsular liver lesions.

Keywords: Monitored Anaesthesia Care Sedation; Radiofrequency Ablation; Liver Tumours

Introduction

Percutaneous radiofrequency ablation (PRFA) therapy was first introduced in 1990 by McGahan., *et al*. as a minimally invasive alternative for patients in whom surgical resection was not feasible [1]. This technique involves real-time, image-guided delivery of targeted thermal energy via a needle electrode to induce coagulative necrosis in primary or metastatic tumors. Among its most established indications are the treatment of liver tumors particularly hepatocellular carcinoma (HCC) in early-stage cirrhosis and the management of inoperable liver metastases [2-4].

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PRFA is typically performed in non-operating room anaesthesia (NORA) suites under ultrasound (USG) or computed tomography (CT) guidance. An electrode is inserted into the tumor and delivers high-frequency alternating current, generating thermal energy (60–100 °C for 4–6 minutes), which results in controlled tissue ablation [4,5]. Pain during PRFA of hepatic lesions arises from multiple sources, including skin puncture, thermal injury, and capsular irritation—particularly in subcapsular tumors, which are generally more painful than centrally located lesions. Hence, effective analgesia and sedation are essential, and NORA delivery is often warranted for optimal patient management.

While several analgesic techniques—such as paravertebral blocks, thoracic epidural analgesia, artificial ascites, and general anaesthesia have been explored for PRFA of subcapsular lesions, each carries inherent technical and clinical complexities. Given that PRFA is typically a day-care, minimally invasive procedure requiring patient cooperation for breath-holding to facilitate precise tumor targeting, monitored anaesthesia care (MAC) is commonly employed. MAC sedation typically includes a combination of intravenous anaesthetics such as ketamine, propofol, and dexmedetomidine, along with opioids, to achieve a calm, cooperative, and spontaneously breathing patient during the procedure.

However, in subcapsular or sub-glisson's capsule lesions, patient movement due to severe capsular pain can compromise needle positioning, complicate ablation accuracy, and increase the risk of complications. To manage this pain, higher doses of sedatives and opioids are often required, which may lead to respiratory depression and airway obstruction—posing further challenges for both anaesthetic and procedural safety [6].

Lidocaine, a well-established local anaesthetic, has demonstrated efficacy in providing localized analgesia when administered directly to nerve endings [7]. A few studies have described the topical application of lidocaine (lignocaine) directly to the Glisson's capsule to attenuate pain during PRFA of subcapsular hepatic tumors, but the available literature remains sparse [8].

We hypothesized that topical application of 2% lignocaine to the Glisson's capsule could reduce intravenous anaesthetic requirements and improve intraoperative comfort during MAC sedation for PRFA of hepatic tumors.

The primary objective of our study was to evaluate the effectiveness of Glisson's capsule infiltration with 2% lignocaine in reducing intravenous anaesthetic consumption during PRFA. The secondary objectives were to assess differences between the lignocaine and control groups in terms of postoperative pain scores, haemodynamic parameters, intraoperative and postoperative sedation levels, and satisfaction scores among patients, anaesthesiologists, and interventional radiologists.

Materials and Methods

After approval from the ethical committee and registration with the clinical trials registry (CTRI/2023/01/048741) this prospective, randomized, controlled study was conducted from 1/05/2023 for one year at tertiary healthcare institute.

The sample size was calculated based on a previous study and power analysis, taking into account anticipated differences in ketamine dosage between groups.

$$n = \frac{2{s_p}^2\left[z_{1-\alpha/2} + z_{1-\beta}\right]^2}{{\mu_d}^2} \qquad {s_p}^2 = \frac{{s_1}^2 + {s_2}^2}{2}$$

α error = 0.01, β error = 0.05, $s_1 = 2.7$, $s_2 = 1.9$, $d = 7.8$, $Z\alpha = 1.96$, power of study 95%.

The calculated sample size was 14 (n = 14). Participants were randomized into two groups with 7 patients each:

- Group L (n = 7): Lidocaine group
- Group C (n = 7): Control group

Reference study of sample size, https://link.springer.com/article/10.1007/s00270-015-1094-3 [9].

Patient selection

Prior to enrolment, all participants underwent a thorough pre-anaesthetic evaluation with relevant investigations. Eligible patients were aged 18–65 years, classified as ASA Grade I–III, and scheduled for PRFA of single subcapsular liver lesions.

Exclusion criteria included:

- Significant cardiac disease
- Airway complications
- Abnormal liver function

- Chronic alcoholism
- Cognitive/psychiatric disorders
- Chronic pain medication use
- Allergy to lidocaine
- Ventilator dependence

Informed written consent was obtained after explaining the procedure, risks, and benefits. Patients were kept nil per oral for 8 h for solids and 2h for clear fluids prior to the procedure.

Randomization and anaesthetic management (Figure 1)

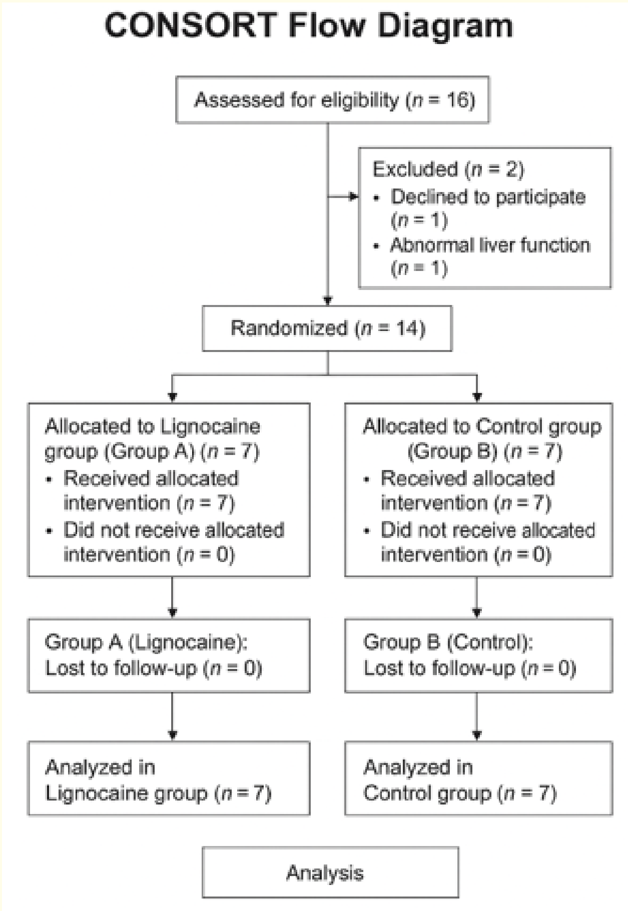

Figure 1: Consort Flow Diagram.

On the day of the procedure, IV access was secured, and ASA standard monitors were applied. Patients were randomized into Group L or Group C using computer-generated random numbers and opaque sealed envelope was used. The study was double blinded to the patient and observer.

Oxygen supplementation (Hudson's face mask, 5 L/min) was provided. All patients received standardized intravenous sedation:

- Midazolam 1 mg
- Fentanyl 0.5 mcg/kg

Tumour localization was performed under ultrasound guidance.

In Group L, local anaesthesia consisted of skin infiltration with 3 ml of 2% lidocaine, followed by 10 ml infiltration over the Glisson's capsule by the interventional radiologist (Figure 2).

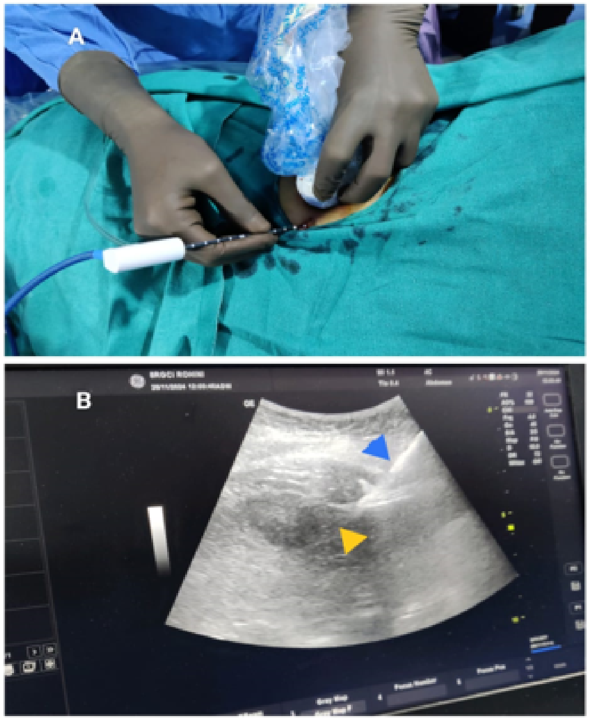

Figure 2: (A) Percutaneous ultrasound guided microwave ablation of liver lesion. (B) Needle placement for lignocaine infiltration, Blue arrow indicates needle and yellow arrow indicate subcapsular liver lesion.

In Group C, only skin infiltration with 3 ml of 2% lidocaine was performed.

Analgesic protocol

At the initiation of ablation, intravenous dexmedetomidine infusion 0.5 mcg/kg over 10 min, followed by 0.5 mcg/kg/h and ketamine 10 mg was administered to all participants. Additional boluses of 10 mg of ketamine were given if the VAS score ≥3. Dexmedetomidine infusion was discontinued after completion of the ablation cycle. Total ketamine dose per patient was recorded.

Outcome measures

The following parameters were recorded: VAS score, pulse rate (PR), mean arterial pressure (MAP), respiratory rate (RR), SpO_2, and Observer's Assessment of Sedation Score (OASS). These were measured every 2 minutes after initiation of ablation, immediately post-procedure, and every 2 h up to 8 h post-procedure.

Analgesic requirements (drug and dose), and comfort scores as assessed by the anaesthesiologist, radiologist, and patient.

It was a day care procedure and all patients in both groups were discharged on the same day with good outcome.

Statistical analysis

Data was compiled using Microsoft Excel and analysed using SPSS software. Categorical data were presented as frequencies, percentages, or proportions, and were analysed for associations between groups using Chi-square test. Continuous data were expressed as mean ± SD for normally distributed data, or median and IQR for non-normally distributed data. Statistical comparisons were performed using independent t-tests for normally distributed data and Wilcoxon signed-rank test for non-parametric data. Repeated-measures ANOVA was used to analyse repeated observations with significant differences. A p-value less than 0.05 was considered statistically significant.

Results

A total of 14 patients belonging to ASA grade I-III were included in this study. The mean age of patients in Group L was 60 years whereas it was slightly lower at 50.86 years in Group C. The mean height in Group L was 163.29 cm (SD = 5.05) compared to 159.57 cm (SD = 11.35) in Group C. The mean weight in Group L was 67.43 kg (SD = 10.58), slightly higher than the mean weight in Group C, which was 66.29 kg (SD = 6.44). Though the difference in means of weight and height, BMI was comparable between the groups. In Group L, 71.4% of patients were male, while 28.6% were female, whereas in Group C, 42.9% were male, and 57.1% were female (Table 1).

Demographic characteristics	N	Group L	Group C
		Mean ± S.D.	
Age	7	60 ± 11.95	50.86 ± 8.21
Height	7	163.29 ± 5.05	159.57 ± 11.35
Weight	7	67.43 ± 10.58	66.29 ± 6.44
BMI	7	25.29 ± 4.19	26.14 ± 2.91
Sex (male/female)	7	5(71.4%)/2 (28.6%)	3 (42.9%)/4(57.1%)

Table 1: Demographic Characteristics.

The total dose of ketamine administered was lower in Group L (21.43 ± 6.90) as compared to Group C (58.57 ± 8.99) with statistical significance ($P = 0.001$) with duration of procedure comparable between the groups ($p < 0.05$) (Table 2).

A.

		N	Mean ± S.D.	*p-value**
Total dose of Ketamine in mg	Group L	7	21.43 ± 6.90	0.001
	Group C	7	58.57 ± 8.99	
Duration of procedure (min.)	Group L	7	9.14 ± 1.069	0.099
	Group C	7	9.14 ± 1.069	

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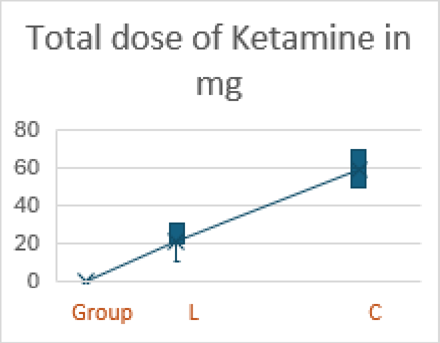

B.

Time Duration		Intraoperative_VAS score			Intraoperative_OAAS score		
	N	Group L	Group C	*p-value**	Group L	Group C	*p-value**
2 min	7	1.57 ± 0.787	2.71 ± 0.488	0.001	4	3.29 ± 0.488	0.001
4 min	7	2.43 ± 0.535	3		3.71 ± 0.488	2.43 ± 0.535	
6 min	7	2	2.86 ± 0.378		3.71 ± 0.489	2	
8 min	7	2	2.29 ± 0.488		3.71 ± 0.488	2	
10 min	7	1.14 ± 1.069	1.29 ± 1.254		2.29 ± 2.13	1.14 ± 1.06	
		Postoperative_VAS score			Postoperative_OAAS score		
0 hr	7	1.29 ± 0.488	2.86 ± 0.378	0.001	3.71 ± 0.488	2.09 ± 0.20	0.001
2 hr	7	0.14 ± 0.378	0.86 ± 0.900		4.56 ± 0.10	2.43 ± 0.535	
4 hr	7	0.12± 0.295	0.71 ± 0.756		4.80 ± 0.15	4.29 ± 0.488	
6 hr	7	0	0		5	5	
8 hr	7	0	0		5	5	

Table 2: A. Total Dose of Ketamine and Duration of Procedure between Group L and Group C; B. VAS scores and OAAS scores during Intraoperative and Postoperative Periods.

Intraoperative, VAS scores were lower in the lignocaine group at all observational points compared to the control group with statistical significance (p = 0.001). Patients in Group L consistently demonstrated higher mean OAAS scores and were responsive to verbal commands during the procedure as compared to Group C. The OASS scores in Group L was significantly higher at all observation points in contrast to Group C (p < 0.05). Mean VAS score was higher in group C patients than that of group L in the immediate post-procedure, at 2h and 4h post-operative observation points with statistical significance (p = 0.001). OAAS score was higher among Group L patients in comparison to group C in the immediate post-operative period and at 2h post-operative period (p = 0.001) with no difference thereafter (Table 2).

Patients in both the groups were haemodynamically stable during the procedure. However, HR and MBP were higher in the control group during the intraoperative period with again higher HR when compared to the study group in the post-operative observation points with statistical significance (P < 0.05) depicted in (Figure 3).

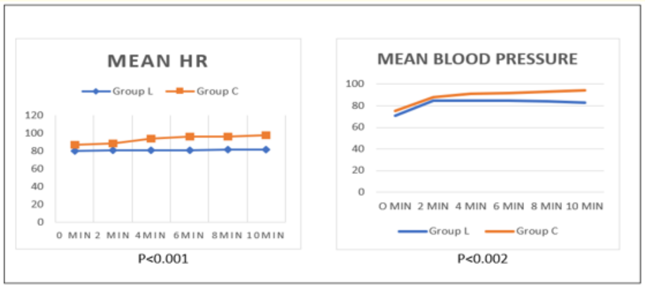

Figure 3: Intraoperative Hemodynamic Parameters.

In consideration to respiratory rate (RR) and oxygen saturation (SPO2) during the intraoperative period participants in both the groups were comparable with no statistical significance ($P > 0.05$). Postoperatively, there was no significant difference in RR between the groups ($p = 0.128$), while in terms of SPO2 significant difference was noted at 0h observation point with Group L (99.29%) compared to Group C (98.57%) ($p = 0.011$).

In the study group, a unanimous consensus of complete satisfaction was evident across all stakeholders, with anaesthetist, surgeon and patients. Conversely, in the control group a varied response was noted with dissatisfaction or slight satisfaction as the majority (Table 3).

Anaesthestist	**Group L**	**Group C**
	Satisfaction level	
Dissatisfied	0%	1 (14.3%)
Slightly satisfied	0%	4 (57.1%)
Satisfied	0%	2 (28.6%)
Very satisfied	7 (100%)	0%
Surgeon	Satisfaction level	
Dissatisfied	0%	1 (14.3%)
Slightly satisfied	0%	6 (85.7%)
Satisfied	0%	0%
Very satisfied	7 (100%)	0%
Patient	Satisfaction level	
Dissatisfied	0%	5 (71.4%)
Slightly satisfied	0%	2 (28.6%)
Satisfied	1 (14.3%)	0%
Very satisfied	6 (85.7%)	0%

Table 3: Satisfaction Levels.

Discussion

Partial hepatectomy remains the treatment of choice for liver tumors. However, in patients with poor hepatic reserve, advanced disease, severe comorbidities, or advanced age, PRFA offers a safer alternative. PRFA has gained increasing attention due to its effectiveness, safety profile, and low complication and mortality rates, particularly for liver tumors [10].

Despite these advantages, PRFA of subcapsular lesions is associated with significant pain, necessitating monitored anaesthesia care (MAC) sedation in non-operating room anaesthesia (NORA) suites [6].

The liver parenchyma itself is relatively insensitive to pain, as it lacks sensory innervation. Pain during PRFA arises primarily from the Glisson's capsule, which contains hepatic pain fibres derived from the hepatic plexus—a combination of sympathetic fibres from the coeliac plexus and parasympathetic fibres from the vagus nerve [11]. Consequently, ablation of subcapsular tumours tends to be more painful, often requiring higher anaesthetic drug doses that may increase the risk of airway complications, haemodynamic instability, and delayed recovery [8].

Lidocaine, a widely used local anaesthetic, has additional anti-inflammatory and anti-cancer properties. Several studies have demonstrated its ability to inhibit cancer cell proliferation, invasion, and migration, while promoting apoptosis, thereby reducing cancer progression and recurrence [12]. In this context, infiltraion of the Glisson's capsule with lidocaine offers not only perioperative analgesia but may also confer oncological benefits.

In our study, patients in the lidocaine group required significantly lower doses of anaesthetic drugs compared to controls. This was accompanied by lower VAS scores, more stable haemodynamics, and better oxygenation throughout the perioperative period ($P < 0.05$). Moreover, higher OAAS scores in the lidocaine group facilitated tumour localization and mobilization, as patients were able to co-operate with brief apnoeic pauses when requested. Satisfaction scores among patients, anaesthesiologists, and interventional radiologists were consistently higher in the lidocaine group.

Alternative regional anaesthetic techniques, such as thoracic paravertebral block with right cervical phrenic nerve block or thoracic epidural anaesthesia, have been employed for PRFA of subcapsular tumours [13]. However, their use is limited in patients with hepatic insufficiency or coagulopathy. Novel approaches including artificial ascites creation and hepatic hilar nerve block have also been described. Hakime., *et al.* demonstrated that artificial ascites alleviates postoperative pain, though the procedure itself is painful and may prolong recovery [9]. Similarly, hepatic hilar nerve block can provide effective analgesia but requires significant expertise, making it less feasible than Glisson's capsule infiltration, which can be easily performed by the interventional radiologist [14].

Nakamura., *et al*. were the first to report that infiltration of local anaesthetic over Glisson's capsule effectively reduces pain during PRFA of liver tumours [8]. Their findings are consistent with ours, including intra-procedural pain reduction and prevention of vagally mediated bradycardia. However, their study did not assess postoperative pain or sedation scores. Importantly, both studies reported no adverse effects associated with the technique.

Overall, our findings suggest that Glisson's capsule infiltration with lidocaine is a simple, safe, and effective adjunct during PRFA of subcapsular liver tumours. It reduces anaesthetic drug consumption, improves patient comfort, and enhances procedural conditions without increasing complications.

Conclusion

In our experience, infiltration of the Glisson's capsule proved to be a safe, simple, and effective technique for reducing anaesthetic requirements during MAC sedation for PRFA of subcapsular liver tumours. It provided patient comfort, facilitated procedural conditions, maintained haemodynamic stability, and was not associated with complications. This approach has the potential to be adopted as a valuable adjunct to MAC sedation in PRFA of liver tumours.

Limitations and Future Directions

The relatively small sample size in this study may limit the generalizability of our findings. Larger, multicentre studies are needed to validate the observed benefits of lidocaine infiltration over Glisson's sheath during PRFA of subcapsular liver tumours. Further research should also focus on determining the optimal concentration, volume, and timing of lidocaine administration to maximize its analgesic efficacy and safety profile. In addition, future studies could evaluate long-term oncological outcomes to assess whether lidocaine's reported anti-cancer properties contribute to improved disease control following PRFA.

No conflict of interest.

Bibliography

1. McGahan JP, Browning PD, Brock JM, Tesluk H. Hepatic ablation using radiofrequency electrocautery. Invest Radiol. 1990;25(3):267–270.
2. Tatl S, Tapan U, Morrison PR, Silverman SG. Radiofrequency ablation: technique and clinical applications. Diagn Interv Radiol. 2012;18:508–516.
3. Beermann M, Lindeberg J, Engstrand J, et al. 1000 consecutive ablation sessions in the era of computer assisted image guidance – lessons learned. Eur J Radiol Open. 2019;6:1–8.
4. Lencioni R, Cioni D, Lera J, et al. Radiofrequency ablation: principles and techniques In: Lencioni R, Cioni D, Bartolozzi C, editors. Focal Liver Lesions. Detection, Characterization, Ablation. Berlin: Springer Verlag; 2005:307–316.
5. Bilchik AJ, Wood TF, Allegra DP. Radiofrequency ablation of unresectable hepatic malignancies: lessons learned. Oncologist. 2001;6(1):24-33.
6. Piccioni F, Poli A, Templeton LC, Templeton TW, Rispoli M, Vetrugno L, Santonastaso D, Valenza F. Anesthesia for Percutaneous Radiofrequency Tumor Ablation (PRFA): A Review of Current Practice and Techniques. Local Reg Anesth. 2019 Dec 4;12:127-137.
7. Lai R, Peng Z, Chen D, et al. The effects of anesthetic technique on cancer recurrence in percutaneous radiofrequency ablation of small hepatocellular carcinoma. Anesth Analg. 2012;114(2):290–296.
8. Nakamura S, Nouso K, Onishi H, Kuwaki K, Hagihara H, Takeuchi Y, Wada N, Morimoto Y, Miyahara K, Yasunaka T, Ikeda F. Prevention of vagotonia and pain during radiofrequency ablation of liver tumors. Hepatology Research. 2014 Dec;44(13):1367-70.
9. Hakime´, A., Tselikas, L., Otmezguine, Y., & Deschamps, F. (2015). Artificial Ascites for Pain Relief During Microwave Ablation of Subcapsular Liver Tumors. *Cardiovasc Intervent Radiol*. DOI: 10.1007/s00270-015-1094-3. Received: 19 December 2014. Accepted: 5 March 2015. Published by Springer Science+Business Media New York and the Cardiovascular and Interventional Radiological Society of Europe (CIRSE).
10. Lee MW, Raman SS, Asvadi NH, Siripongsakun S, Hicks RM, Chen J, Worakitsitisatorn A, McWilliams J, Tong MJ, Finn RS, Agopian VG. Radiofrequency ablation of hepatocellular carcinoma as bridge therapy to liver transplantation: A 10-year intention-to-treat analysis. Hepatology. 2017 Jun 1;65(6):1979-90.

11. Frank H. Netter, MD: Atlas of Human Anatomy, Fifth Edition, Saunders - Elsevier, Chapter Abdomen, Subchapter 28 Viscera (Accessory Organs), Guide: Liver, Pages 148 and 149 and Subchapter 29 Visceral Vasculature, Guide Abdomen: Visceral Vasculature, Pages 153 to 157 and Subchapter 30, Innervation, Page 15
12. Zhang C, Xie C, Lu Y. Local anesthetic lidocaine and cancer: insight into tumor progression and recurrence. Frontiers in Oncology. 2021 Jun 24;11:669746.
13. Yeung JH, Gates S, Naidu BV, Wilson MJ, Smith FG. Paravertebral block versus thoracic epidural for patients undergoing thoracotomy. Cochrane Database of Systematic Reviews. 2016(2).
14. He KS, Fernando R, Cabrera T, Valenti D, Algharras A, Martínez N, Liu DM, Noel G, Muchantef K, Bessissow A, Boucher LM. Hepatic hilar nerve block for hepatic interventions: anatomy, technique, and initial clinical experience in thermal ablation of liver tumors. Radiology. 2021 Oct;301(1):223-8.

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