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Effect of ultrasound-guided pulsed radiofrequency on intercostal neuralgia after lung cancer surgery

A retrospective study

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Abstract

This retrospective study investigated the effect of ultrasound-guided pulsed radiofrequency (UGPRF) on intercostal neuralgia (ICN) after lung cancer surgery (LCS).

This retrospective observational study analyzed the outcome data of UGPRF on ICN in 80 patients with LCS. All those patients were allocated into a treatment group (n = 40) and a control group (n = 40). All patient data were collected between January 2018 and November 2019. The primary outcome was pain intensity (measured by numerical rating scale, NRS). The secondary outcomes were sleep quality (measured by Pittsburgh Sleep Quality Index, PSQI), anesthetic consumption, and treatment-related adverse events.

After treatment, patients in the treatment group showed better outcomes in NRS ($P < .01$), PSQI ($P < .01$), and anesthetic consumption ($P < .01$), than patients in the control group. No treatment-related adverse events were documented in both groups in this study.

The results of this study found that UGPRF may benefit patients for pain relief of ICN after LCS.

Abbreviations: ICN = intercostal neuralgia, LCS = lung cancer surgery, NRS = numerical rating scale, PRF = pulsed radiofrequency, PSQI = Pittsburgh Sleep Quality Index, UG = ultrasound-guided, UGPRF = ultrasound-guided pulsed radiofrequency.

Keywords: intercostal neuralgia, lung cancer, surgery, ultrasound-guided pulsed radiofrequency

1. Introduction

Lung cancer is one of the most frequently diagnosed cancers around the world.[1–4] It is also the leading cause of highest mortality and morbidity in such patients.[5–8] Surgery is recommended for lung cancer as one of the most effective management.[9–12] However, lung cancer surgery (LCS) is traumatic and invasive procedures and often accompanies remarkable risks for postoperative lung complications, such as pneumonia, and intercostal neuralgia (ICN).[13–20]

A variety of nonoperative managements are the first choice for ICN, which is responsible for relieving pain intensity of ICN in patients who received LCS, such as physical therapy, alternative medicine, acupuncture, and laser therapy.[21–23] Similar to other non-surgery modality, ultrasound-guided pulsed radiofrequency (UGPRF) is an alternative treatment when other conservative treatments are ineffective.[24,25] Previous study reported that pulsed radiofrequency (PRF) can relieve chronic pain by applying an electrical field and heat bursts to affected neural tissue without injury.[26,27] With the help of ultrasound-guided (UG) techniques, PRF can more accurately target the affected regional never blocks by offering direct visualization of nerves.[28,29] Thus, UGPRF can more effectively to manage pain conditions than PRF alone. Although there is limited evidence of UGPRF for the treatment of ICN after LCS, a lot of previous studies have reported the effect of UGPRF for other pain conditions. Thus, this retrospective study tried to investigate the effect of UGPRF for treating ICN after LCS.

2. Methods

2.1. Ethic approval

This retrospective study received approval from the Medical Ethical Committee of The Fifth Affiliated Hospital of Xinjiang Medical University. Informed written consent was waived in this retrospective study.

2.2. Study design

A retrospective study was performed at The Fifth Affiliated Hospital of Xinjiang Medical University and 4th (Xing Yuan) Hospital of Yulin. It was conducted between January 2018 and November 2019 according to the ethical standards of 1964

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TW and HH contributed equally to this work.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Declaration of Helsinki. A total of 80 patients with ICN following LCS were divided into a treatment group (n = 40) and a control group (n = 40), based on different treatments they received. No randomization procedure was utilized, and the researchers and patients were not blinded in this retrospective study. The data were anonymously collected for analysis by a data analyst.

2.3. Participants

Eligible patients fulfilled the inclusion criteria as below: all patients were diagnosed as ICN because of the LCS; aged between 18 and 75 years old; pain intensity of ICN (numerical rating scale, NRS ≥ 4, at the range of 0–10[30]) prior to the treatment; and all patients received successful lung cancer resection. Exclusion criteria: multiple organ dysfunctions; ICN caused by other diseases, such as traumatic injury; presence of mental disorders; presence of any local bone pathology; serious psychiatric or neurological disorders; and patient records without sufficient information.

2.4. Intervention schedule

All patients in both groups administered physical therapy. Additionally, patients in the treatment group also received UGPRF. It was performed as follows. The patients were placed in a supine position with sterile conditions and appropriate monitoring. The local skin and soft tissue was injected 1 mL of 2% lidocaine before the radiofrequency needles were inserted. Then, the probes were reached to the point of target nerves under the ultrasound guidance. The radiofrequency intervention was performed by a 10-cm, 22-gauge cannula with a 10-mm active part and <0.2 mA current intensity. The frequency was 2 Hz at 40 V, and there were 20 ms active and 480 ms silent periods. The temperature was maintained under 42 °C. Each target nerve point was treated for 8 minutes each session.

2.5. Outcome indicator measurements

Primary outcome indicator was pain intensity of ICN (measured by NRS). It ranges from 0 (no pain) to 10 (worst pain), with higher score meaning worse pain. Secondary outcome indicators were sleep quality (measured by Pittsburgh Sleep Quality Index, PSQI[31]), anesthetic consumption, and treatment-related adverse events. PSQI consists of 19 self-rated questions and 5 questions rated by sleep partner.[31] Each question scored from 0 (no sleep difficulty) to 3 (severe sleep difficulty). The higher score suggests worse sleep quality.

2.6. Statistical analysis

Statistical analysis was carried out using SPSS software (SPSS 17.0, IBM Corp., Armonk, NY). Descriptive outcome data were presented in mean and standard deviation, and number and frequency according to different data types. As for continuous outcome indicators, *t* test (normally distributed data) or Mann–Whitney *U* test (non-normally distributed data) was utilized. As for categorical outcome indicators, chi-squared test or Fisher exact test was used for data analysis. We defined a 2-side $P < .05$ as having statistical significance.

3. Results

A total of 80 patient records met the inclusion criteria. All baseline characteristics are summarized in Table 1. Women represented 67.5% (n = 27) of the study sample, and 32.5% (n = 13) were men in the treatment group, while the women and men were 60.0% (n = 24) and 40.0% (n = 16), respectively in the control group. The mean age and ICN duration were 58.5 (10.3) years and 2.7 (1.2) months in the treatment group, while those were 61.2 (9.8) years and 2.5 (1.4) months in the control group. As for race, 62.5% (n = 25) patients were Han ethnicity, and 37.5% (n = 15) patients were Uighur ethnicity in the treatment group, while there were 52.5% (n = 21) patients of Han ethnicity, and 47.5% (n = 19) patients of Uighur ethnicity in the control group.

Table 1

Patient characteristics at baseline.

Characteristics	Treatment group (n = 40)	Control group (n = 40)	*P* value
Age, y	58.5 (10.3)	61.2 (9.8)	.23
Gender			
Male	27 (67.5)	24 (60.0)	.49
Female	13 (32.5)	16 (40.0)	–
Race			
Han ethnicity	25 (62.5)	21 (52.5)	.37
Uighur ethnicity	15 (37.5)	19 (47.5)	–
Educational background			
Primary school or below	5 (12.5)	3 (7.5)	.46
Secondary school	7 (17.5)	10 (25.0)	.41
High school	16 (40.0)	18 (45.0)	.65
College or above	12 (30.0)	9 (22.5)	.45
Side			
Right	17 (42.5)	22 (55.0)	.26
Left	23 (57.5)	18 (45.0)	–
ICN duration, mo	2.7 (1.2)	2.5 (1.4)	0.49

Data are present as mean ± standard deviation or number (%); ICN = intercostal neuralgia.

Before treatment, there were not significant differences in NRS ($P = .61$, Table 2), PSQI ($P = .45$, Table 3), and anesthetic consumption ($P = .28$, Table 4) between 2 groups. Compared with the treatment before the study administration, patients achieved greater improvements in NRS ($P < .01$, Table 2), PSQI ($P < .01$, Table 3), and anesthetic consumption ($P < .01$, Table 4) after treatment within 2 groups.

After treatment, there were significant differences in NRS ($P < .01$, Table 2), PSQI ($P < .01$, Table 3), and anesthetic consumption ($P < .01$, Table 4) between 2 groups in this study. No treatment-related adverse events were recorded in this study.

4. Discussion

Lung cancer is one of the most common cancers globally, which can also result in high rates of death and disability.[5–8] Surgical resection remains the mainstay of effective treatment for such

Table 2

Comparison of NRS between 2 groups.

NRS	Treatment group (n = 40)	Control group (n = 40)	*P* value
Baseline	6.5 (1.9)	6.3 (1.6)	.61
After treatment	2.9 (2.0)	4.1 (2.5)	
Change from baseline	3.6 (3.0, 4.1)*	2.2 (1.8, 2.5)*	
Difference between groups	1.4 (1.2, 1.7)		.02

Data are present as mean ± standard deviation or range; NRS = numerical rating scale.
* $P < .01$, compared with baseline.

Table 3

Comparison of PSQI between 2 groups.

PSQI	Treatment group (n = 40)	Control group (n = 40)	*P* value
Baseline	14.7 (2.8)	14.2 (3.1)	.45
After treatment	8.0 (3.3)	9.7 (3.6)	
Change from baseline	6.8 (6.3, 7.2)*	4.5 (4.1, 4.9)*	
Difference between groups	2.3 (2.0, 2.5)		.03

Data are present as mean ± standard deviation or range; PSQI = Pittsburgh Sleep Quality Index.
* $P < .01$, compared with baseline.

Table 4

Comparison of anesthetic consumption after treatment between 2 groups.

Pregabalin consumption	Treatment group (n = 40)	Control group (n = 40)	*P* value
Baseline	1.5 (0.3)	1.4 (0.5)	.28
After treatment	0.6 (0.3)	1.0 (0.4)	
Change from baseline	0.9 (0.7, 1.2)*	0.4 (0.2, 0.7)*	
Difference between groups	0.5 (0.3, 0.7)		<.01

Data are present as mean ± standard deviation or range.
* $P < .01$, compared with baseline.

patients. However, patients who received this management also experience a variety of complications after LCS, such as ICN.[13–20]

Non-invasive therapy, such as UGPRF has been reported to relieve various pain disorders. However, very few evidence regarding this issue is available. Thus, this retrospective study explored the effect of UGPRF for the treatment of patients with ICN after LCS. The results of this study exerted that patients in the treatment group showed better outcome enhancement in NRS ($P < .01$), PSQI ($P < .01$), and anesthetic consumption ($P < .01$), than those of patients in the control group. It indicates that UGPRF may be effective for ICN relief following LCS.

As for limitations, this retrospective study may suffer from several following drawbacks. At first, the sample size of this study is pretty small, which may impact the effect of UGPRF on ICN after LCS. Then, this study only collected and analyzed outcome data before and after treatment. No long-term follow-up outcome data after treatment was harvested and appraised. Thirdly, this retrospective study did not apply randomization and blind approaches to both patients and researchers, which may affect bias of patient selection. Last but not least, the restriction of this study is its retrospective nature. Future studies should avoid all those limitations.

5. Conclusion

The results of this study showed that UGPRF may be effective for alleviating pain intensity of ICN after LCS.

Author contributions

Conceptualization: Tong Wei, Hui Hou, Qiu-xia Mu.
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