# World Journal of *Clinical Cases*

World J Clin Cases 2024 July 26; 12(21): 4455-4858





Published by Baishideng Publishing Group Inc

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#### **ABOUT COVER**

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#### **RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: Xiao-Mei Zheng; Production Department Director: Xiang Li; Cover Editor: Jin-Lei Wang.

NAME OF JOURNAL	INSTRUCTIONS TO AUTHORS
World Journal of Clinical Cases	https://www.wignet.com/bpg/gerinfo/204
<b>ISSN</b>	GUIDELINES FOR ETHICS DOCUMENTS
ISSN 2307-8960 (online)	https://www.wjgnet.com/bpg/GerInfo/287
LAUNCH DATE	GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
April 16, 2013	https://www.wignet.com/bpg/gerinfo/240
FREQUENCY	PUBLICATION ETHICS
Thrice Monthly	https://www.wjgnet.com/bpg/GerInfo/288
<b>EDITORS-IN-CHIEF</b> Bao-Gan Peng, Salim Surani, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati	PUBLICATION MISCONDUCT https://www.wjgnet.com/bpg/gerinfo/208
EDITORIAL BOARD MEMBERS	ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/2307-8960/editorialboard.htm	https://www.wignet.com/bpg/gerinfo/242
PUBLICATION DATE	STEPS FOR SUBMITTING MANUSCRIPTS
July 26, 2024	https://www.wjgnet.com/bpg/GerInfo/239
COPYRIGHT	ONLINE SUBMISSION
© 2024 Baishideng Publishing Group Inc	https://www.f6publishing.com

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World J Clin Cases 2024 July 26; 12(21): 4770-4776

DOI: 10.12998/wjcc.v12.i21.4770

ISSN 2307-8960 (online)

CASE REPORT

# Percutaneous cervical cordotomy for managing refractory pain in a patient with a Pancoast tumor: A case report

Kuan-Yu Lu, Feng-Sheng Lin, Chia-Shiang Lin, Hsuan-Chih Lao

Specialty type: Medicine, research and experimental

Provenance and peer review: Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's classification Scientific Quality: Grade B Novelty: Grade B Creativity or Innovation: Grade B Scientific Significance: Grade B

P-Reviewer: Zhou S, China

Received: March 26, 2024 Revised: May 15, 2024 Accepted: May 30, 2024 Published online: July 26, 2024 Processing time: 97 Days and 1.4 Hours



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## Abstract

#### BACKGROUND

According to the World Health Organization analgesic ladder, cancer-related pain generally begins with pharmacotherapy in a stepwise approach. Nevertheless, some patients continue to experience poorly controlled pain despite medications, particularly when considering adverse effects and self-care quality. Percutaneous cervical cordotomy is an alternative interventional procedure for unremitting unilateral intractable cancer-related pain.

#### CASE SUMMARY

The patient was diagnosed with lung cancer with destruction of the brachial plexus and ribs. For 2 mo, the patient experienced progressive severe weakness and pain in the right upper extremity. Notably, the pain intensity reached an extreme level, particularly when lying supine, even under heavy sedation. This heightened pain response posed a significant challenge; as a result, the patient was unable to undergo further evaluation through magnetic resonance imaging. Ultimately, he underwent percutaneous cervical cordotomy for symptom relief, resulting in complete resolution of right arm pain. After a 3-mo follow-up, the pain did not recur, and only a flurbiprofen local patch was required for mild scapular tightness.

#### **CONCLUSION**



Cordotomy, under careful patient selection, appears to enhance the quality of life of patients with unilateral cancerrelated pain.

Key Words: Cordotomy; Cancer pain; Intractable pain; Fluoroscopy; Radiofrequency therapy; Case report

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**Core Tip:** Percutaneous cervical cordotomy provides a valuable alternative for the management of intractable cancer-related pain resistant to analgesics. The presented case involves a patient with advanced bronchogenic carcinoma experiencing severe upper limb pain and restricted range of motion. Conscious sedation ensures a comfortable and safe procedure. After cordotomy, the patient experienced relief from cancer-related pain without relying on opioids, significantly improving his quality of life.

Citation: Lu KY, Lin FS, Lin CS, Lao HC. Percutaneous cervical cordotomy for managing refractory pain in a patient with a Pancoast tumor: A case report. World J Clin Cases 2024; 12(21): 4770-4776 URL: https://www.wjgnet.com/2307-8960/full/v12/i21/4770.htm DOI: https://dx.doi.org/10.12998/wjcc.v12.i21.4770

#### INTRODUCTION

Spinal cordotomy, an invasive procedure for the treatment of intractable pain, is not controlled by conventional therapies, such as analgesics or nerve block. It aims to disrupt the nociceptive pathway in the anterolateral column, particularly the lateral spinothalamic tract, by thermal or mechanical destruction[1]. Spiller and Martin[2], who described the first "open" cordotomy in 1912, treated a patient who suffered from pain caused by a lower spinal cord tumor. In 1963, Mullan et al[3] introduced percutaneous cordotomy under fluoroscopy guidance and electrical monitoring. Percutaneous cordotomy, with its attendant real-time patient feedback, appears to be much safer than the open procedure; as a result, it was generally reconsidered in the pain care algorithm. In addition to not requiring long-term follow-up or maintenance, percutaneous cordotomy allows for interventions without interruption of chemotherapy [4]. With the broader adoption of opioids and the introduction of different interventional pain procedures, the need for spinal cordotomy in intractable pain management has diminished[1]. However, a small portion of patients with intractable pain unresponsive to medical and peripheral interventions may benefit from spinal cordotomy. Cordotomy is used most commonly for the treatment of cancer-related pain below the mid- to low-cervical dermatomes, which is lateralized opposite the side of the cordotomy [4].

#### CASE PRESENTATION

#### Chief complaints

A 59-year-old man visited our emergency department (ED) complaining of progressive right upper limb weakness, numbness, and persistent pain for 2 mo.

#### History of present illness

Over the past 2 mo, the patient sought medical attention at local clinics with limited success. Consequently, he came to our hospital for help. According to the patient, he experienced pain radiating from his right hand to the shoulder, consistent with the C5-T1 dermatome. He could not raise or hold his hand because of intermittent lancinating pain and shock-like sensations in the forearm. Profound muscle weakness and limited range of motion were noted, exacerbated by severe pain. Managing his symptoms required an upright position with the head leaned forward because lying down intensified the electric-like pain.

Upon examination in the ED, a chest X-ray (CXR) revealed progressive opacity in the right upper lobe, prompting further investigations. Subsequent chest computed tomography (CT) revealed a substantial soft tissue mass in the right apical lung exceeding 10 cm in diameter, with osteolytic destruction of the adjacent 1st to 3rd ribs, indicative of locally advanced bronchogenic carcinoma. After admission to the chest medicine ward, we were consulted for the treatment of his intractable pain.

Despite a daily oral equivalent of 200 mg morphine, the patient's pain intensity, measured by the numeric rating scale, remained high with a maximum score of 7. Difficulties arose during examinations requiring a supine posture.

#### History of past illness

The patient denied any systematic disease.



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Figure 1 Preoperative imaging shows a huge space-occupying lesion at the right apical lung with adjunct bony destruction. A: Chest radiograph. The asterisks indicate the second and third ribs at the left side, which was blurred at the right side; B: Chest computed tomography. A soft tissue mass (> 10 cm in diameter) occupied the entire right apical lung. The arrows indicate the first rib. The first rib in the right side was surrounded by the mass. The asterisk indicates the second rib. The second rib in the right side was damaged. The feature of the image highly suggested a locally advanced bronchogenic carcinoma.

#### Personal and family history

The patient had no significant personal or family history.

#### Physical examination

The physical examination showed limited elevation of the shoulder, with a height < 1 cm. The range of motion of his right elbow was approximately 30°. This right elbow extension was limited. He could barely abduct or adduct his finger. No abnormalities were found in the examinations of other systems.

#### Laboratory examinations

His hemoglobin level was 8.4 g/dL (reference, 13-18 g/dL); white blood cell count, 12400/mm<sup>3</sup> (reference, 4000-10000/mm<sup>3</sup>); creatinine, 2.2 mg/dL (reference, 0.4-1.2 mg/dL); and blood urea nitrogen, 34 mg/dL (reference, 8-20 mg/ dL). All other laboratory test results were within the normal ranges.

#### Imaging examinations

CXR at the ED revealed a huge space-occupying lesion at the right apical lung with adjunct bony destruction. Chest CT presented a soft tissue mass (> 10 cm in diameter) occupying the entire right apical lung, which was highly suggestive of a locally advanced bronchogenic carcinoma (Figure 1).

#### MULTIDISCIPLINARY EXPERT CONSULTATION

The patient was evaluated by multidisciplinary experts in radiology, oncology, chest medicine, chest surgery, psychology, nutrition, social work, and hospice care during the admission period.

#### FINAL DIAGNOSIS

A definitive diagnosis of lung adenocarcinoma was confirmed by CT-guided biopsy. Pathological examination revealed that the lung parenchyma was infiltrated with adenocarcinoma cells with an acinar growth pattern (Figure 2).

#### TREATMENT

After extensive discussions, a percutaneous cervical cordotomy was performed under biplane fluoroscopic guidance. The patient was positioned supine and underwent conscious sedation, facilitated by dexmedetomidine infusion at a rate of 0.4-0.5 µg/kg/h, complemented by intermittent boluses of 1-2 mg remimazolam. The procedure utilized a 20-g spinal needle and a 28-g straight, sharp cannula with a 2-mm electrode tip (11.7 cm 28 G trocar, 21-G spinal needle, Cosman Electrode, LCETM LCED-TC; Cosman Medical, Burlington, MA, United States) to disrupt the nociceptive pathway in the anterolateral column at the C1-C2 vertebral level (Figure 3).

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Figure 2 Pathological examination of the patient's lung, which was obtained from the computed tomography-guided biopsy. A: Lung parenchyma with infiltrating adenocarcinoma cells; B: Infiltrating adenocarcinoma cells with an acinar growth pattern.



Figure 3 Fluoroscopy image of the anterior-posterior view when advancing the spinal needle during percutaneous cervical cordotomy. A: When the needle tip enters the intrathecal space, the cerebrospinal fluid is drained. The needle tip did not cross through the midline, which is indicated by an asterisk, the dens of axis (C2); B: Radiofrequency (RF) generator was inserted into the spinal needle. The patient's discomfort area was triggered by the sensory test. After confirmation of the target lesion, RF thermocoagulation was applied to destroy the neuropathway of the pain; C: Schematic illustration of percutaneous cervical cordotomy and the relative anatomical position of the lateral spinothalamic tract. C: Cervical; L: Lumbar; T: Thoracic.

Sonography confirmed a depth from the skin to the dura mater of 6 cm at the left side of the neck. After confirmation of the entry point, local anesthetic was infiltrated to ease the passage of the needle into the C1-C2 interlaminar space. The anatomical schematic of the percutaneous cervical cordotomy is illustrated in Figure 3. The needle was advanced into the anterolateral quadrant of the spinal cord. Impedance changes were monitored to confirm the location of the electrode tip; an impedance of 150  $\Omega$  indicated the cerebrospinal fluid, whereas 600-700  $\Omega$  signified the spinal cord parenchyma. Upon assessment of the spinal cord, sensory and motor stimulations were utilized to confirm the target site, the lateral spinothalamic tract, and ensure that other neuropathways were not involved. To alleviate discomfort during radiofre-



Figure 4 Trajectory of pain alteration. The orange arrow and black dot represent the percutaneous cervical cordotomy. A: Numeric rating scale score of pain during hospitalization. After the procedure, a pain-free period was noted. He complained of intermittent pain, which can be relieved by nonopioid medications, during the cancer treatment; B: Oral morphine equivalent dosage during hospitalization. After the procedure, the opioid dosage was tapered gradually.

quency (RF) thermocoagulation, an intermittent bolus of 10 mg propofol, for a total of 50 mg, was administered, achieving coagulation at 65 °C for 90 s.

#### OUTCOME AND FOLLOW-UP

The patient exhibited a notable improvement in symptoms immediately upon awakening from sedation. Postoperatively, both the equivalent dosage of oral morphine and pain intensity markedly decreased (Figure 4). Subsequent palliative cancer management, including radiotherapy and chemotherapy, proceeded smoothly. Opioid analgesic dosage was gradually tapered, and the patient was entirely weaned off it within 3 wk. No significant respiratory or sympathetic dysfunction was noted, and a 3-mo follow-up revealed no pain recurrence; only a flurbiprofen local patch was required for mild scapular tightness.

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Figure 5 Spinal needle crossing the midline. The spinal needle appears to have crossed the midline (asterisk) and near the contralateral lamina. However, the patient did not complain of any discomfort. We presumed that the needle may have pushed the spinal cord, instead of being stabbed, when we were advancing the needle. Therefore, the path of the spinal needle should be adjusted after going backward.

#### DISCUSSION

In this study, we presented the challenging case of a patient diagnosed with lung adenocarcinoma complicated by the destruction of the brachial plexus and adjacent ribs, leading to severe, relentless neoplasm-related pain in the right upper limb despite aggressive pharmacotherapy. Despite efforts to obtain a preprocedural magnetic resonance imaging (MRI) for the evaluation of percutaneous cordotomy, the patient's distress prevented successful cooperation, necessitating alternative imaging modalities. Consequently, we opted for biplane X-ray imaging under light sedation for the preprocedural assessment.

During the procedure, we encountered several technical challenges, notably in confirming the position of the needle tip using anterior-posterior and lateral X-ray views of the cervical spine. Despite our best efforts, impedance measurements of the RF generator did not consistently increase, particularly when the needle approached the midline and contralateral lamina (Figure 5). This discrepancy raised concerns about the accurate placement of the needle and potential inadvertent spinal cord penetration. Therefore, incorporating advanced imaging such as CT guidance[1] or MRI[5] during the procedure could enhance safety and precision in target localization. A hybrid operating room may also be beneficial.

To mitigate procedural discomfort and ensure patient safety, neurophysiological stimulation was employed for lesion confirmation after insertion into the cervical spinal cord. Given the need for patient cooperation during this critical phase, dexmedetomidine served as the primary anesthetic agent with adjuvant support. Despite meticulous planning, unexpected muscle twitching was observed upon reaching the target lesion site, suggesting the involvement of the anterior corticospinal tract by the RF generator. In our review of the literature, the corticospinal tract, also known as the pyramidal tract, originated from the primary motor cortex and descended through the medulla before crossing or remaining uncrossed to join the lateral corticospinal tract in the spinal cord[6]. This anatomical intricacy underscores the challenges associated with precisely targeting the intended neural pathway during percutaneous cordotomy.

In comparison with standard procedures outlined in textbooks, we opted against contrast instillation because of its potential interference with impedance measurements of the RF generator. Although contrast administration is recommended for visualizing the cervical spinal cord[7], our decision was guided by the need to ensure accurate needle placement without access to preprocedural MR images. Despite these deviations, our modified approach utilizing a smaller-gauge RF generator with a reduced electrode tip size yielded promising outcomes, with the patient experiencing pain relief and minimal postoperative complications during follow-up assessments.

#### CONCLUSION

Percutaneous cordotomy represents a viable interventional option for patients experiencing intractable cancer-related pain and potentially severe neuropathic pain resulting from nerve destruction or entrapment. Conscious sedation, facilitated by dexmedetomidine and remimazolam, provided effective anesthesia for ensuring proper positioning and maintaining a safe airway throughout the procedure.

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#### ACKNOWLEDGEMENTS

We appreciate the expert comments of the reviewers and editors and the contacts they shared.

#### FOOTNOTES

Author contributions: Lu KY, Lin FH, Lin CS, and Lao HC participated in the clinical treatment of the patient; Lu KY and Lao HC wrote the manuscript; All authors have read and approved the final manuscript.

Informed consent statement: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

Conflict-of-interest statement: The authors have no conflicts of interest to declare.

CARE Checklist (2016) statement: The author has read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

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Country of origin: Taiwan

ORCID number: Kuan-Yu Lu 0009-0008-6129-394X; Hsuan-Chih Lao 0000-0003-0143-3556.

S-Editor: Gao CC L-Editor: Filipodia P-Editor: Cai YX

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