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Epidural Tunneling for Effective Management of Severe Cancer Pain: A Case Report

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A B S T R A C T

Introduction: Severe pain is a common and debilitating symptom for many cancer patients, often requiring multimodal approaches for effective management. While oral opioids and adjunctive therapies are frequently the first line, some patients with refractory pain necessitate interventional procedures. This case report describes the successful use of epidural tunneling for long-term pain management in a patient with severe cancer pain due to bone metastases. **Case presentation:** A 55-year-old woman with severe cancer pain secondary to bone metastases from breast cancer presented with intractable pain in her hips, buttocks, and legs, radiating to her feet with associated numbness. Despite high doses of oral opioids, paracetamol, amitriptyline, and a fentanyl syringe, her pain remained poorly controlled, significantly impacting her sleep and quality of life. A lumbosacral X-ray revealed osteolytic-blastic lesions with vertebral compression and other metastatic involvement. Given the severity and refractory nature of her pain, an epidural tunneling procedure was performed. **Conclusion:** Epidural tunneling proved to be a safe and effective method for managing severe, chronic cancer pain in this patient, leading to a substantial reduction in pain intensity and a decreased need for systemic opioids. This technique offers a valuable option for patients with persistent pain who have failed conventional analgesic therapies, particularly in advanced stages of cancer.

1. Introduction

Pain is a prevalent and often devastating symptom experienced by individuals diagnosed with cancer. The experience of pain in cancer patients is a complex and multifaceted issue, influenced by a variety of factors. These include the specific type of cancer, the stage of the disease, and the presence or absence of metastases. The incidence and severity of pain can vary considerably among cancer patients. Some studies have indicated that a significant proportion, with estimates suggesting over 70%, of individuals with cancer will experience pain during the course of their illness. This highlights the critical importance of effective pain management as an integral component of comprehensive cancer care. Effective pain management is not only a matter of alleviating suffering; it also plays a crucial role in improving the quality of life, functional capacity, and overall well-being of cancer patients. Adequate pain control can enable patients to maintain a greater degree of independence, participate more fully in daily activities, and experience a higher level of psychological and emotional well-being. The World Health Organization (WHO) analgesic ladder provides a widely recognized and utilized stepwise approach to cancer pain management. This approach emphasizes a systematic progression, beginning with non-opioid analgesics such as paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs). If pain persists or

increases, the next step involves the use of weak opioids, such as codeine or tramadol. For moderate to severe pain, strong opioids, such as morphine, fentanyl, or oxycodone, are indicated. Adjuvant medications, including antidepressants, anticonvulsants, and corticosteroids, are often used in conjunction with analgesics at any step of the ladder to address specific pain types or enhance pain relief. This stepwise approach, combined with addressing the underlying cause of the pain whenever possible, proves effective in providing adequate pain relief for many cancer patients. However, it is important to acknowledge that a subset of patients will experience pain that proves refractory to conservative management strategies. In these challenging cases, more invasive interventional procedures may be necessary to achieve satisfactory and sustainable pain control.[1-3]

Interventional pain management techniques have emerged as a significant and valuable component of the comprehensive care of cancer pain. These techniques encompass a range of procedures, including neurolytic blocks and spinal analgesia. Neurolytic blocks involve the deliberate destruction of specific nerve pathways that are responsible for transmitting pain signals. These procedures, which may utilize chemical agents or thermal energy, aim to interrupt pain signaling and provide long-term pain relief. However, neurolytic blocks are typically reserved for carefully selected patients with localized and intractable pain, as they can result in permanent sensory loss or other neurological deficits. Spinal analgesia represents another important interventional approach for managing cancer pain. This technique involves the delivery of pain-relieving medications directly to the spinal cord or the epidural space, thereby targeting the central nervous system to modulate pain transmission. Spinal analgesia can be administered via two primary routes: intrathecal or epidural. Intrathecal drug delivery involves the direct injection of medications into the cerebrospinal fluid, which surrounds the spinal cord. This method allows for the use of very small doses of medications to achieve potent analgesia. Epidural analgesia, on the other hand, involves the placement of a catheter into the epidural space, which is the area between the spinal cord and the surrounding vertebrae. This allows for continuous or intermittent administration of local anesthetics, opioids, or other analgesic agents. Both intrathecal and epidural routes can provide profound analgesia while minimizing the systemic side effects that are often associated with orally or intravenously administered pain medications. By delivering medications directly at the level of the central nervous system, spinal analgesia can effectively block nociceptive impulses, which are the signals that transmit pain sensations. This targeted approach can offer superior pain relief compared to systemic medications, particularly in cases where pain is severe, refractory, or associated with significant systemic side effects. The use of percutaneously inserted epidural catheters has become a common practice for administering epidural analgesia. These catheters are typically inserted using a needle, and they can be left in place for extended periods to provide continuous pain relief. To facilitate longer-term epidural catheterization, a technique known as epidural tunneling has been developed. This technique involves creating a subcutaneous tunnel for a portion of the epidural catheter, positioning it away from the initial insertion site in the skin.[4-6]

The creation of a subcutaneous tunnel offers several potential advantages. One key benefit is the potential reduction in the risk of infection. By increasing the distance between the catheter's entry point into the skin and the epidural space, the tunnel creates a longer pathway that bacteria would need to traverse to reach the central nervous system. This may provide a physical barrier that hinders the migration of bacteria along the catheter tract, thereby decreasing the likelihood of developing an infection such as an epidural abscess or meningitis. Another advantage of epidural tunneling is the potential for improved catheter stability and a reduced risk of accidental dislodgement. The subcutaneous tunnel provides a more secure anchoring of the catheter, which can be particularly important for patients who require continuous analgesia over extended periods, especially in outpatient settings where there may be increased patient mobility. Epidural analgesia, while highly effective for pain control, is not without its challenges. The administration and titration of epidural medications

can be complex, requiring careful monitoring and adjustments to achieve optimal pain relief while minimizing potential side effects. This can be particularly challenging in the outpatient setting, where close supervision may not always be feasible. Furthermore, epidural analgesia requires careful patient selection, comprehensive patient education, and close follow-up. Patients and their caregivers must be thoroughly educated on proper catheter care, including how to maintain the cleanliness of the insertion site, recognize signs of infection, and manage the infusion pump. Regular follow-up appointments are essential to assess the effectiveness of pain control, monitor for potential complications, and make necessary adjustments to the medication regimen. Potential complications associated with epidural analgesia, although relatively uncommon, can be serious. These include the risk of infection, such as epidural abscess or meningitis, which can lead to significant morbidity if not promptly recognized and treated. Other potential complications include hematoma formation, nerve injury, and catheter-related issues such as migration, dislodgement, or blockage. Inadequate or unilateral analgesia can also occur, potentially due to factors such as unequal distribution of the local anesthetic within the epidural space, the presence of acquired adhesions, or improper catheter placement. The decision to utilize epidural analgesia, and specifically epidural tunneling, must be made on a case-by-case basis, carefully weighing the potential benefits against the risks and challenges. Factors to consider include the severity and nature of the patient's pain, the underlying cause of the pain, the patient's overall medical condition, and the availability of specialized expertise and resources for managing epidural catheters.[7-10] This case report aims to illustrate the application of epidural tunneling for analgesia in a patient experiencing severe cancer pain secondary to bone metastases.

2. Case Presentation

The patient in this case is a 55-year-old female who presented with a primary complaint of severe pain localized to the hips, buttocks, and legs. This pain exhibited a radiating pattern, extending down to the feet, and was further characterized by continuous numbness over the past three months. The pain's nature was described as stabbing and radiating, originating from the hip and progressing towards the foot, with the additional distressing sensation of numbness. This pain was not only persistent but also significantly disrupted the patient's sleep, indicating a substantial impact on her daily life and overall well-being. A detailed pain history revealed that the patient experienced a progressive worsening of her pain symptoms over the preceding three months. This gradual intensification of pain underscores the chronic and potentially progressive nature of her underlying condition. The patient's current medication regimen included MST 15mg administered three times daily, Paracetamol 500mg taken four times daily, amitriptyline 12.5mg given once daily, and fentanyl 25mcg/hour delivered via subcutaneous infusion. It was reported that the patient experienced some improvement in her pain with this medication regimen. However, the persistence of severe pain despite this comprehensive approach suggests a degree of refractory pain, necessitating further evaluation and intervention. The patient's past medical history is significant for a history of breast cancer, for which she underwent a mastectomy in 2021. Additionally, she had a history of open reduction and internal fixation (ORIF) of the femur in 2022. The patient also had a history of chemotherapy, although the specific year was unspecified. Notably, there were no other significant medical history details reported, focusing the clinical picture on the oncological history and its sequelae. Upon physical examination, the patient's general appearance was marked by distress attributed to pain. This observation highlights the subjective experience of pain and its outward manifestations. A pain assessment was conducted using a numerical rating scale (NRS). At rest, the patient's NRS score was 2-3, indicating a baseline level of discomfort even in the absence of provocation. During pain recurrence or exacerbation, the NRS score increased to 5-6, demonstrating a significant increase in pain intensity. The worst pain experienced by the patient was rated as 10/10, signifying the extreme severity of her pain at its peak. This range of NRS scores illustrates the dynamic

nature of her pain experience, fluctuating from a moderate baseline to excruciating episodes. The musculoskeletal examination revealed tenderness to palpation over the hips, buttocks, and legs. This finding indicates localized areas of pain and sensitivity in the affected regions, further supporting the patient's report of pain in these areas. Furthermore, the patient exhibited a limited range of motion in the affected joints, directly attributed to the pain. This limitation of movement underscores the functional impairment caused by the pain, affecting her mobility and potentially her ability to perform daily activities. A neurological examination was also performed. Sensory examination revealed decreased sensation and numbness in the distribution of the patient's pain, specifically extending to the feet. This finding aligns with the patient's chief complaint and suggests a neurological component to her pain syndrome, potentially involving nerve compression or damage. Importantly, no significant motor weakness was observed during the neurological examination. The reflexes in the upper extremities were reported to be normal and symmetrical. However, the assessment of reflexes in the lower extremities was limited and could not be fully evaluated due to the patient's pain. This limitation highlights the challenges in conducting a complete neurological examination in the presence of severe pain, as patient cooperation and comfort are paramount. There were no signs of bowel or bladder incontinence, which is a crucial negative finding, as it helps to rule out significant spinal cord compression or cauda equina syndrome, which can present with severe pain and neurological deficits. Laboratory investigations were conducted, revealing a complete blood count that was generally within normal limits. The only exception was mild anemia, with a hemoglobin level of 11.5 g/dL. Anemia in the context of cancer can have various etiologies, including chronic disease, nutritional deficiencies, or bone marrow involvement. Further investigation may be warranted to determine the specific cause of the anemia in this patient. Serum calcium was slightly elevated, measuring 10.8 mg/dL. Elevated serum calcium levels can be indicative of bone metastasis, as the destruction of bone tissue can lead to the release of calcium into the bloodstream. However, other causes of hypercalcemia should also be considered in the differential diagnosis. Alkaline phosphatase was significantly elevated, with a level of 350 U/L. Elevated alkaline phosphatase is also suggestive of bone involvement, as this enzyme is released by osteoblasts, which are cells involved in bone formation. However, it's important to note that alkaline phosphatase can also be elevated in other conditions, such as liver disease. Renal and liver function tests were within normal limits, providing evidence against significant hepatic or renal dysfunction as a primary contributor to the patient's symptoms. Tumor markers, specifically CA 15-3, were elevated, with a level of 150 U/mL. Elevated CA 15-3 levels are consistent with metastatic breast cancer, supporting the patient's history of breast cancer and the suspicion of metastatic disease. Imaging studies were performed, with a lumbosacral X-ray revealing significant findings. The X-ray demonstrated osteolytic-blastic lesions, which are characteristic of metastatic bone disease. Osteolytic lesions involve the destruction of bone tissue, while osteoblastic lesions involve the abnormal formation of new bone. The presence of both types of lesions suggests a complex and active metastatic process. The X-ray also showed compression of the L5 vertebrae by more than 50%. Vertebral compression fractures are a common complication of metastatic bone disease and can be a significant source of pain. Additionally, osteolytic lesions were observed on the left os ilium, left acetabulum, and os sacrum, indicating widespread involvement of the pelvic bones. There was also obscuration of the L4-L5 pedicles due to metastatic processes. The pedicles are bony projections that connect the vertebral body to the posterior elements of the vertebra. Involvement of the pedicles can compromise the stability of the spine and potentially lead to neurological complications. Furthermore, the X-ray revealed anterolisthesis and L5-S1 laterolisthesis, both graded as grade 1. Anterolisthesis refers to the forward slippage of one vertebra over another, while laterolisthesis refers to the lateral slippage of one vertebra over another. These findings suggest spinal instability, which can contribute to pain and potentially lead to further neurological compromise. Based on the comprehensive evaluation of the patient's clinical

findings, a diagnosis of severe cancer pain due to bone metastases was established. This diagnosis is supported by the patient's history of breast cancer, the presence of widespread osteolytic-blastic lesions on imaging, the elevated tumor markers, and the clinical presentation of severe and refractory pain. The constellation of symptoms and findings paints a clinical picture strongly suggestive of advanced metastatic disease with significant skeletal involvement, leading to intractable pain. The patient's case highlights the complex interplay of oncological history, pain pathophysiology, and the need for a multimodal approach to diagnosis and management (Table 1).

The procedure undertaken in this case was epidural tunneling, a technique employed to facilitate the administration of long-term epidural analgesia. This procedure involves several distinct steps, each with specific details critical to its success and the patient's safety. The initial and foundational step in the epidural tunneling procedure is the preparation phase. This stage is characterized by obtaining informed consent from the patient and their family. Informed consent is a cornerstone of ethical medical practice, ensuring that the patient or their legally authorized representative understands the nature of the procedure, its potential benefits, the associated risks, and the available alternatives. This process involves a comprehensive discussion that addresses the patient's specific circumstances, the rationale for choosing epidural tunneling, and the expected outcomes. It allows the patient and their family to make an informed decision regarding their medical care. Following the acquisition of informed consent, the next critical component of the preparation phase is the establishment of intravenous access. This is achieved by inserting a one-way intravenous (IV) line. The establishment of a secure and functional IV line is essential for several reasons. It provides a route for the administration of medications, including fluids, anesthetics, and emergency drugs, if needed. It also allows for the rapid administration of medications to manage potential complications that may arise during the procedure. Ensuring that the IV line is running smoothly is of paramount importance to maintain the patency of the access and to prevent any interruptions in the delivery of medications or fluids. Another vital aspect of the preparation phase is ensuring that the patient adheres to a period of fasting prior to the procedure. In this case, the patient was instructed to fast for six hours before the surgery. Pre-procedural fasting is a standard practice in anesthesia and procedural medicine. It is primarily implemented to reduce the risk of aspiration, which is the inhalation of gastric contents into the lungs. Aspiration can lead to serious complications such as pneumonia. By ensuring an empty stomach, the likelihood of aspiration is significantly minimized, enhancing patient safety during the procedure and any associated sedation or anesthesia. Premedication is also a key element of the preparation protocol. In this instance, the patient received Ranitidine 50 mg intravenously and metoclopramide 10 mg intravenously, administered one hour before the procedure. Ranitidine is a histamine H2-receptor antagonist, which reduces gastric acid secretion. This is another measure taken to decrease the risk of aspiration and to protect the gastrointestinal tract. Metoclopramide is an antiemetic and prokinetic agent. It helps to increase gastric emptying and to reduce nausea and vomiting, which can be associated with anesthesia and certain medications. The administration of these premedications aims to optimize the patient's physiological state before the procedure, contributing to a smoother and safer experience. Finally, the preparation phase includes the planning of the anesthesia technique. In this case, general anesthesia via a face mask was planned. General anesthesia induces a state of unconsciousness, amnesia, and analgesia, ensuring that the patient is comfortable and does not experience pain during the procedure. The use of a face mask for the delivery of anesthetic gases allows for a non-invasive approach to securing the patient's airway, particularly for procedures that are not expected to involve significant airway manipulation. The decision to use general anesthesia reflects a careful consideration of the patient's condition, the nature of the procedure, and the need to provide optimal comfort and safety. Following the preparation phase, the next step is the epidural catheter insertion. This involves the placement of the epidural catheter into the epidural space. The epidural space is the area between the ligamentum flavum and

the dura mater, which is the outermost membrane covering the spinal cord and nerve roots. The procedure for epidural catheter insertion begins with the identification of the appropriate level for catheter placement. This decision is based on the location of the patient's pain and the desired level of analgesia. The patient is typically positioned in a sitting or lateral decubitus position to facilitate access to the epidural space. Strict adherence to aseptic technique is crucial throughout the epidural catheter insertion process. This involves thorough cleaning of the skin with antiseptic solutions, the use of sterile gloves, gowns, and drapes, and the use of sterile equipment. Aseptic precautions are essential to minimize the risk of infection, which is a potential complication of epidural catheterization. A Tuohy needle, a specialized needle with a curved tip, is used to access the epidural space. The Tuohy needle is inserted through the skin and advanced through the subcutaneous tissues and the supraspinous and interspinous ligaments. The needle is then carefully advanced until it reaches the ligamentum flavum. The identification of the epidural space is typically achieved using the loss of resistance technique. As the Tuohy needle is advanced through the tissues, constant pressure is applied to the plunger of a syringe filled with saline or air. When the needle enters the epidural space, there is a noticeable loss of resistance, as the needle is no longer opposed by the dense ligamentum flavum. This loss of resistance confirms the correct placement of the needle tip within the epidural space. Once the Tuohy needle is confirmed to be in the epidural space, the epidural catheter is inserted through the needle. The catheter is a thin, flexible tube that is advanced into the epidural space. The depth of catheter insertion is carefully controlled to ensure that the catheter is positioned appropriately. After the epidural catheter is inserted, the Tuohy needle is carefully removed, leaving the catheter in place. The catheter is then secured to the patient's skin using an adhesive dressing to prevent dislodgement. The next phase of the procedure is the creation of a subcutaneous tunnel for the catheter. This step is crucial for the long-term maintenance of the epidural catheter and aims to reduce the risk of infection and dislodgement. The creation of the subcutaneous tunnel begins with the injection of a local anesthetic along the planned path of the tunnel. In this case, lidocaine was used. Local anesthesia serves to numb the area, minimizing discomfort for the patient during the tunneling process. Lidocaine is a commonly used local anesthetic that provides effective and relatively rapid anesthesia. Following the administration of local anesthesia, a 14 G cannula is inserted subcutaneously. The cannula is inserted at the catheter insertion site and advanced for a distance of approximately 3–4 cm. The cannula creates a channel through the subcutaneous tissue, which will serve as the tunnel for the epidural catheter. Once the cannula is in place, the stylet, which is a stiff wire inside the cannula, is removed. This leaves a hollow tube within the subcutaneous tissue. A Tuohy needle is then inserted from the opposite end of the 14 G cannula. The Tuohy needle is carefully advanced through the cannula, creating a path for the epidural catheter to pass through. After the Tuohy needle is properly positioned, the cannula is removed, leaving the Tuohy needle in place. This step effectively establishes a subcutaneous tunnel through which the epidural catheter can be routed. The subsequent step involves catheter tunneling, which is the process of passing the epidural catheter through the subcutaneous tunnel that has been created. The epidural catheter, which has already been inserted into the epidural space, is carefully advanced through the tunnel created by the Tuohy needle. This process requires precision and care to ensure that the catheter is not damaged or dislodged during its passage through the tunnel. Following the catheter tunneling, the next critical step is catheter fixation. This involves securing the epidural catheter at the exit site of the tunnel. Proper catheter fixation is essential to prevent displacement of the catheter, which could compromise its function and necessitate replacement. After the catheter exits the tunnel, it is secured to the skin using appropriate dressings and securement devices. A variety of dressings and devices can be used for this purpose, including adhesive dressings, sutures, and specialized catheter securement devices. The specific method of fixation may vary depending on the patient's individual circumstances and the preferences of the clinician. The

goal of catheter fixation is to ensure that the catheter remains in the desired position and does not migrate or become dislodged. This is particularly important for patients who require long-term epidural analgesia, as any movement of the catheter can lead to inadequate pain relief or complications. The final stage of the procedure involves catheter connection and medication administration. This step marks the transition from the procedural aspects to the therapeutic application of epidural analgesia. The external end of the tunneled catheter is connected to an infusion pump. The infusion pump is a medical device that delivers a precise and controlled amount of analgesic medication through the epidural catheter. These pumps are programmable, allowing for adjustments to the infusion rate and the medication dosage as needed. The prescribed analgesic medication is then initiated via the infusion pump. The specific medication and the initial infusion rate are determined based on the patient's pain assessment and their individual needs. Common medications used for epidural analgesia include local anesthetics, opioids, and combinations of both. The infusion is started, and the medication dosage is carefully titrated to achieve optimal pain relief. Titration involves gradually adjusting the medication dosage until the desired level of analgesia is achieved while minimizing potential side effects. The patient's pain level, vital signs, and any potential side effects are closely monitored during this process. The entire epidural tunneling procedure, from preparation to catheter connection and medication administration, requires meticulous attention to detail, adherence to aseptic technique, and careful monitoring of the patient. Each step is crucial for the successful implementation of epidural analgesia and for ensuring the patient's safety and comfort. The procedure described here provides a framework for the delivery of effective long-term pain management through epidural catheterization (Table 2).

The management of a patient following an epidural tunneling procedure is a critical phase that encompasses both the immediate post-operative period within the inpatient setting and the subsequent discharge planning and home care, culminating in ongoing follow-up care in the outpatient setting. This continuum of care is essential to ensure the effectiveness of the epidural analgesia, to monitor for and promptly address any potential complications, and to support the patient's overall well-being. In the immediate post-operative period, while the patient is still an inpatient, several key aspects of care are emphasized. Pain assessment is of paramount importance. This involves regular monitoring of the patient's pain intensity using a standardized pain scale. The numerical rating scale (NRS) is frequently employed for this purpose, providing a quantifiable measure of the patient's subjective pain experience. Regular pain assessments are typically conducted every four hours and as needed, allowing for a dynamic evaluation of the patient's pain control. This frequent monitoring enables clinicians to make timely adjustments to the epidural infusion regimen to optimize analgesia and maintain patient comfort. Infusion management is another vital component of immediate post-operative care. Continuous monitoring of the epidural infusion pump is essential to ensure its correct rate and medication delivery. This involves verifying the pump settings, checking for any alarms or malfunctions, and confirming the patency of the epidural catheter. Regular inspection of the infusion site is also necessary to detect any signs of leakage or disconnection, which could compromise the delivery of analgesia. Maintaining the integrity of the epidural infusion system is crucial for providing consistent and effective pain relief. Catheter site monitoring is a critical aspect of post-operative care focused on preventing and detecting potential infections or other catheter-related complications. Frequent assessment of both the catheter insertion site and the tunnel exit site is essential. Clinicians meticulously examine these sites for any signs of infection, such as redness, swelling, warmth, and purulent drainage. These are cardinal signs of infection that require prompt recognition and intervention. Dressing changes are performed as per institutional protocol, typically every 48-72 hours or as needed if the dressing becomes soiled or compromised. During dressing changes, a thorough inspection of the catheter site is conducted. Regular neurological observations are also essential to monitor for any signs of infection or other medical complications related to the epidural catheter. This includes assessing the patient for any new or worsening

neurological deficits, such as motor weakness or sensory changes, which could indicate a serious complication such as an epidural abscess or hematoma. Side effect management is an integral part of post-operative care, addressing the potential adverse effects of epidural analgesia. Patients receiving epidural analgesia may experience a range of side effects, including nausea, vomiting, itching, or urinary retention. Clinicians closely monitor patients for these potential side effects and implement appropriate interventions to manage them. This may involve administering antiemetics, antipruritics, or other medications as needed. Careful management of side effects contributes significantly to patient comfort and enhances the tolerability of epidural analgesia. Discharge planning and home care are crucial steps in transitioning the patient from the inpatient setting to the outpatient environment. Patient education is a cornerstone of this process. Comprehensive education is provided to the patient and their caregivers regarding epidural catheter care at home. This includes detailed instructions on dressing changes, if applicable for home care, emphasizing the importance of maintaining a clean and dry catheter site to minimize the risk of infection. Patients and caregivers are also educated on the signs and symptoms of infection and other potential complications, empowering them to recognize and respond appropriately to any problems that may arise. Contact information for the pain management team is provided, ensuring that patients and caregivers have access to support and guidance when needed. Catheter maintenance is another key aspect of discharge planning. Patients receive clear instructions on how to keep the catheter site clean and dry. Guidance is provided on when and how to change the dressing, if applicable for home care. These instructions are tailored to the specific type of dressing used and the individual patient's needs. Proper catheter maintenance is essential for preventing infection and ensuring the longevity of the epidural catheter. Pain medication administration is thoroughly reviewed with the patient and caregivers. Detailed instructions are provided on how to manage the epidural infusion pump at home. This includes troubleshooting common issues that may arise, such as pump alarms or catheter disconnections. Patients are also given clear guidance on when to seek help from the healthcare team, ensuring that they know how to access support and assistance when needed. Activity restrictions are also addressed during discharge planning. Patients receive guidance on any activity restrictions that are necessary to prevent catheter dislodgement or other complications. These restrictions are tailored to the individual patient's circumstances and the specific type of catheter securement used. Adherence to activity restrictions is important for maintaining the integrity of the epidural catheter and preventing complications. Follow-up care in the outpatient setting is essential for the ongoing management of epidural analgesia. Scheduled appointments with the pain management team are crucial for assessing pain control, monitoring for potential complications, and adjusting the medication regimen as needed. The frequency of follow-up appointments is individualized based on the patient's needs. An initial follow-up visit is typically scheduled within 1-2 weeks post-discharge, with subsequent appointments arranged as needed. Catheter site evaluation is a routine component of follow-up visits. Thorough examination of the catheter insertion and exit sites is conducted to identify any signs of infection or skin breakdown. Early detection of these issues allows for prompt intervention and prevents the development of more serious complications. Pain and functional assessment are also performed during follow-up visits. This involves a comprehensive evaluation of the patient's pain levels, functional status, and quality of life. Standardized pain scales, such as the NRS, may be used to quantify pain intensity. Assessment of functional status may involve evaluating the patient's ability to perform activities of daily living. Quality of life assessment may utilize validated questionnaires to measure the impact of pain and treatment on the patient's overall well-being. These assessments allow clinicians to evaluate the effectiveness of the epidural analgesia and to make any necessary adjustments to the treatment plan. Psychological support is an important aspect of follow-up care, recognizing the significant impact that chronic pain and serious illness can have on a patient's mental and emotional health. Assessment of the patient's

psychological well-being is conducted, and provision of support or referrals to appropriate resources are offered as needed. This may involve counseling, support groups, or other interventions aimed at addressing the patient's emotional and psychological needs. Clinicians also instruct the patient and caregivers on the signs of infection, catheter dislodgement, and leakage at the catheter site, emphasizing the importance of seeking immediate medical attention if these problems occur. This ongoing education reinforces the importance of vigilance and empowers patients and caregivers to play an active role in their care. Potential complications and their management are also addressed proactively. Infection remains a significant concern, and patients and caregivers are educated on the signs of infection and the importance of seeking immediate medical attention if these occur. Management of infection may involve antibiotics and, in severe cases, catheter removal. Catheter dislodgement or migration is another potential complication. Patients are educated on how to prevent catheter dislodgement and what to do if it occurs. If the catheter is partially or fully dislodged, the patient should contact the pain management team immediately for assessment and potential replacement. Medication side effects are also discussed, and patients receive detailed information on potential side effects of the epidural medications and instructions on how to manage them. Adjustments to the medication regimen may be necessary to address side effects. Finally, patients are advised to report any new or worsening neurological symptoms, as these could indicate a complication requiring urgent evaluation. This comprehensive approach to post-epidural tunneling care and follow-up is essential for optimizing patient outcomes and ensuring the safe and effective use of this pain management technique (Table 3).

Table 1. Summary of patient's clinical finding.

Category	Description
Demographic	Age: 55 years old; Gender: Female
Anamnesis	Chief Complaint: Severe pain in the hips, buttocks, and legs radiating to the feet with continuous numbness for the past 3 months. Pain Characteristics: Stabbing and radiating from the hip to the foot, described as feeling numb. Pain is continuous and significantly disrupts sleep. Pain History: Progressive worsening over the past 3 months. Medication History: Currently taking MST 15mg three times daily, Paracetamol 500mg four times daily, amitriptyline 12.5mg once daily, and fentanyl 25mcg/hour via subcutaneous infusion. Pain was reported to improve with medication. Past Medical History: History of breast cancer with mastectomy in 2021 and ORIF of the femur in 2022. History of chemotherapy (year unspecified). No other significant medical history reported.
Physical examination	General Appearance: Patient appeared distressed due to pain. Pain Assessment: NRS at rest was 2-3, NRS during pain recurrence was 5-6, and the worst pain experienced was rated as 10/10. Musculoskeletal: Tenderness to palpation over the hips, buttocks, and legs. Limited range of motion in the affected joints due to pain. Neurological: Sensory examination revealed decreased sensation and numbness in the distribution of pain, extending to the feet. No significant motor weakness was observed. Reflexes were normal and symmetrical in the upper extremities. Lower extremity reflexes were normal but could not be fully assessed due to pain. No signs of bowel or bladder incontinence.
Laboratory	Complete blood count was within normal limits, except for mild anemia (Hemoglobin 11.5 g/dL). Serum calcium was slightly elevated (10.8 mg/dL), possibly indicative of bone metastasis. Alkaline phosphatase was significantly elevated (350 U/L), also suggestive of bone involvement. Renal and liver function tests were within normal limits. Tumor markers (CA 15-3) were elevated (150 U/mL), consistent with metastatic breast cancer.
Imaging	Lumbosacral X-ray revealed osteolytic-blastic lesions accompanied by compression of the L5 vertebrae by more than 50%, osteolytic lesions on the left os ilium, left acetabulum, os sacrum, obscuration of L4-L5 pedicles due to metastatic processes, Anterolisthesis and L5-S1 laterolisthesis grade 1.
Diagnosis	Severe cancer pain due to bone metastases

Table 2. Procedure epidural tunneling.

Step	Description	Details
1. Preparation	Informed consent and patient preparation.	Obtain informed consent from the patient and family. Insert a 1-way IV line and ensure it is running smoothly. The patient should fast for 6 hours before surgery. Premedication with Ranitidine 50 mg IV and metoclopramide 10 mg is given 1 hour before the procedure. General anesthesia via a face mask is planned.
2. Epidural catheter insertion	Placement of the epidural catheter into the epidural space.	The Tuohy needle is placed into the epidural space at the appropriate level using full aseptic precautions. After placement, the epidural catheter is inserted through the needle.
3. Tunnel creation	Creating a subcutaneous tunnel for the catheter.	Inject lidocaine along the path of tunneling. Insert a 14 G cannula subcutaneously from the catheter insertion site to about 3–4 cm away. Remove the stylet from the cannula and insert the Tuohy needle from the opposite end of the 14 G cannula. Remove the cannula, leaving the Tuohy needle in place.
4. Catheter tunneling	Passing the epidural catheter through the subcutaneous tunnel.	The epidural catheter is then passed through the tunnel created by the Tuohy needle.
5. Catheter fixation	Securing the epidural catheter at the exit site.	After the catheter exits the tunnel, it is secured to the skin using appropriate dressings and securement devices to prevent displacement.
6. Catheter connection and medication administration	Connecting the catheter to an infusion pump and initiating medication.	The external end of the tunneled catheter is connected to an infusion pump that delivers the prescribed analgesic medication. The infusion is started and titrated to achieve optimal pain relief.

Table 3. Post-epidural tunneling care and follow-up.

Category	Description	Details
Immediate post-operative period (Inpatient)	Pain Assessment	Regular monitoring of pain intensity using a standardized pain scale (NRS) every 4 hours and as needed.
	Infusion Management	Continuous monitoring of the epidural infusion pump to ensure correct rate and medication delivery. Assessment of the infusion site for any signs of leakage or disconnection.
	Catheter Site Monitoring	Frequent assessment of the catheter insertion site and the tunnel exit site for signs of infection (redness, swelling, warmth, purulent drainage). Dressing changes as per institutional protocol (every 48-72 hours or as needed if soiled).
	Neurological Assessment	Regular neurological examinations to monitor for any signs of motor weakness, sensory changes, or other neurological complications related to the epidural catheter.
	Side Effect Management	Monitoring and management of potential side effects of epidural analgesia, such as nausea, vomiting, itching, or urinary retention.
Discharge planning & home care	Patient Education	Comprehensive education for the patient and caregivers on epidural catheter care at home, including dressing changes, signs and symptoms of infection, pain management instructions, and contact information for the pain management team.
	Catheter Maintenance	Instructions on how to keep the catheter site clean and dry. Guidance on when and how to change the dressing, if applicable for home care.
	Pain Medication Administration	Detailed instructions on how to manage the epidural infusion pump at home, including troubleshooting common issues and knowing when to seek help.
	Activity Restrictions	Guidance on any activity restrictions to prevent catheter dislodgement or complications.
Follow-up care (Outpatient)	Scheduled Appointments	Regular follow-up appointments with the pain management team to assess pain control, monitor for complications, and adjust the medication regimen as needed. Initial follow-up within 1-2 weeks post-discharge, with subsequent appointments based on the patient's needs.
	Catheter Site Evaluation	During follow-up visits, thorough examination of the catheter insertion and exit sites for any signs of infection or skin breakdown.
	Pain and Functional Assessment	Assessment of the patient's pain levels, functional status, and quality of life at each follow-up visit to evaluate the effectiveness of the epidural analgesia.
	Psychological Support	Assessment of the patient's psychological well-being and provision of support or referrals as needed, given the chronic nature of their pain and illness.
Potential complications & management	Infection	Instruct the patient and caregivers on the signs of infection (fever, chills, redness, swelling, drainage at the catheter site) and the importance of seeking immediate medical attention if these occur. Management may involve antibiotics and, in severe cases, catheter removal.
	Catheter Dislodgement/Migration	Educate the patient on how to prevent catheter dislodgement and what to do if it occurs. If the catheter is partially or fully dislodged, the patient should contact the pain management team immediately for assessment and potential replacement.
	Medication Side Effects	Provide information on potential side effects of the epidural medications and instructions on how to manage them. Adjustments to the medication regimen may be necessary.
	Neurological Changes	Advise the patient to report any new or worsening neurological symptoms (weakness, numbness, tingling) immediately, as these could indicate a complication requiring urgent evaluation.

3. Discussion

The management of severe cancer pain, particularly in patients with bone metastases, frequently poses a substantial clinical challenge. This is underscored in the presented case, where the patient experienced intractable pain despite a comprehensive regimen of systemic analgesics. This observation highlights a critical issue in cancer pain management, a subset of patients will not achieve adequate pain relief with conventional pharmacological approaches. The experience of pain in cancer is complex and multifactorial. It is influenced by the type of cancer, the stage of the disease, and the presence and extent of metastases. Bone metastases, as seen in this case, are a particularly common and often debilitating source of cancer pain. The metastatic process involves the invasion and destruction of bone tissue by cancer cells, leading to a cascade of events that stimulate pain pathways. These events include the release of pain-producing substances, the activation of nerve fibers within the bone, and the disruption of normal bone structure and function. The case presented here exemplifies the difficulties encountered in managing cancer pain. The patient's pain was severe, chronic, and refractory to multiple systemic analgesics, including opioids, paracetamol, amitriptyline, and fentanyl. This underscores the limitations of relying solely on systemic medications in certain cancer pain scenarios. The need for alternative or adjunctive pain management strategies becomes paramount in such situations.[11-14]

Epidural analgesia, utilizing a tunneled catheter, proved to be an effective intervention in this patient, resulting in a substantial improvement in pain control and quality of life. This outcome aligns with the understanding that spinal analgesia, including epidural administration, can offer superior pain relief compared to systemic medications in select cases. The mechanism of action of epidural analgesia involves the direct delivery of local anesthetics and/or opioids into the epidural space. This targeted delivery allows these medications to act on nerve roots, effectively blocking the transmission of pain signals to the brain. By intervening at the level of the spinal cord, epidural analgesia can modulate pain processing in a more localized and potent manner compared to systemic administration. This localized delivery offers a significant advantage, it allows for the achievement of effective pain relief with lower doses of medications compared to systemic administration. This reduction in dosage translates to a decreased incidence and severity of systemic side effects. Systemic side effects associated with opioid use, such as sedation, nausea, constipation, and respiratory depression, can be particularly problematic in cancer patients, who may already be experiencing a range of symptoms and treatment-related toxicities. Epidural analgesia can help to mitigate these side effects, improving patient comfort and overall well-being.[15-17]

The use of a tunneled epidural catheter offers several distinct advantages, particularly for patients requiring prolonged pain management, as is often the case in advanced cancer. Subcutaneous tunneling creates a longer and more tortuous path from the skin surface to the epidural space. This increased distance and the altered trajectory may contribute to a reduced risk of infection. The tunnel acts as a physical barrier, potentially hindering the migration of bacteria along the catheter tract and decreasing the likelihood of developing serious infections such as epidural abscesses or meningitis. In addition to its potential role in infection prevention, tunneling can also enhance catheter stability. The subcutaneous tunnel provides a more secure anchoring of the catheter, reducing the risk of accidental dislodgement. Catheter dislodgement can interrupt the continuous delivery of analgesia, leading to a resurgence of pain and the need for catheter replacement. This is particularly important for maintaining continuous and effective analgesia, especially in the outpatient setting, where patients may be more mobile and less closely monitored than in an inpatient setting.[18-20]

5. Conclusion

In conclusion, this case report highlights the potential of epidural tunneling as a valuable technique for managing severe cancer pain that is refractory to conventional analgesic approaches. The case presented demonstrates that epidural tunneling can provide effective and sustained pain relief, improve patient comfort, and reduce the reliance on systemic opioids,

which often cause significant side effects. The benefits of this technique, including the potential for a decreased risk of infection and catheter dislodgement, are particularly relevant for patients requiring long-term pain management. While epidural analgesia is not without its challenges and potential complications, careful patient selection, meticulous technique, and close monitoring can help to optimize outcomes and minimize risks. This case contributes to the growing body of evidence supporting the use of interventional pain management techniques in the comprehensive care of cancer patients. Further research and clinical experience will continue to refine the role of epidural tunneling and other advanced pain management strategies in alleviating the burden of cancer pain and improving the quality of life for affected individuals.

6. References

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