Abstract: Pain in patients with cancer can be refractory to pharmacological treatment or intolerable side effects of pharmacological treatment may seriously disturb patients’ quality of life. Specific interventional pain management techniques can be an effective alternative for those patients. The appropriate application of these interventional techniques provides better pain control, allows the reduction of analgesics and hence improves quality of life. Until recently, the majority of these techniques are considered to be a fourth consecutive step following the World Health Organization’s pain treatment ladder. However, in cancer patients, earlier application of interventional pain management techniques can be recommended even before considering the use of strong opioids.

Epidural and intrathecal medication administration allow the reduction of the daily oral or transdermal opioid dose, while maintaining or even improving the pain relief and reducing the side effects. Cervical cordotomy may be considered for patients suffering with unilateral pain at the level below the dermatome C5. This technique should only be applied in patients with a life expectancy of less than 1 year.

Plexus coeliacus block or nervus splanchnicus block are recommended for the management of upper abdominal pain due to cancer. Pelvic pain due to cancer can be
managed with plexus hypogastricus block and the saddle or lower end block may be a last resort for patients suffering with perineal pain. Back pain due to vertebral compression fractures with or without pathological tumor invasion may be managed with percutaneous vertebroplasty or kyphoplasty. All these interventional techniques should be a part of multidisciplinary patient program.

**Key Words:** evidence-based medicine, cancer, epidural, intrathecal, cordotomy, plexus coeliacus block, nervus splanchnicus block, plexus hypogastricus block, saddle block, lower end block, vertebroplasty, kyphoplasty

**INTRODUCTION**

This review on interventional treatment of pain in patients with cancer is part of the series “Evidence-based Interventional Pain Medicine according to Clinical Diagnoses”. Recommendations formulated in this chapter are based on “Grading strength of recommendations and quality of evidence in clinical guidelines” described by Guyatt et al.,¹ and adapted by van Kleef et al. in the editorial accompanying the first article of this series² (Table 1). The latest literature update was performed in October 2010.

The treatment of pain in patients with cancer is a delicate balance, affected by a range of interfering factors, such as the patient’s general condition, the co-medication, and the nature of the pain, which is usually a mixture of nociceptive and neuropathic pain. Interventional pain management techniques have a specific role in the treatment of pain in patients with cancer.³ Until recently, mainly because of potential complications and special requirements of aftercare and the need for specific devices, these techniques have been mostly used as a last resort among the arsenal of pain treatment options in patients with cancer. Several recent publications, however, as well as the new guidelines on the management of pain in patients with cancer of the Dutch association of anesthesiologists (NVA), the society of Dutch comprehensive cancer centers VIKC and the Dutch Institute for Health Care Improvement (CBO), have recommended the use of certain interventional techniques at earlier stages, possibly even at the stage, where opioid treatment is first being considered.⁴ Reserving the use of these techniques until the last few days of life is certainly not a good idea. All interventional pain management techniques impose a certain burden on the patient, which must be taken into account when considering these treatment options. In addition, correct performance of these techniques requires one or more days of hospitalization. This information must be communicated to the patient to allow for an informed decision-making process.

### Table 1. Summary of Evidence Scores and Implications for Recommendation

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A+</td>
<td>Effectiveness demonstrated in various RCTs of good quality. The benefits clearly outweigh risk and burdens</td>
<td>Positive recommendation</td>
</tr>
<tr>
<td>1B+</td>
<td>One RCT or more RCTs with methodological weaknesses, demonstrate effectiveness. The benefits clearly outweigh risk and burdens</td>
<td></td>
</tr>
<tr>
<td>2B+</td>
<td>One or more RCTs with methodological weaknesses, demonstrate effectiveness. Benefits closely balanced with risk and burdens</td>
<td></td>
</tr>
<tr>
<td>2B±</td>
<td>Multiple RCTs, with methodological weaknesses, yield contradictory results better or worse than the control treatment. Benefits closely balanced with risk and burdens, or uncertainty in the estimates of benefits, risk and burdens</td>
<td>Considered, preferably study-related</td>
</tr>
<tr>
<td>2C+</td>
<td>Effectiveness only demonstrated in observational studies. Given that there is no conclusive evidence of the effect, benefits closely balanced with risk and burdens</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>There is no literature or there are case reports available, but these are insufficient to prove effectiveness and/or safety. These treatments should only be applied in relation to studies</td>
<td>Only study-related</td>
</tr>
<tr>
<td>2C–</td>
<td>Observational studies indicate no or too short-lived effectiveness. Given that there is no positive clinical effect, risk and burdens outweigh the benefit</td>
<td></td>
</tr>
<tr>
<td>2B–</td>
<td>One or more RCTs with methodological weaknesses, or large observational studies that do not indicate any superiority to the control treatment. Given that there is no positive clinical effect, risk and burdens outweigh the benefit</td>
<td></td>
</tr>
<tr>
<td>2A–</td>
<td>RCT of a good quality which does not exhibit any clinical effect. Given that there is no positive clinical effect, risk and burdens outweigh the benefit</td>
<td>Negative recommendation</td>
</tr>
</tbody>
</table>
The interventional pain management techniques can be classified into two main categories:

1. Intrathecal/epidural administration of medication, used to treat pain refractory to oral and transdermal pharmacologic therapy.
2. Specific targeted nerve blocks; in this article the following techniques will be discussed: cervical cordotomy, plexus coeliacus block, nervus splanchnicus block, plexus hypogastricus block, and lower end (saddle) block.

Another treatment modality that is becoming more popular is spinal cord and peripheral nerve stimulation, which, however, has not (or at least not yet) played an important role in oncologic pain management.

A. EPIDURAL AND INTRATHECAL ADMINISTRATION OF ANALGESICS

Epidural and intrathecal administration of analgesics directly targets the receptors or pain transmission pathways in the spinal cord. The use of these techniques is mainly proposed in situations, where oral or transdermal analgesics have insufficient effect or produce unacceptable side effects. Central administration of the analgesics is then expected to increase the analgesic effect and reduce the risk of side effects. In addition, this administration route allows simultaneous administration of other analgesics, such as bupivacaine and clonidine. The analgesic is administered via a catheter into the cerebrospinal fluid (intrathecal or spinal) or outside the dura mater (epidural).

The use of epidural and intrathecal drug administration has not increased, despite considerable progress in our understanding of the safety, effectiveness, and side effects of epidural and intrathecal opioid administration techniques, and further optimization of the logistics that allow its use in the home situation. This may be attributed to the fact that various new opioids have become available, and average individual dosages have increased, allowing the switch to epidural and intrathecal opioids to be postponed. The increasing use of subcutaneous opioids at patients’ homes has also reduced the use of intrathecal and epidural administration. There is still an indication for intrathecal and epidural analgesics, however, provided that optimal use has been made of all options for oral and transdermal opioids.\(^4\)

A.I DIAGNOSIS

A. I.A History

There are two major reasons to switch to epidural or intrathecal analgesia, when the pain cannot be sufficiently relieved despite suitable dosages of opioids, where indicated co-analgesics, and when side effects prove intolerable despite aggressive treatment.

A. I.B Physical Examination

Physical examination of patients who are suffering pain that is refractory to oral or transdermal analgesics and for whom intrathecal or epidural analgesia is being considered should focus on:

1. Inspecting the painful area, concentrating on local problems of infection, skin abnormalities or open wounds, as well as on possible causes of the pain, such as a tumor compressing a nerve tract. It is important to estimate the consequences of the presence of such a tumor.
2. Detailed neurologic examination and tests of skin sensitivity by means of pinprick, ice cube or cold roller and ether test, to allow the difference in response to be evaluated after the catheter has been placed and local analgesics and opioids have been delivered.
3. Inspection of the entire spinal column, focusing on the sites, where the catheter is to be inserted and tunneled.
4. Clinical examination of mobility and motor function of the patient’s lower limbs, which might be affected by the use of the spinal or epidural catheter.

A.I.C Indications for the Use of an Epidural or Intrathecal Catheter

1. Pain resistant to very high dosages of oral, transdermal, or systemic opioids.
2. Pain that is responsive to systemic opioids but accompanied by intolerable side effects like nausea, vomiting, constipation, or allergic reactions.
3. Pain that cannot be treated with other modalities such as neurolytic blocks, cordotomy, or...
other neuroablative of neuromodulatory techniques.

4. Refractory pain of oncologic origin occurring in a localized and well-defined area.

A.I.D Contraindications for the Use of an Epidural or Intrathecal Catheter

1. Elevated intracranial pressure.
2. Generalized or localized infections at the spinal level corresponding to the painful area.
3. Suspected tumor mass at the level of the insertion site.
4. Hemorrhagic diatheses.
5. Allergic reaction to the epidural or intrathecal agents to be used.
6. Agitation or cognitive disorders that may induce the patient to unexpectedly pull out the catheter, which are not expected to subside after the administration of locoregional analgesics.
7. Expected problems in nursing the exit or insertion site of the catheter or exchanging the medication supply.

A. II.A Epidural and Spinal Drug Delivery

In a 2005 Cochrane review, Ballantyne was only able to include 1 RCT comparing intrathecal morphine delivery and conventional (oral and transdermal) administration of opioids in patients with pain due to cancer. The clinical success rates were 85% and 71%, respectively. The group receiving intrathecal morphine reported less pain and fewer side effects, and survived longer. The other studies included in the review were cohort studies of patients exclusively treated with epidural or intrathecal opioids. The effectiveness of epidural opioids has been reported on in 31 uncontrolled studies involving a total of 1343 patients. Intrathecal opioid delivery was studied in 28 cohort studies involving a total of 722 patients, the most frequently used opioid being morphine. Good to excellent analgesic effect was achieved in 87% and 89% of the intrathecal and epidural groups, respectively.

Addition of a local anesthetic has been most extensively studied using bupivacaine. One RCT and several cohort studies found that the addition of bupivacaine is effective for those patients who fail to achieve sufficient pain relief with intrathecal and epidural morphine.

A prospective observational study on the effect of intrathecal morphine and levobupivacaine, included 55 cancer patients who were highly opioid tolerant. Complete data with adequate follow-up until death were available for 45 patients. The initial morphine dose was calculated from the previous opioid consumption. During treatment the doses of morphine and levobupivacaine were adjusted according to the clinical needs and balanced with adverse effects. Statistical significant differences in pain intensity were noted at all time intervals until death. Significant improvement in drowsiness and confusion was found until 1 month after starting intrathecal therapy. The daily morphine dose was threefold increased at the time of hospital discharge. Subsequent dose increases were not significant. The use of systemic opioids decreased significantly until death.

Administration of clonidine has been investigated in one RCT and several cohort studies. Clonidine proved more effective than placebo (56% and 5%, respectively) especially for patients with neuropathic pain.

For an audit in a tertiary centre medical records of 29 patients who received intrathecal drug administration were reviewed. Eighty-six percent of those patients had metastatic cancer. The main reason for intrathecal drug administration was poor pain control. The pain intensity decreased significantly at the time of hospital discharge. The number of opioid side effects decreased.

Epidural and intrathecal medication. The most frequently used types of medication for epidural or intrathecal delivery are morphine, hydromorphone, fentanyl, bupivacaine, ropivacaine, and clonidine. These drugs are often combined; a commonly used mixture consists of morphine 1 mg/mL and bupivacaine 2 to 3 mg/mL. Intrathecal delivery starts at a continuous rate of 0.5 to 2 mL/hour, with a bolus option of 0.1 to 0.3 mL per 20 minutes. If the infusion rate is below 0.5 mL/hour, the concentration of the morphine and bupivacaine solution must be adjusted. When using morphine, it is important to remember that this compound is metabolized to morphine-6 glucuronide, and morphine-3 glucuronide. There is a limit to the amount of latter that can be processed in a long-term spinal administration (maximum 16 mg intrathecal morphine per day), and excess administration may cause opioid-induced hyperalgesia.

Higher doses of local anesthetics may induce motor weakness and sensory deficiencies. In addition, urinary retention may occur, as well as transient arterial hypotension. There are no literature reports on toxic effects
on the nervous system in case of long-term administration of local anesthetics on nerve tracts. Intrathecal clonidine can be added to the opioids and/or local anesthetics if required, at doses of 150 to 600 μg/day.

Ziconotide, the synthetic analog of the omega-conotoxin, has been used in both chronic nonmalignant pain and pain due to cancer. A randomized controlled trial found intrathecal ziconotide to be effective in relieving pain in patients with cancer or AIDS over a short follow-up period. In the recently published Italian registry, ziconotide was used for the management of chronic pain, in general. In those patients with cancer, a significant improvement in pain intensity was achieved faster than in noncancer patients.

In U.S., in refractory cases the use of intrathecal ziconotide starting at low dose 1 to 2 μg/day with a slow titration up to 8 to 10 μg/daily or higher seemed successful in several cases. However, the side effects are the major limitation of this drug.

A. II.B Additional Considerations

The choice between implantable drug delivery systems and external pumps depends mainly on the patient’s life expectancy. When the patient’s condition and life expectancy justifies the use of an implantable pump, because of the complexity and dynamic state of cancer pain preference should be given to a programmable pump that allows patient controlled bolus administration. A cost-effectiveness analysis has shown that implantable systems are to be preferred over external pumps if the patient has a life expectancy of at least 3 months.

Epidural delivery will be preferred if the treatment goal is focal analgesia and a short treatment period is expected. The catheter tip is then inserted at the level of vertebra corresponding to the dermatome, where analgesia is required. Intrathecal delivery will be preferred if the painful area to be treated is large, if a disorder of the epidural space precludes the insertion of a catheter, or if the patient has a life expectancy of more than a few weeks.

A. II.C Side Effects and Complications

Side effects like nausea, urinary retention, pruritus, and headaches are common in the start-up phase of intrathecal treatment. A study found that infections occurred in 1% (epidural), or 2% (intrathecal) of cases. In the epidural group, 16% of the patients had to have their catheter exchanged or removed because of catheter-related complications (such as fibrosis). The corresponding figure in the intrathecal group was 5%. Other catheter-related complications, like infections and mechanical obstruction, have been reported with varying incidence rates (1% to 44%).

A recent study into safety and complications found a relation between the occurrence of an inflammatory mass around an intrathecal catheter and the concentrations and dosages of morphine used. Previously, a relation had been found between high dosages of intrathecal morphine and the occurrence of myoclonias and hyperpathia. Long-term intrathecal morphine administration also results in hormonal changes: hypogonadotropic hypogonadism, and hypocorticism.

A systematic review and meta-analysis investigated the infection rates associated with epidural catheters in place for at least 7 days. Of the 12 studies, 9 were published after 1990. Eight were retrospective (3893 patients) and 4 studies were prospective (735 patients). There were 6.1% catheter-related infections, 4.6% superficial and 1.2% deep infections. The incidence of catheter-related infections was calculated to be 0.4/1000 catheter days.

Another systematic review and meta-analyses on the serious complications with external intrathecal catheters identified 10 articles, including a total of 821 patients. Twenty catheter-related infections; 10 superficial and 10 deep infections were noted. The risk for bleeding was calculated to be 0.9% and for neurologic injury 0.4%. The authors concluded that the risks for serious complications are low in both hospitalized and homebound patients with intrathecal catheters. Aprili, et al. in their meta-analysis on the related topic specifically looking at tunnelled intrathecal catheters, found a rate of superficial infection of 2.3%, with deep infection rate of 1.4%, bleeding at 0.9%, and neurologic injury 0.4%. They further calculated that every 71st patient would get an infection after 54 days of therapy through statistical means.

A. II.D Other Therapeutic Options

Spinal drug delivery is usually considered as a final option when all other treatment modalities produce insufficient results. If spinal drug delivery is contraindicated or impossible for a particular patient, treatment may include of a combination of therapeutic modalities involving subcutaneous or intravenous administration of analgesics. If a patient in the terminal stages is suffering from a refractory pain syndrome, palliative
sedation can be considered, in consultation with the patient and their caregivers.

A. II.E Evidence for Epidural and Intrathecal Medication Delivery for Cancer Pain Relief

The evidence for epidural and intrathecal medication delivery for cancer pain is listed in Table 2.

A. III. RECOMMENDATIONS

Use of intrathecal medication delivery is recommended for patients with refractory pain due to cancer especially when they have a significant neuropathic pain component. To this end, morphine should preferably be combined with a local anesthetic. Epidural delivery may be considered for short treatments or for a quick assessment of the required dosage; in all other circumstances, intrathecal delivery is to be preferred.

In some locations of the U.S., home catheter care is virtually unavailable, and an implanted pump can be used with a 40 mL reservoir, and maximal medication concentration fill prior to sending a patient to a home hospice situation with a remote geographical location. Often, this reservoir will outlast the patient’s life expectancy with fair certainty. Also, in many practices, the patient therapy manager device (PTM) with the Medtronic brand implanted pump will allow the patient to deliver “as needed” boluses, simplifying the home care programming needs significantly.

A. III.A Technique

Preparing the patient.

1. Discuss the method and the consequences of placing an epidural or intrathecal catheter with the patient and their family or caregivers.

2. Ensure that a suitable treatment facility is available, equipped with all the materials required for normal anesthesia, resuscitation, and sterile procedures. If the patient is to be given anesthesia, he will need to be fasted. Note that with some tumors of the gastrointestinal tract, the patient can never be regarded as fasted.

3. Ensure the availability of a radiographic image intensifier to check the specific position of the catheter or to inspect the cause of unexpectedly difficult insertion, especially when inserting an epidural or intrathecal catheter near the tumor or extensive metastases.

4. Evaluate the patient’s physical condition to determine the most suitable position for the treatment: cervical and thoracic catheters are best inserted with the patient sitting upright, unless the physical condition does not allow this or extensive sedation or anesthesia is required. Lumbar catheters are preferably inserted with the patient in lateral recumbent position, unless the patient is unable to lie down due to, eg, extreme dyspnea.

Preparation for the intervention. The insertion site for the needle should be 10 to 15 cm from the intended catheter tip position. In the case of epidural analgesia, the following levels should be chosen for the following types of pain:

1. Lumbar insertion (Th12 to L5) for sub-diaphragmatic pains and pains in the pelvis and lower limbs.

2. Low thoracic approach (Th8 to Th12) for patients with lymphedema of the lower half of the body, previous lower back surgery, a tumor in the lumbar spine, presence of pyelostomy catheters or high upper abdominal tumors.

3. Mid-thoracic approach (Th4 to Th8) for patients with thoracic pain due to tumors of the thorax (rib metastases, oncologic rib fractures, mesotheliomas, or pulmonary tumors).

4. High thoracic approach (Th1 to Th4) for patients with a pancoast tumor, severe neuropathic pain from mammary tumors or brachial plexopathy (due to tumor infiltration or radiotherapy) and refractory angina pectoris.

5. A spinal (intrathecal) catheter should always be inserted at the lumbar level, below the level of the presumed lower end of the Conus medullaris (L1 to L2).

Inserting the needle and introducing the catheter.

1. Apply local anesthesia to the skin and underlying subcutaneous tissues at the insertion site of the epidural or spinal needle and along the
tunneling pathway. If required, the patient may also be sedated using propofol, ketamine, or other agents.

2. Place a 17G Tuohy needle preferably on the midline, as a paramedian approach is associated with a greater risk of accidental puncture of epidural blood vessels, paresthesias or radicular pain. Use the “loss of resistance” technique with a specially adapted syringe to detect the epidural space.

3. For epidural pain control, the epidural catheter can now be introduced, ensuring that the catheter tip ends up at the intended level for effective pain relief.

4. For spinal (intrathecal) pain control, the Tuohy needle is placed transversely and inserted until CSF reflux is obtained. Although the “dural click” can be felt in some cases, this is frequently not the case, and the surgeon should check regularly whether CSF is flowing from the needle. As patients who have only been given local anesthesia are usually able to well indicate when the spinal space has been accessed, their reactions should be observed. When CSF flows from the needle (positive glucose test can confirm if necessary) the catheter is advanced through the spinal space to the required level, guided by the patient’s reactions. Avoid excessive CSF leakage. Initial insertion of the catheter through the spinal space may be somewhat difficult. If necessary, check the position of the spinal catheter radio graphically with a contrast medium.

5. Check whether CSF is flowing from the catheter, preferably by allowing the catheter to hang downward and letting any fluid drain out by gravity.

6. Withdraw the Tuohy needle by 1 to 2 cm, but do not remove it until an incision has been made and the first tunneling device has been introduced (see below).

7. Delivering a bolus of morphine and/or a local anesthetic after the catheter has been inserted may result in rapid pain relief.

8. Tunnel the epidural/intrathecal catheter.

9. Make a 4 to 6 mm incision down to the fascia around the Tuohy needle, to free the needle from the surrounding skin.

10. If tunneling cannot be completed in one movement, make incisions along the intended course of the tunneled catheter, except at the exit site (to prevent any CSF leakage along the catheter).

11. If patients prefer to have a full immersion bath, apply paravertebral tunneling across the shoulder to the ipsilateral parasternal area.

12. If the paravertebral route is contraindicated, for instance due to paravertebral metastases, extensive tumor growth or skin damage due to radiotherapy along the intended course of the catheter, abdominal tunneling in a ventral direction may be used.

13. Ensure that the catheter is not accidentally retracted during the tunneling procedure; if in doubt, check by means of radiography.

14. Use a second Tuohy needle or a special tunneling needle to guide the catheter subcutaneously. The tunneling device should always be inserted from peripheral to central.

15. With each manipulation of the catheter, check whether CSF is still spontaneously flowing by gravity from the end of the catheter when held below the level of insertion.

16. Finally, connect the catheter to the special connector and fasten the connector onto the skin to prevent the catheter being dislocated and accidentally withdrawn from the spinal space.

17. The catheter may also be connected to a permanent access port system, which is fastened subcutaneously over a hard substrate. This requires a pocket to be made on the fascia of the thoracic wall.

18. Check whether the catheter is sufficiently embedded in the subcutaneous adipose tissue at all incision sites, to avoid fistula formation.

19. Cover all incision sites with aseptic bandaging, while covering the catheter exit site with separate bandaging for easy nursing access. Connect a micropore bacterial filter and connect this to a medication pump from which all air has been removed. Ensure that the catheter is free of air from the point, where it leaves the pump to the micropore filter.

20. Try to avoid traction on the catheter by providing extra loops on the skin or in the tunneling channel, as this reduces the risk of dislocation.

21. After the incisions have healed and a semipermeable bandage has been applied to the catheter exit site, the patient will be able to take a shower or use a hip bath.

22. If a subcutaneous Port-a-cath is used, the needle insertion should always be checked.
**Instructions.** Instructions must be provided:

1. To the patient about the correct way to use the pump (possible bolus option).
2. To the patient’s family about the care required by the patient and any special concerns.
3. To the nursing staff about programming, exchanging batteries and medication cassettes, pain assessment, and advice for correct usage (Instructions should preferably be given in writing or by referring to printed guidelines for this treatment available at the clinic).
4. To the patient’s family doctor and other medical staff involved, about preferred dosage, possible side effects, aspects to be observed and possible adjustments.

**Observation.** After an epidural or spinal catheter has been installed, the patient should be observed at the postoperative care department for a few hours, after which they should stay on a hospital ward for further observation for at least two to three days, which time can be used:

1. To teach the patient how to use the pump correctly.
2. To find the correct dosage for optimum pain relief.
3. To identify and treat possible side effects.
4. To dress the wounds correctly.

For permanent implantable pumps specific surgical techniques are used.

**B. UNILATERAL PAIN WITH LIMITED LIFE EXPECTANCY**

**INTRODUCTION**

Unilateral oncologic pains situated below the shoulder or dermatome C5, such as may occur with pancoast, pleural mesothelioma or invasion of the brachial, or lumbar plexus, may be eligible for treatment with cordotomy, if they prove refractory to other techniques.

Cordotomy involves creating a lesion of the spinothalamic tract at the C1 to C2 level of the spinal cord with the aim of relieving unilaterally localized pain below the level of dermatome C5. The technique was first described by Mullan in 1963. Although the treatment was originally applied for nononcologic pain, because of the potential side effects, it is now mainly reserved for the management of patients with refractory pain due to cancer whose maximum life expectancy is 1 year.

**B. I DIAGNOSIS**

**B. I.A History**

Unilateral refractory pains due to cancer located under the dermatome C5 are eligible for treatment with cordotomy. Best results are obtained for the treatment of neuropathic pain and incident pain, occurring by some form of strain. Visceral pain, especially abdominal pain, is not an indication for cordotomy. It is also important to assess whether pain elsewhere in the body is well-controlled. The patient must be informed that successful cordotomy may unmask other pain.

**B. I.B Physical Examination**

Clinical neurologic examination results obtained before and after treatment should be compared to identify any neurologic deficits. This includes pain perception and/or temperature perception on both sides, as well as motor function.

**B. I.C Additional Tests**

The referring doctor must have completed the technical examination that is required to accurately identify the causes of the pain, to provide a detailed picture of the situation before any interventional pain management techniques are applied.

**B. I.D Differential Diagnosis**

All causes of unilateral pain of nononcologic, neurologic, osteogenic, or myofascial origin must be excluded.

**B. II TREATMENT OPTIONS**

**B. II.A Cordotomy**

The effects of cordotomy on patients have been described in one nonrandomized study and a number of observational studies. A study comparing cordotomy with subarachnoid phenol found that both techniques yielded similar pain control at lower opioid dosages. Seven of the 10 cordotomy patients developed pain on the contralateral side of the body, whereas 4 of the 10 patients developed complications, which resulted in functional deterioration. Since 1990,
6 case series have been described in which a total of 677 patients with cancer were treated with unilateral cordotomy.22–27 The authors reported considerable or even complete pain reduction in 82% to 98% of the patients, whereas opioid consumption was reduced by 50%. The best results were obtained in the treatment of unilateral pain.

A number of patients (31% to 88%) experienced recurrence of the pain, which can usually be effectively treated with opioids. Two studies described 3 patients who survived for considerably longer than 2 years.23,27 These patients did not develop neuropathic pain as a result of the procedure. However, this number is too small to allow conclusions about the long-term safety of cordotomy. A recent report describes a patient who survived 5 years after right-sided cervical cordotomy. Sensory dysfunction was observed in the left side of the body, but no motor neuron or autonomic dysfunction was observed. There was limited influence on the patient’s daily activities.28

Cordotomy is only used for cancer patients suffering severe pain, which is refractory to pharmacologic treatment. The Dutch CBO guidelines for the treatment of pain from cancer recommend that these therapeutic options should only be considered for patients with a limited life expectancy (1 year).4

The immediate results of the treatment are evaluated by applying the pinprick test to the patient’s thorax. We recommend regular evaluation of the pain (at least weekly). In view of the complexity of the pain syndrome and the risk of other (masked) pains becoming manifest, we recommend that the pharmacologic treatment be adjusted on the basis of the patient’s complaints.

There have been contradictory reports about the value of bilateral cordotomy to relieve pain due to cancer. Amano et al.22 found that 95% of the 60 patients who had a bilateral cordotomy reported (virtually) complete pain reduction, vs. 82% of the patients who had a unilateral cordotomy. In this study, however, both groups were suffering from bilateral pain. In contrast, Sanders et al.25 found no advantage of bilateral cordotomy, whereas the risk of complications appeared greater.

Computer tomography-guided radiofrequency (RF) treatment was also described for ablation of the upper spinal cord pain pathways. Of a series of 55 patients, 42 underwent a unilateral cervical cordotomy. Patients reported initial and 6 months pain relief of 98% and 80%, respectively.29

Another series of 207 patients treated with CT-guided cordotomy over 20 years reports an initial success rate of 92.5%. The success rate was higher in patients suffering with pain due to malignancies. In this group, cordotomy was achieved in 83%. Bilateral cordotomy was successfully applied in 12 cases.30

B. II.B Side Effects and Complications

The localization of the tractus spinothalamicus lateralis and the size of the thermolesion relative to the spinal cord, explains the risk of damage to adjoining nerve tracts. Reported complications include pareses (up to 10%), bladder dysfunction (up to 15%), and respiratory depression (up to 10%),31 as well as head and neck pain and dysesthesias. These side effects proved to be permanent in a number of cases.25 In addition, there is a risk of other, previously masked pains becoming manifest, or of developing “mirror pain,” that is, pain on the contralateral side. The incidence of such pain syndromes is between 9% and 63%.31 Interestingly, none of the studies reported neuropathic pain due to the treatment. The risk of major complications is larger with bilateral cordotomy.25

B. II.C Other Treatment Options

If patients are not eligible for cordotomy, epidural or intrathecal analgesics may be considered. Surgical neuroablation techniques have been abandoned because they were insufficiently selective.

B. II.D Evidence for Cordotomy

The evidence for cervical cordotomy is given in Table 3.

B.III RECOMMENDATIONS FOR CORDOTOMY

Cordotomy may be considered for patients with unilaterally localized refractory oncologic pain below the level of dermatome C5, with a maximum life expectancy of 1 year, who obtain insufficient relief from conventional treatment. Cordotomy should only be carried out at centers, where staffs have extensive experience with this treatment.

<table>
<thead>
<tr>
<th>Technique</th>
<th>Evaluation</th>
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<tr>
<td>Cervical cordotomy</td>
<td>2 C +</td>
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Table 3. Summary of the Evidence for Cordotomy
B. III.B Technique for Fluoroscopy Guided Cordotomy

Cordotomy is applied at cervical level, between C1 and C2, where the fibers of the tractus spinothalamicus lateralis run close together in the anterolateral quadrant. The fibers are somatotopic, with the most cervical fibers in the most anterior position and the most sacral fibers in most posterior position. The treatment is applied on the contralateral side of the pain (Figure 1).

All aspects of the procedure should be thoroughly discussed with the patient beforehand, including the fixation of the head, the unpleasant effects that may be caused by stimulating the spinal cord and the potentially lengthy duration of the procedure. During the intervention, a nurse should always be at hand to reassure the patient if necessary. The patient will need to cooperate to check the correct placement of the electrode in the spinal cord.

The radiofrequency treatment is performed using a thermocouple cordotomy electrode (eg, Levin) with a 2 mm noninsulated tip. The patient is placed in supine position and the head firmly fixed.

The arch of C1 is projected as a line in lateral fluoroscopy. The angles of the jaw and the meatus acusticus externus must also be projected over it as a reference. This ensures the best visibility of the space between C1 and C2, which is projected as an arrow shape with its tip pointing ventrally.

Treatment is carried out under sedation, while monitoring ECG and blood pressure. It starts with a 20G spinal needle being inserted into the subarachnoid space between the first and second cervical vertebrae. The direction should be as ventral as possible. Its position should be checked by means of lateral fluoroscopy. As soon as the CSF is reached, a mini-myelogram is made, using emulsified contrast medium (lipiodol with NaCl 0.9% 2:6, or with CSF 1:1 after very thorough shaking) to visualize “3 lines”: the ventral side of the spinal cord, the ligamentum denticulatum and the posterior surface of the dural sac (Figure 2).

Depending on the position of the needle, a second spinal needle may be introduced. This should be inserted, using a stylet, 1 to 2 mm ventral to the ligamentum denticulatum, at a right angle to the spinal cord, where the tractus spinothalamicus lateralis is situated.

The (Levin) thermocouple electrode is inserted after the stylet has been removed. It is connected to the radiofrequency generator, after which the tip of the electrode is inserted into the spinal cord with the free hand, while measuring the impedance. Impedance suddenly rises from 150 to 300 Ω in the CSF to 1200 to 1500 Ω in the spinal cord (Figure 3). The needle often encounters a rubbery kind of resistance at this point. Sedation can now be terminated.

Stimulation at a frequency of 50 Hz causes a contralateral heat sensation (hot or burning sensation or

Figure 1. Anatomic representation of cordotomy: (a) needle placement between C1 and C2, (b) location of the tractus spinothalamicus lateralis in the anterolateral part of the spinal cord, (c) maximum extent of the area, where pain can be treated by left-sided cordotomy.
chill) at stimulation thresholds < 0.1 V. These sensations should be perceived in or above the area to be treated. The patient should preferably not feel any stimulation responses in the ipsilateral musculus trapezius and neck muscles (due to stimulation of the anterior horn) or the arms and legs (tractus corticospinalis) at a frequency of 2 Hz at 0.5 to 2 V, as this could result in paresis if the lesion is made. If these conditions are met, the needle has been correctly inserted in the anterolateral quadrant at a safe distance from the tractus corticospinalis.

Radiofrequency treatment is applied for 10 seconds at a temperature of between 80 and 90°C, after which the contralateral analgesia is checked by means of pinprick. Muscle force in the ipsilateral arm and leg should also be checked after each lesion. The procedure should be repeated one or two times, depending on the size and intensity of the analgesic area.

Edema development in the spinal cord may result in side effects, including persistence or increase of the pain, so regularly checking the patient’s pain level is a precondition for optimum treatment. In view of the complexity of the pain syndrome, and the risk that previously masked pains may become manifest, adjusting the pharmacologic treatment on the basis of the patient’s complaints may be required. Special care should be taken with patients who are being treated with high opioid dosages, for whom rapid adjustment of the dosage is often required to prevent respiratory depression.

B. III.C Technique for CT-Guided Cordotomy

For a description of this technique we refer to Kanpolat et al.30

C. UPPER ABDOMINAL PAIN DUE TO CANCER OF THE PANCREAS/STOMACH

INTRODUCTION

Pancreatic carcinoma usually leads to death within a relatively short time, as the diagnosis is often established at a time when cancer is already in an advanced stage, where tumor resection is no longer an option. Patients often first present with upper abdominal pain, although in the advanced stages they also frequently complain of back pain. Cancer of the pancreas is also

Figure 2. Needle placement for cordotomy: note the myelogram at the level of the ligamentum denticulatum.

Figure 3. Definitive needle position for percutaneous cordotomy: note the increase in impedance as the needle is advanced into the spinal cord.
associated with anorexia, loss of appetite, sleeping problems and weight loss.

Upper abdominal pain may also be caused by metastases of stomach cancer.

The plexus coeliacus is the network of orthosympathetic (sympathetic) nerve fibers located in front of the aorta at the level of truncus coeliacus. The plexus is formed from the nervi splanchnici, which arise from the thoracic truncus sympathicus. Plexus coeliacus block was first described by Cappis in 1914 for the treatment of upper abdominal pain after abdominal surgery. It is most currently applied in patients with cancer, usually due to pancreatic carcinoma.

C.I DIAGNOSIS

C. I.A History Taking and Clinical Symptoms

If a patient presents with severe upper abdominal pain and also complains of loss of appetite, sleeping problems and unexplained weight loss, the doctor should first seek to confirm the cause of the pain.

The pain is worse when the patient lies down and subsides as he or she sits up or bends forward.

Patients will report indistinctly localized, deep-seated pain, which resembles pinching, cramps or colic. Other symptoms include referred pain, such as shoulder pain, which occurs as the tumor invades the diaphragm, and is caused by stretching, compression or invasion of visceral structures.

C. I.B Physical Examination

Although physical examination is irrelevant to the pain syndrome, it is important to ascertain whether the pain is indeed situated in the upper abdomen. Additional radiation of the pain to the lower abdomen or back due to a primary upper abdominal process is not a contraindication for nerve blocks/neurolysis. Patients should also be checked for local anatomic abnormalities (severe scoliosis) and infections at the level of the intended puncture site. In addition, the patient must be able to lie in prone position for the duration of the procedure.

C.I.C Additional Testing (Multidimensional)

Basic additional examination includes medical imaging, whether or not followed by laparoscopic examination, during which any obstructive symptoms can be treated. The technical examination required for accurate assessment of the cause of the pain should have been completed by the referring doctor. The examination should yield an accurate understanding of the situation before interventional pain control techniques are applied.

C.I.C Differential Diagnosis

Pain related to nononcologic problems are not eligible for neurolytic plexus coeliacus block.

C.II TREATMENT OPTIONS

C. II.A Interventional Management

A meta-analysis of 24 studies assessing the effectiveness of plexus coeliacus block among a total of 1145 patients with various types of cancer was published in 1995. This analysis showed that 89% of the patients report reduced pain after 2 weeks, with complete relief reported by 58% of the patients. The corresponding figures after 3 months were 90% and 56%, respectively. Later publications based on double-blind RCTs have confirmed the conclusions of the meta-analysis that plexus coeliacus block leads to reduced pain scores and/or reduced opioid consumption. Reported effects on quality of life have been variable. A meta-analysis evaluating the effect size of the treatment showed that plexus coeliacus block reduces the pain, but does not remove the need for opioids. It concluded that plexus coeliacus block is not a substitute for pharmacologic treatment.

A double-blind randomized controlled trial compared the efficacy of conventional analgesic treatment and sham intervention with plexus coeliacus block and analgesic treatment. Pain reduction was greater in the group receiving active plexus coeliacus block at 1 week and over time. Opioid consumption and quality of life were not significantly different between groups. One year after randomization 16% of patients in the plexus coeliacus block group were still alive compared with 6% in the conventional treatment group, this difference was, however, not significant.

The efficacy of CT-guided neurolytic plexus coeliacus block was compared with pharmacological treatment of pain due to pancreatic cancer. In the short term (1 to 14 days after the intervention) the VAS score of patients in the group having received a neurolytic block were significantly lower than in the group receiving pharmacological treatment. In the longer term up to 90 days after randomization, the difference
in VAS pain score disappeared. The opioid consumption, however, remained significantly lower in the neurolytic block group over the complete follow-up period. There were no differences in quality of life between the two groups.\textsuperscript{35}

An open randomized comparison of clinical effectiveness of protocol-driven opioid analgesia, plexus coeliacus block, or thoracoscopic splanchnicectomy in patients with pancreatic and other abdominal malignancies showed no differences in outcome between the 3 groups at 2 month follow-up.\textsuperscript{36} The results of this latter study differ from previous findings. The reported mortality rate within the 2 months follow-up suggests that the population studied consists of patients whose cancer is in a far advanced stage.

A comparative study found that ethanolization of the nervus splanchnicus was superior to plexus coeliacus block in terms of pain relief and quality of life in patients with a pancreatic tumor.\textsuperscript{37} Therefore, this technique may be recommended, although further research is required to confirm the results.

### C. II.B Complications

Although there have been reports of transient hypotension or diarrhea, as well as local pain, percutaneous plexus coeliacus block appears to be a relatively safe technique. There have been only a few reports of serious complications like pareses, paresthesias (1%), hematuria, pneumothorax, and shoulder pain (1%).\textsuperscript{32} There are case reports of paraplegia due to plexus coeliacus block.\textsuperscript{38–40} A recently published case report described hemorrhagic gastritis and duodenitis following plexus coeliacus neurolysis. The patient had a known history of gastritis and duodenitis and developed severe upper GI bleeding immediately following the plexus coeliacus neurolysis. It was speculated that inhibition of the sympathetic tone caused increased blood flow to the GI system, which resulted in active bleeding from previously indolent hemorrhagic gastritis and duodenitis.\textsuperscript{41}

Relieving abdominal pain may cause other pains to become manifest. Although this means that it is often not possible to completely terminate analgesic treatment, considerable dosage reductions may be achieved.

**Contraindications for plexus coeliacus or nervus splanchnicus block.**

1. hemorrhagic diatheses.
2. local infections.

### C.III RECOMMENDATIONS

We recommend the use of plexus coeliacus block or nervus splanchnicus block to reduce pain or opioid use in patients with upper abdominal pain due to malignancy. This treatment may be considered as soon as opioid treatment is started. Plexus coeliacus or nervus splanchnicus block may be repeated if necessary. The choice between these two techniques depends on the preferences and experience of the attending physician.

### C. III.A Technique

**Plexus Coeliacus Block**

Various techniques to approach the plexus coeliacus have been described. Literature reports do not indicate one to be superior to the others, although the results of nervus splanchnicus block at the Th11 level appear to be better than those of the transaortal approach.\textsuperscript{37} The sections below discuss the posterior transaortal, paravertebral (retrocrural), and transdiscal techniques for plexus coeliacus block and nervus splanchnicus block.

Plexus coeliacus plexus block can also be implemented surgically and endoscopically (by a gastroenterologist), but these techniques are beyond the scope of this article. Also, there is a growing experience with anterior, ultrasound-guided techniques.

### Table 4. Summary of Evidence for Upper Abdominal Pain

<table>
<thead>
<tr>
<th>Technique</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td>Neurolytic plexus coeliacus block</td>
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<tr>
<td>Neurolytic nervus splanchnicus block</td>
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3. patient’s inability to lie in prone position.
4. tumor invasion into the insertion site.

### C.IIL C Other Treatment Options

Initial treatment of upper abdominal pain due to pancreatic carcinoma consists of analgesics like nonsteroidal anti-inflammatory drugs and opioids, which may be administered in various forms.

### C.IID Evidence for Interventional Management

The evidence for interventional management of upper abdominal pain due to cancer is summarized in Table 4.
Posterior transaortal technique. The patient is lying in prone position, with support under the abdomen to achieve thoracolumbar kyphotic position. This increases the distance between the ribs and crista iliaca and between the processus transversus of the adjoining vertebral bodies. For the sake of comfort, the patient’s head is turned sideways with the arms hanging down along the body or placed above the head.

It may be useful to mark the following reference points on the skin with a marking pen: the crista iliaca, the 12th rib, the dorsal midline, the vertebral bodies, and the lateral limit of the paraspinal muscles. It is also useful to mark the intersection of the 12th rib and the lateral border of the paraspinal muscles on the left side (which usually corresponds to the L2 level). A steel ruler can then be used to draw bilateral lines parallel to the lower edge of the 12th rib. These lines, which cross the L1 vertebral body, serve to indicate the direction of the needle. The surgery site is prepared and covered with sterile drapes.

The skin, subcutaneous tissues and muscles are anesthetized with a local anesthetic at the site, where the needles will be inserted. For the sake of patient comfort, spinal anesthesia with a short-acting local anesthetic may be considered.

A 20 or 22G, 15 cm stylet needle is inserted from the left. The needle is initially oriented at an angle of 45° to the midline and about 15° cranially to make contact with the L1 vertebral body. As soon as the needle touches the bone, its depth of insertion is noted, after which the needle is retracted to the subcutaneous tissue. It is then repositioned slightly laterally (at about 60° to the midline) to pass along the lateral surface of the L1 vertebral body. All this is carried out under fluoroscopic guidance. The needle is now cautiously advanced until aortic pulsations are felt in the needle. The stylet is then removed from the needle, and the needle is advanced so as to perforate the aortic wall. Blood emerging from the needle indicates it is in intrathoracic position. The needle is advanced until no more blood emerges, indicating that the needle tip is in pre-aortic position. A “click” may be felt as the needle perforates the aortic wall. It is important to use anteroposterior as well as lateral views to ensure correct needle placement.

After the needle has reached its correct position, the stylet is removed and the hub is checked for blood and CSF, lymph fluid and urine. A small amount of contrast medium is then injected and its distribution pattern is checked with the help of the C-arm. If the contrast medium shows insufficient dispersion bilaterally, it may be necessary to introduce another needle from right side for the instillation of the neurolytic agent.

In the anteroposterior view, the contrast medium should show up in the midline, concentrated around the Th12 to L1 vertebral bodies. The contrast medium should not spread beyond the contours of the vertebral bodies on the fluoroscopic image. The lateral view of the vertebral body should show a smooth posterior outline. The contrast medium should not spread dorsally toward the nerve roots.

Alternatively, if the procedure is carried out under CT-guidance, the contrast medium should appear laterally and behind the aorta. If the contrast medium is present only in the retrocrural space, the needles should be advanced deeper, to reduce the risk of local anesthetic or the neurolytic agent spreading to the somatic nerves.

Paravertebral (retrocrural) approach. The Th12 vertebral body is identified in a posteroanterior view and marked. The C-arm is then rotated to an oblique position (about 45°) on the side, where the needle is to be inserted. The image should show the side of the diaphragm lateral to the vertebral body. Observe the diaphragm movements as the patient breathes in and out. If the diaphragm obscures the Th12 vertebral body and rib, identify the Th11 rib. For both levels, the needle insertion site on the skin is located at the point, where the connection between rib and vertebral body cross each other.

After the skin at this site has been anesthetized, a 14G, 5 cm extracath (as an introducer) is inserted under fluoroscopic guidance, in such a way that the catheter moves toward the target like the head of a needle. After the extracath has been inserted to two-thirds of its length, the stylet is removed and replaced by a 20 or 22G, 15 cm stylet needle. The C-arm is kept in oblique position. An extension tube is connected to the needle. The needle tip is advanced anteriorly in short (0.5 cm) increments, with the needle tip continuing to slide along the vertebral body. Both needles are advanced further, under fluoroscopic guidance, past the Th12 to L1 vertebral body. Check for blood or CSF by means of aspiration. The final needle location is checked on lateral views. After the contrast medium has been injected, the lateral view should show it in prevertebral position, whereas the anteroposterior view should show it within the contours of
the spine (Figures 4, 5 and 6). A neurolytic agent can now be gradually injected (see below).

**Transdiscal technique.** This approach was first described by R. Plancarte, but needs to be further assessed for efficacy and safety.

The transdiscal procedure is also carried out under fluoroscopic or CT-guidance. The patient lies in prone position with a support underneath the iliac crest to widen the access to the intradiscal space. Fluoroscopy is used to identify the Th12 to L1 level. The C-arm is then rotated obliquely to the left at an angle of 15 to 20°. It is important to align the inferior endplates using a cranio-caudal projection. The needle insertion site is 5 to 7 cm from the midline. After the skin and subcutaneous tissues have been locally anesthetized, the needle is advanced under tunnel view to the inferior aspect of the facet joint. After the disc has been penetrated, 0.5 mL contrast medium (iohexol) is injected to check the position of the needle in the disc. The needle is then advanced until “loss of resistance” is perceived, indicating that the needle has exited the Th12 to L1 disc. After the final needle position has been checked with the help of contrast medium, 10 mL phenol in 10% saline (or 10% phenol in glycerin) is injected, followed by injection of 2 to 3 mL of air to prevent intradiscal leakage of the neurolytic agent.

Diagnostic prognostic blocks with the retrocrural technique are carried out by injecting 12 to 15 mL

![Figure 4](image-url) **Figure 4.** Neurolytic plexus coeliacus block: needle position in anteroposterior view. The needles enter at the L2 level and point obliquely upward toward L1 (a stent is present in the ductus choledochus).

![Figure 5](image-url) **Figure 5.** Neurolytic coeliacus plexus block: anteroposterior view showing dispersion of contrast medium around Th12 to L1, both pre- and retro-aortic.

![Figure 6](image-url) **Figure 6.** Neurolytic plexus coeliacus block: anteroposterior view showing dispersion of contrast medium within the spinal contours. Note the characteristic vacuole-like bright areas indicating correct placement.
lidocaine 1% or 0.25% ropivacaine through both needles. Most researchers recommend carrying out therapeutic blocks by first injecting 10 to 16 mL of local anesthetic, followed by 10 to 16 mL of 96% ethyl alcohol, or a 10% solution of phenol in telebrix (10% phenol in glycerin in U.S.) via both needles. Many researchers have simultaneously injected a contrast medium to check the dispersion of the neurolytic agent. Before injecting the neurolytic solution, the area around the needle should be covered with wet gauze, followed by fractionated injection of the solution in 1 mL aliquots. This prevents the neurolytic agent from spreading to surrounding structures, and thus reduces the risk of complications. We recommend the use of 10% phenol in telebrix or in glycerin as a reference. After the neurolytic agent has been injected, each needle should be flushed with physiologic serum, or a local anesthetic to prevent fistula formation.

Nervus Splanchnicus Block

An alternative to the paravertebral (retrocrural) approach is the nervus splanchnicus block technique proposed by Abram and Boas. This blocks the nervi splanchnici, branches of the thoracic truncus sympathicus and the nerve supply to the plexus coeliacus.

The patient is lying in prone position with support under the abdomen to achieve thoracolumbar kyphotic position. The Th11 vertebral body is identified, after which the C-arm is rotated from the anteroposterior orientation in a caudal and lateral direction, allowing the concave mid-portion of the vertebral body to be visualized without being obscured by ribs or the processus transversus.

A 20 or 22G, 15 cm needle is inserted paravertebrally, using a tunnel view, in the direction of the concave mid-portion of the vertebral body. Try to make contact with the vertebral body. Under lateral fluoroscopy, the needle is advanced to the anterolateral aspect of the Th11 vertebral body. Radiographic imaging should show the tip of the needle just within the contour of the Th11 body in an anteroposterior view, just at the anterior border of the Th11 vertebra in a lateral view. A small volume of contrast medium is injected to check dispersion along the anterolateral aspect of the vertebral body. Before the neurolytic agent is injected (as described above), the area around the needle is covered with wet gauze, after which the neurolytic solution can be injected in fractions, preferably together with contrast medium. The same procedure is repeated on the other side. The needles then have to be flushed with saline, or a local anesthetic.

Aftercare. After the procedure, patients may experience pain at the insertion site, (orthostatic) hypotension or diarrhea. Patients should therefore be sufficiently hydrated and hospitalized for a night to check for signs of hypotension.

D. VISCERAL PAIN DUE TO PELVIC TUMORS

INTRODUCTION

Patients with extensive tumors in the small pelvis often perceive little benefit from oral or parenteral analgesics, or may experience intolerable side effects at the required dosages. This may necessitate a plexus hypogastricus block. Pain relief in the small pelvis is possible because afferent tracts innervating the organs in the small pelvis run along the sympathetic nerves, bundles and ganglia, making them easily accessible to neurolytic blocks. As visceral pain is often a major component of the pain due to tumors in the small pelvis, these neurolytic techniques deserve to be more commonly used for patients in the advanced stages of cancer in the small pelvis. The superior plexus hypogastricus is located bilaterally in the retroperitoneum, along the 3rd to 5th lumbar vertebrae, often extending to the upper third part of the first sacral vertebra.

D.I DIAGNOSIS

D.I.A History Taking and Clinical Symptoms

Plexus hypogastricus block may be considered for patients with a tumor in the small pelvis and pain in the lower abdomen. Patients with mostly visceral pain report ill-defined, dull, indistinctly localized pain.

D.I.B Physical Examination

Examination should concentrate on the anatomy of the lower back and sacrum, and try to detect signs of infection and superficial tumor growth. Areas to which the pain radiates should be assessed to identify secondary and primary pains. The examiner should also assess whether the patient is able to lie in prone position for the duration of the treatment without the risk of collapse.
D. I.C Additional Testing
The location of the pain must be very carefully identified. If the patient suffers from radicular pain or very extensive painful zones in the lower abdomen or lower body, the preferred treatment option is epidural or intrathecal pain control. Pain in the higher parts of the upper abdomen should preferably be treated with plexus coeliacus block.

The technical examination requires accurate assessment of the cause of the pain and should have been completed by the referring doctor. This examination should yield an accurate understanding of the situation before interventional pain control techniques are applied.

Before deciding to carry out a neurolytic block, the physician should apply a diagnostic block with a local anesthetic, which should produce a 50% reduction of the pain for the normal duration of action of the anesthetic.

D. I.D Contraindications
1. Hemorrhagic diatheses.
2. Serious infections in the area, where the needle is to be inserted.
3. Extensive tumor invasion in the area, where the needle is to be inserted.

D. I.E Differential Diagnosis
Pain complaints related to nononcologic problems are not eligible for treatment with plexus hypogastricus block.

D. II TREATMENT OPTIONS
D. II.A Interventional Management

Plexus hypogastricus block. Plexus hypogastricus block has only been evaluated in observational studies. The study with the largest number of patients was that by Plancarte et al.44 Of the 277 patients included in their study, 51% reported satisfactory pain relief. One study compared the effects of plexus hypogastricus block with those of pharmacologic treatment,45 and found a favorable effect of nervus sympathicus block on both pain and opioid consumption. The data provided, however, do not allow the specific effectiveness of plexus hypogastricus block to be evaluated. All studies involving more than 10 patients reported at least 60% of patients showing considerable pain reduction.4

D. II.B Complications
Plexus hypogastricus block is a relatively safe technique provided it is carried out under X-ray or CT guidance. Neurolysis of somatic nerves or intravascular injection of neurolytic agent is possible.

Bilateral superior plexus hypogastricus block can cause sexual dysfunction in men.46 There are several cases of lumbar plexopathy with hip flexor weakness (AW Burton and B Hamid, unpublished data) due to injection into the musculus psoas major laterally, and the operator must be careful to inject the neurolytic solution medially enough to avoid the psoas compartment.

D. II.C Evidence for Interventional Management
The evidence for interventional management of visceral pain due to cancer is summarized in Table 5.

D. III RECOMMENDATIONS
We recommend the use of plexus hypogastricus block for patients with visceral pain due to pelvic tumors.

D. III.A Technique
The patient is lying in prone position on a radio transparent table, with a support underneath the pelvis to reduce lumbar lordosis. It might be useful to apply lumbar spinal or epidural anesthesia before starting the plexus hypogastricus block procedure, to reduce the discomfort caused by the puncture. Alternatively, the deep paravertebral muscles may be infiltrated with local anesthetics.

The fluoroscopy tube is positioned in such a way as to allow the promontory or the concave mid-portion of the L5 vertebral body to be seen in tunnel view from the needle insertion point 5 to 7 cm lateral of the midline, at the L4 level. This means that the tube has to be angulated by about 45°, both in anteroposterior and cranial view.

A 20 or 22G, 15 cm needle is positioned at the front of the L5 to S1 intervertebral space, under radiographic guidance (tunnel view). Use aspiration to

Table 5. Summary of the Evidence for Plexus Hypogastricus Block

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<thead>
<tr>
<th>Technique</th>
<th>Evaluation</th>
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</thead>
<tbody>
<tr>
<td>Neurolytic plexus hypogastricus block</td>
<td>2 C+</td>
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check its position, to avoid injecting into the iliac blood vessels. The radiographic images should show the tip of the needle paravertebrally at the level of the L5 to S1 intervertebral space in anteroposterior view, whereas a lateral view should show the tip just touching the anterior border of the L5 to S1 vertebra (Figures 7, 8, and 9). At this point, it is useful to inject a water-soluble contrast agent to confirm the correct position of the needle and avoid intravascular injection. The contrast medium should not disperse beyond the lateral confines of the L5 vertebral body, or in a dorsal direction toward the nerve roots. A diagnostic plexus hypogastricus block can be carried out using 6 to 8 mL bupivacaine 0.25% to 0.5%. A therapeutic block is carried out using 6 to 8 mL 10% phenol solution in telebrix (in glycerin in U.S.) on each side of the vertebra. The safety of the procedure can be improved by fractionated injection, with continuous monitoring of the dispersion of the phenol by means of contrast medium. Care must be taken to avoid the psoas compartment laterally at L5 to S1 level.

**E. PERINEAL PAIN DUE TO PELVIC TUMORS**

**INTRODUCTION**

Perineal pain caused by tumors may be treated with intrathecal phenolization of the lower sacral roots of the cauda equine (lower end block or saddle block). Physicians have hesitated to use this technique, however, because of the risk of permanent damage to the nerves controlling bladder and rectum function, with potentially serious consequences. That is why the technique is usually considered only as a last resort, after all other forms of oral or parenteral pain control have been tried and either proved ineffective or have caused intolerable side effects.

**E.I DIAGNOSIS**

**E. I.A History Taking and Clinical Symptoms**

Lower end block may be considered for patients with perineal pain due to tumors of the small pelvis. The
technique is often considered only after the anus has already been surgically removed and the patient has been fitted with a stoma and a permanent bladder catheter.

E. I.B Physical Examination
The lower back and sacral zone must be carefully inspected to check for any infections or tumor invasion. Check whether the patient is able to sit up during the procedure and is cooperative. The patients must be able to accurately report sensory perceptions in the lower limbs.

E. I.C Additional Testing
Perineal pain should be of mainly somatic origin, and no other suitable therapy should be available. A precondition for the use of this technique is pre-existing urinary and fecal incontinence or the presence of a bladder catheter and an artificial anus.

E.II TREATMENT OPTIONS
E. II.A Interventional Management
Although lower end block is described in textbooks,47,48 no high-quality studies on the subject have been published in the past 20 years. Three recent case reports included a limited number of patients. The results in these reports were variable: the median duration of the effect was 3 months, but opioid dosages could be reduced to 60%.49–51

E. II.B Complications
1. Loss of sensory function, sometimes with dysesthesias of the lower limbs and/or the buttocks.
2. Loss of urinary or anal sphincter function.

E. II.C Contraindications
1. Life expectancy > 6 months.
2. Blood coagulation deficiencies.
3. Extensive tumor invasion.
4. Extensive infection in the needle insertion area.

E. II.D Evidence for Interventional Management
The evidence for interventional management of perineal pain due to pelvic tumors is summarized in Table 6.

E.III RECOMMENDATIONS
A lower end block should only be considered for the treatment of cancer patients who experience pain in the small pelvis and have lost normal bladder or rectal function. As there have been no formal studies of the effectiveness of the treatment and the duration of the effect, we recommend using this technique only in the context of an experimental study or in cases of compassionate use with no other available forms of effective pain relief available with good informed consent.

E. III.A Technique
The patient should be able to respond normally when being spoken to or asked questions during the procedure. There should be enough nursing staff present to place and hold the patient in the correct position and to change the patient’s position during the procedure. All regulations for implementing aseptic procedures must be strictly observed. An intravenous line must be inserted to allow medication to be administered, and precautions for resuscitation must be in place.

The lower lumbar spinal segments must be in kyphotic position, so as to achieve maximum curvature. A large area should be disinfected and covered with a sterile surgical drape with an opening. The skin is anesthetized. A 22G spinal needle is inserted in the L5 to S1 intervertebral space at median level (midline approach), and carefully advanced until CSF flows from the needle. The phenol solution (6% in glycerin) is then freshly drawn into a 2 mL syringe with accurate volume graduation lines. The phenol syringe is connected to the spinal needle. The patient’s position must now be adjusted. The patient is asked (assisted by the nursing staff) to lean backward at an angle of 45°, so that the back is at a 45° angle to horizontal. This requires considerable effort on the part of nursing staff. Phenol is now injected in 0.2 mL aliquots into the intrathecal space, to a total volume of 1 mL over a period of 5 minutes. Infiltration should be immediately stopped if the patient indicates sensory changes in the lower limbs, or the buttocks. In some cases, injection must be continued to a maximum total volume of 1.5 mL. The spinal needle is then removed and the patient should

Table 6. Summary of the Evidence for Lower End Block

| Technique Evaluation |
|----------------------|------------------|
| Intrathecal phenolization of lower sacral roots of cauda equina | 0 |
remain seated at a backward angle of 45° for the next 6 hours. Their blood pressure must be regularly checked, and some fluid replacement may be required.

Changes in pain perception should be checked by monitoring the VAS score for pain. Oral or parenteral analgesics should only be gradually reduced in the course of the following days, if the treatment has an analgesic effect. It is rarely possible to end analgesic use completely, as successful treatment often causes other pains to become manifest.

F. SPINAL PAIN RELATED TO VERTEBRAL COMPRESSION FRACTURE (WITH OR WITHOUT PATHOLOGIC TUMOR INVASION)

INTRODUCTION

Many cancer patients suffer morbidity due to skeletal metastasis, pain, and vertebral compression fractures. Skeletal complications are very common in multiple myeloma regardless of stage, and in metastatic breast, prostate, and other solid tumors.

Extradural metastases account for some 95% of secondary spinal tumors. The primary sources of metastatic neoplasms to the spinal axis vary among the published series with 65% coming from carcinoma of the breast, lung, and prostate. Renal cell carcinoma and myeloma also occur and together account for 10% of spinal metastases.52

F. I DIAGNOSIS

F. I.A History Taking and Clinical Symptoms

Patients with cancer who develop significant axial spinal pain merit imaging studies via their oncologist to rule out metastatic disease or pathological fracture. Focal spinal pain in a cancer patient nearly always mandates some sort of radiological workup. Vertebral compression fracture pain is typically incidental, and nonradiating. Patients with neurologic deficit, band-like pain, or any loss of bowel and bladder control may have spinal cord compression and merit an immediate neurosurgical evaluation to include imaging studies.

F. I.B Physical Examination

Patients with cancer-related vertebral fracture should have a complete neurologic exam to ensure that the spinal cord is not compromised prior to consideration of these techniques. Furthermore, the pain should be concordant with the level of pathology.

F. II TREATMENT OPTIONS

F. II.A Interventional Management

Pathologic spinal involvement without fracture is usually treated with conventional radiotherapy. A spinal vertebral compression fracture with tumor is often treated with the same way, but the mechanical pain can be refractory to the radiation therapy. In these cases, percutaneous vertebroplasty (PV) or kyphoplasty can be helpful. In cases involving neurologic compromise or significant epidural disease, open surgical treatment may be indicated.

Percutaneous vertebroplasty and kyphoplasty. Indications for PV have expanded to include osteoporotic compression fractures and painful vertebral metastasis. Kyphoplasty is a modification of PV; it involves the percutaneous placement of balloons (called “tamps”) into the vertebral body with an inflation/deflation sequence to create a cavity prior to the cement injection. Percutaneous kyphoplasty (PK) may restore vertebral body height and reduce the kyphotic angulation of the compression fracture prior to bone cement injection.53,54 A recent prospective trial in noncancer VCF’s shows good efficacy, with significant reduction in pain and improved function.55 Several smaller case series show good pain improvement with these procedures.56

F. II.B Complications

Complications are rare, but can be serious and the exact incidence is unknown. Most case series report asymptomatic polymethyl methacrylate (PMMA) extravasation rates of around 10% to 15%.54,57 The Society for Interventional Radiology (SIR) divides complications for these techniques into minor and major. Minor complications are those considered to require no therapy and having no consequence, such as PMMA extravasation into the disc. Major complications are those requiring therapy, including an unplanned increase in the level of care needed, or having ongoing permanent sequelae (eg, PMMA into the spinal canal with neurologic deficit). SIR noted published complication rates for major complications to be less than 1%, except in those with neoplastic involvement of the vertebrae, where the reported level of major complications is less than 5%.58,59
Table 7. Indications and Contraindications for Percutaneous Vertebroplasty

<table>
<thead>
<tr>
<th>Indications</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painful osteoporotic vertebral compression fracture refractory to 3 weeks of analgesic therapy</td>
<td>Asymptomatic vertebral compression fracture</td>
</tr>
<tr>
<td>Painful vertebrae due to benign or malignant primary or secondary bone tumors</td>
<td>Patient improving on medical therapy</td>
</tr>
<tr>
<td>Painful vertebral compression fracture with osteonecrosis (Kummel’s disease)</td>
<td>Ongoing Infection</td>
</tr>
<tr>
<td>Reinforcement of vertebral body prior to surgical procedure*</td>
<td>Prophylaxis in osteoporotic patient</td>
</tr>
<tr>
<td>Chronic traumatic vertebral compression fracture with nonunion*</td>
<td>Uncorrectable coagulopathy</td>
</tr>
<tr>
<td>Absolute contraindications</td>
<td>Myelopathy due to retropulsion of bone/canal compromise</td>
</tr>
<tr>
<td>Relative contraindications</td>
<td>Allergy to PMMA or opacification agent</td>
</tr>
<tr>
<td>Radicular pain</td>
<td>VCF &gt; 70% height loss*</td>
</tr>
<tr>
<td>Severe spinal stenosis, asymptomatic retropulsion of bony fragment</td>
<td>Tumor extension into canal/epidural space</td>
</tr>
<tr>
<td>Tumor extension into canal/epidural space</td>
<td>Lack of surgical backup*</td>
</tr>
</tbody>
</table>

Modified from McGraw et al. and updated by Gangi et al. Recommendations from the more recent update (Gangi 2006 are marked with *).

F. II.C Evidence for Vertebroplasty or Kyphoplasty

Recent reviews and editorials have called for a more critical evaluation of these procedures in view of some recent studies questioning the efficacy of these procedures in noncancer situations.

Table 8 summarizes the level of evidence.

F. III RECOMMENDATIONS FOR VERTEBROPLASTY OR KYPHOPLASTY

In summary, we view PV/PK as valuable adjunctive therapies for cancer patients with painful vertebral compression fractures from all etiologies. The overall complication rate is low and efficacy acceptable.

F. III.A Technique

The technique of both vertebroplasty and balloon kyphoplasty has been described in Peh et al.

Table 8. Summary of the Evidence for Vertebroplasty and Kyphoplasty in the Management of Vertebral Compression Fractures With or Without Pathologic Tumor Invasion

<table>
<thead>
<tr>
<th>Technique</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertebroplasty</td>
<td>2 B +</td>
</tr>
<tr>
<td>Kyphoplasty</td>
<td>2 B +</td>
</tr>
</tbody>
</table>

VII. SUMMARY

Interventional pain management techniques in the treatment of refractory oncologic pain syndromes are indicated if oral or parenteral analgesics cause such severe side effects that a satisfactory quality of life and satisfactory pain relief cannot be reached.

All of the techniques described in this article should only be considered in a specific multidisciplinary pain centre, with all capacities of a thorough clinical follow-up.

These interventional techniques require high attention, great care and thorough specialist knowledge as well as extensive expertise. The clinical center needs to meet all requirements for the safe implementation of interventional techniques.

Effective nursing assistance, a specially equipped operating area and effective aftercare are required to satisfy all safety regulations.

ACKNOWLEDGEMENTS

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REFERENCES


