EVIDENCE-BASED MEDICINE

Evidence-Based Interventional Pain Medicine
according to Clinical Diagnoses

10. Thoracic Pain

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■ **Abstract:** Approximately 5% of the patients referred to outpatient pain clinics suffer thoracic pain. Thoracic pain in this article is limited to thoracic radicular pain and pain originating from the thoracic facet joints. Thoracic radicular pain is characterized by radiating pain in the localized area of a nervus intercostalis. The diagnosis of thoracic facet pain should be considered if the patient complains of paravertebral pain that is aggravated by prolonged standing, hyperextension, or rotation of the thoracic spinal column.

Based on the analyses of the results in the literature combined with experience in pain management, symptoms, assessment, differential diagnosis, and treatment possibilities of thoracic radicular pain and thoracic facet pain are described and discussed. Conservative treatment consists of medications according to the World Health Organization pain ladder. Transcutaneous electrical nerve stimulation is an option. Physical therapy is usually applied in the form of manual therapy.

Interventional treatment may be considered when conservative treatment fails. For thoracic radicular pain, the available evidence on efficacy and safety supports recommendation (2 C+) of pulsed radiofrequency treatment of the ganglion spinale (DRG). If this treatment has a short-lasting effect and the pain is segmental, then radiofrequency treatment of the ganglion spinale (DRG) can be performed. Recommendation (2 C+) is applicable. However, extensive skills are required to perform this procedure above the level of Th7. This treatment should take place in specialized centers. For thoracic facet pain, radiofrequency treatment of the ramus medialis of the thoracic rami dorsales is recommended (2 C+). ■

Key Words: evidence-based medicine, thoracic radicular pain, thoracic facet pain, radiofrequency treatment, pulsed radiofrequency

INTRODUCTION

This review on thoracic pain is part of the series "Evidence-based Interventional Pain Medicine according to clinical diagnoses." Recommendations formulated in this article 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.[2] in the editorial accompanying the first

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Table 1. Summary of Evidence Scores and Implications for Recommendation

Score	Description	Implication
1 A+	Effectiveness demonstrated in various RCTs of good quality. The benefits clearly outweigh risk and burdens	Positive recommendation
1 B+	One RCT or more RCTs with methodologic weaknesses, demonstrate effectiveness. The benefits clearly outweigh risk and burdens	
2 B+	One or more RCTs with methodologic weaknesses, demonstrate effectiveness. Benefits closely balanced with risk and burdens	
2 B±	Multiple RCTs, with methodologic 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.	Considered, preferably study-related
2 C+	Effectiveness only demonstrated in observational studies. Given that there is no conclusive evidence of the effect, benefits closely balanced with risk and burdens	
0	There is no literature or there are case reports available, but these are insufficient to suggest effectiveness and/or safety. These treatments should only be applied in relation to studies.	Only study-related
2 C–	Observational studies indicate no or too short-lived effectiveness. Given that there is no positive clinical effect, risk and burdens outweigh the benefit	Negative recommendation
2 B–	One or more RCTs with methodologic 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	
2 A–	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	

RCT, randomized controlled trial.

article of this series (Table 1). The latest literature update was performed in October 2009. Per agreement of the authors, the names of the anatomical structures are noted in Latin.

Thoracic pain symptoms are relatively rare, comprising an estimated 5% of the patients referred to an outpatient pain clinic.[3–5] Thoracic pain symptoms are significant, but the number of publications on the etiology of thoracic pain is limited. Patients with thoracic pain should always be thoroughly examined because important underlying pathology could be the cause of the symptoms. Diagnoses such as angina pectoris, herpes zoster infection, thoracic disc herniations, pulmonary tumors or pleural tumors, and aneurysms can also give rise to prolonged thoracic pain of unknown origin.[6] Chronic thoracic pain after surgical interventions, such as thoracotomy, mastectomy, and coronary artery bypass surgery are relatively often the cause of thoracic pain.[7–9] Referred pain from internal organs often results in diffuse thoracic pain and can be caused by pulmonary embolisms, esophageal carcinoma, achalasia, or pancreatic diseases.

The diagnosis in thoracic pain is difficult and often "spine related": The cause of this pain may come from the nerve endings of the periosteum, nervi intercostales, ligaments, intervertebral discs, and facetal joins[10] Consequently, thoracic pain syndromes of spinal origin are commonly seen in medical practice, spinal osteoporotic fractures needs to be ruled out in these patients. These types of pain are often nociceptive. Postoperative pain frequently appears after thoracotomies, sternotomies, and mastectomies; and often causes neuropathic pain.

Because there are many causes of thoracic pain, we limit our discussion to pain symptoms for which interventional pain management might be possible, ie, thoracic radicular pain and pain originating from the thoracic facet joints.

A. THORACIC RADICULAR PAIN SYMPTOMS

A.I DIAGNOSIS

Thoracic radicular pain is characterized by radiating pain in the area innervated by a nervus intercostalis. The symptoms are usually unilateral and the pain is rarely felt in the area covered by two nerves. Thoracic radicular pain is not a typical clinical syndrome, as in the lumbar area. Different causes can give rise to thoracic radicular pain (Table 2). There are different pain patterns possible: constant pain or intermittent pain, nociceptive or neuropathic pain, or a combination of these. The cause of the pain may be malignant. In contrast to the signs and symptoms of a lumbar disc herniation, a disc herniation at the thoracic level does not cause radicular symptoms but pyramidal tract signs. The areas innervated by the nervus intercostalis are overlapping which often makes it difficult to find a relationship between the pain pattern and the nerve or nerve root involved. Thoracic radicular pain can be caused by an unknown neuralgia of the nervus intercostalis,

Table 2. Causes of Thoracic Radicular Pain

Neuralgia
• Intercostal neuralgia
• Neuralgia of the abdominal wall
Pain radiating from the spinal cord
• Osteoporosis
• Vertebral collapse
• Vertebral metastases
Scar pain
• Post-thoracotomy
• Postmastectomy
• Post-thoracoscopy
• Intercostobrachial neuralgia
• Postlobectomy
• Pfannenstiel incision
Rib pathology
• Fracture/pseudarthrosis
• Rib resection

compression of a segmental nerve upon its emergence from the foramen intervertebrale, or as a result of rib pathology. There is an exceptional form that appears most in middle-aged patients termed the 12th rib syndrome.[11] This syndrome refers to irritation of the nervus subcostalis caused by compression against the iliac crest. The pain is often experienced in the segment of the 11th and 12th rib.

A.I.A HISTORY

Initially, questions should be asked about the localization of the pain. It is important to determine a potential cause (Table 2). The specific clinical history can be brief in the event of surgery and traumas. It is important to ask if the symptoms are related to respiration or if it worsens upon coughing. General symptoms such as weight loss and chronic cough should not be omitted. In the event of intercostal neuralgia, a heavy pain, which is shooting and sharp, occurs along the nervus intercostalis. This pain is not affected by position or manipulation. Pain resulting from rib pathology or compression of nervi intercostales is often position dependent, is often worse on sitting and less when lying down.[12]

A.I.B PHYSICAL EXAMINATION

Examination of the thoracic spinal column consists of inspection at rest and during movement, and palpation of the vertebrae and the paravertebral region. Provocation of pain specifically with different movements of the spine can be an indication of a spinal cause of the pain. The sensation of the thorax and abdomen should be examined. Hypo/hyperalgesia, allodynia, and loss of sensation are indications that it might be neuropathic pain.

Pressure pain on the sternum and sternocostal junctions is usually associated with a local pain pattern (eg, Tietze's syndrome), but it can sometimes be accompanied by radicular pain. Pressure pain over a rib can be an indication of the level of the pain generator. Pressure pain may be noted over the course of the distal section of the 11th and/or 12th rib, particularly in older patients.

Compression on the thorax can be a sensitive examination, eliciting pain originating from the sternocostal joints and pain from the sternocostal junction. Palpation of the abdomen is necessary to rule out intra-abdominal pathology.

A.I.C ADDITIONAL TEST

Since thoracic radicular pain is not a clinical syndrome and its cause is not always unambiguously derived from the clinical history or physical examination, additional examination is indicated in most cases. In the event of a collapsed vertebra, an X-ray of the spinal column is sufficient. Along with a clinical history of a trauma, with or without a history of osteoporosis, the diagnostics can be completed.

A magnetic resonance imaging (MRI) could be necessary to rule out malignant causes of the pain and epidural metastases. This is particularly important if there is a history of malignancy, or in cases of acute development of severe pain or progressive pain symptoms, but also if recent physical examination showed the development of symptoms of neurological impairment. A thoracic X-ray can be useful in the event of thoracic wall pathology. If there are abnormalities, the patient should be referred to a pulmonary physician for further evaluation. In cases of doubt or when intra-abdominal pathology is suspected, then an ultrasound or a computed tomography (CT) scan may be indicated.

Diagnostic Selective Nerve Blocks

It is difficult to determine which nerve is causing the pain based on clinical examination because the innervations of a nervus intercostalis overlap. Therefore, diagnostic blocks of nervi intercostales are performed. Blocks of the nervi spinales at level Th11 or Th12 can also be carried out by using the same technique commonly used at the lumbar level. Intercostal blocks can be carried out above the Th10 level to localize the level of the pain. Obviously, one must be careful not to cause pneumothorax. The advantage of intercostal blocks is that spread of the drug to the epidural space is less probable, because of its more

peripheral location. Theoretically, this guarantees better selectivity of the test block.

Intercostal blocks should be performed under radiological control after the level has been established. First, the rib is identified and then the needle is carefully inserted a few millimeters deeper. The exact needle position is monitored after injection of 0.5 mL of contrast in the area of the nerve sheath. When the intercostal groove is outlined or the image of the nervus intercostalis appears, 1 mL of local anesthetics can be injected. If this does not occur, then the needle needs to be inserted slightly deeper. After the injection, there should be a >50% reduction of pain during the local anesthetic blockade. Usually, three levels are tested because there is often an overlap of segments. The level at which the largest temporary pain symptom reduction occurs is selected for treatment.

A.I.D DIFFERENTIAL DIAGNOSIS

The differential diagnosis of thoracic radicular pain may be difficult. Pain originating from sternocostal junctions and the sternum such as described above with Tietze's syndrome can be treated with an injection of local anesthetic solution, potentially with corticosteroids.[11]

Radiation of pain with a thoracic facet syndrome can present as radicular pain. In this case, the dermatomal area of innervation is often not affected entirely, but mostly the dorsal (proximal) section.

Pain from costovertebral joints usually occurs in ankylosing spondylitis (Bechterew's disease). The first, 11th, and 12th ribs (the ribs with just one facet plane), and the sixth through the eighth ribs (the longest ribs) are most frequently affected.[13]

Pain related to costovertebral joints is usually unilateral, and nagging or burning in character. The onset of pain may be acute. The pain on the skin is usually projected in the paravertebral section of the dermatome, but can also be localized in more than one segment due to the bilateral innervation. Sometimes the pain manifests itself as atypical chest pain. There is often hyperalgesia in the adjacent epidermal region. There might be pressure pain across the joints and pain induced by the manipulation of the corresponding rib. This last symptom is typical for pain originating from the costovertebral joints. Other symptoms are similar to pain originating from the thoracic facet joints. If the pain is localized in the areas innervated from Th10 through Th12, then differential diagnosis of a renal cause of the pain can be considered. In rare cases, mesothelioma can present as thoracic radicular pain, the painful region usually involves more than one or two segments. If the cause is not determined than it is usually intercostal neuralgia or, in lower thoracic segments, abdominal wall neuralgia.

A.II TREATMENT OPTIONS

A.II.A CONSERVATIVE MANAGEMENT

Medical treatment with analgesics can be applied according to the World Health Organization pain ladder. In the event of neuropathic pain, co-analgesics such as antiepileptics and antidepressants can be administered. Transcutaneous electrical nerve stimulation (TENS) is an option for the treatment of thoracic radicular pain. Results for this specific treatment are not known. Physical therapy is usually applied in the form of manual therapy and focuses on the facet joints or costovertebral joints.

A.II.B INTERVENTIONAL MANAGEMENT

Interventional pain treatments consist of intercostal block, percutaneous radiofrequency (RF) treatment of the ganglion spinale (dorsal root ganglion, DRG) and pulsed radiofrequency (PRF) treatment of the ganglion spinale (DRG) or of the nervus intercostalis.

Intercostal Block

There are no recent publications that evaluated the effectiveness of intercostal blocks for the above-mentioned pain symptoms.

(Pulsed) Radiofrequency Treatment

Two publications report good results from RF treatment in thoracic radicular pain management. Stolker et al. evaluated 45 patients with thoracic radicular pain.[14] There was a significant reduction of pain in more than 70% of the patients 13 to 46 months after the treatment. A similar study was conducted by van Kleef and Spaans.[5] They found that 52% of the patients had significant pain reduction for 9 to 39 months. The effectiveness of the treatment was smaller when several segments were involved in the pain syndrome. There are no studies that compared RF treatment and treatment with PRF. There is one small retrospective study with a brief follow-up in which the treatment with PRF treatment of the nervi intercostales was compared with that of the ganglia spinalia (DRG).[15] PRF of the DRG resulted in a higher percentage of success, and the duration of the pain relief was longer (5 months vs. 3 months). The effect of classic RF treatment is better and lasts longer, but it damages the ganglion spinale (DRG).

Table 3. Evidence for Interventional Management of Thoracic Radicular Pain

Technique	Evaluation
Intercostal block	0
Radiofrequency treatment of thoracic ganglion spinale (DRG)	2 C+
Pulsed radiofrequency treatment of thoracic ganglion spinale (DRG)	2 C+

A.II.C COMPLICATIONS OF INTERVENTIONAL MANAGEMENT

The most prevalent complication of interventional treatment is postprocedural pain. Local pain occurs for a few days after almost all procedures. Twenty percent of the patients who received RF treatment reported that the postprocedural pain lasted for a few weeks. The most significant complication of thoracic blocks is pneumothorax; drainage maybe necessary in a number of cases. The patient is usually discharged from the outpatient clinic a few hours after the procedure. It should be emphasized that the presence of pneumothorax should be checked first. When in doubt, a thoracic X-ray should be made to rule it out.

Other Interventional Treatments

In cases of compression fractures resulting from osteoporosis, or even metastases, vertebroplasty can be considered.[16]

A.II.D EVIDENCE FOR INTERVENTIONAL MANAGEMENT

A summary of the available evidence for interventional treatment of thoracic radicular pain is given in Table 3.

A.III RECOMMENDATIONS

In cases of chronic thoracic radicular pain, an intercostal block can be performed as part of the diagnostic blocks. In case of therapy resistant pain, RF treatment or PRF treatment of the ganglion spinale can be considered.

A.III.A CLINICAL PRACTICE ALGORITHM

The practice algorithm is illustrated in Figure 1.

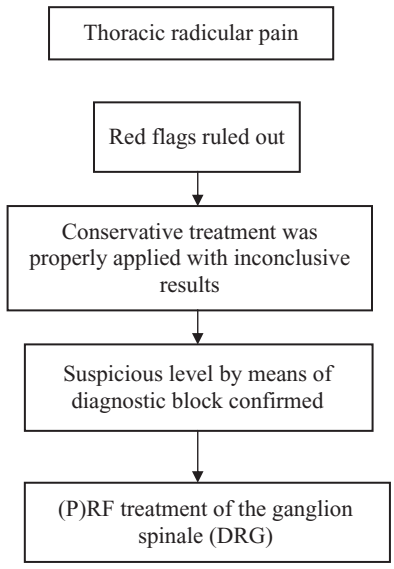

Figure 1. Decision algorithm for the treatment of thoracic radicular pain. PRF, pulsed radiofrequency; DRG, ganglion spinale (dorsal root ganglion).

A.III.B TECHNIQUES

RF Treatment of the Thoracic Ganglion Spinale (DRG) above Th7

The treatment is performed in a prone patient without sedation so that the communication with the patient is optimal. Because there is frequent overlap of the one thoracic segmental segment to the other, it is advisable to perform two or more diagnostic blocks in order to identify the segment involved. An intercostal block can be performed in order to confirm the involvement of a thoracic segmental nerve.[17] The RF treatment is performed at the level where the most significant pain relief can be gained. In the higher thoracic region, the classic posterolateral approach cannot be employed because the foramen intervertebrale is located more anteriorly and the proper injection site is difficult to reach due to the angle with the ribs. This is the reason why an alternative technique is applied to reach the ganglion spinale (DRG) at Th7 and higher.

Approach of the Ganglion Spinale above Th7

A dorsal approach is chosen with the patient in a prone position. The position of the needle tip is the craniodorsal part of the foramen intervertebrale, which is the same as in the classical dorsolateral approach. The site of insertion of the needle is the middle point (outer half) of the pediculus arcus vertebrae in the anterior posterior (AP) view (Figure 2). This approach is supported by data from a cadaver study which showed that the ganglion spinale (DRG) is located more laterally.[18] The injection site is confirmed with a lateral fluoroscopic view. This should focus on the median dorsal quadrant of the foramen intervertebrale where the ganglion spinale (DRG) is located. After local anesthetic injection, a small hole is

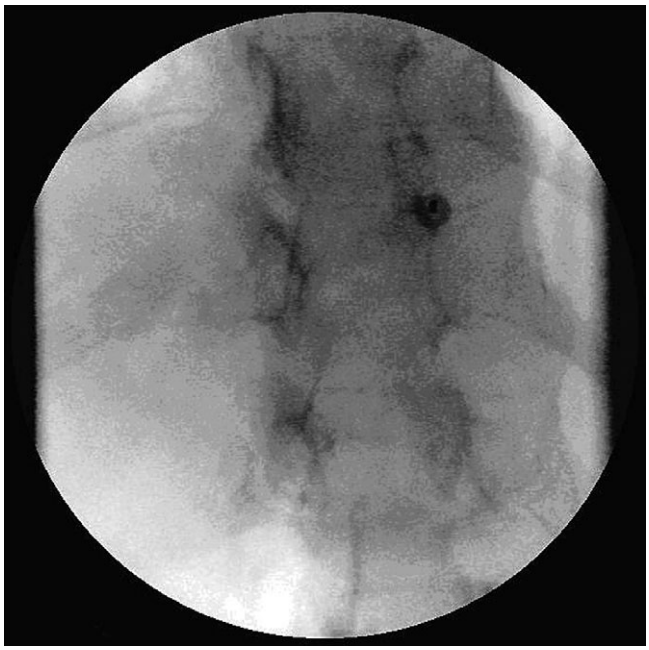

Figure 2. Radiofrequency treatment of the ganglion spinale (DRG) Th10: oblique view.

Figure 3. Radiofrequency treatment of the ganglion spinale (DRG) Th10: lateral view.

drilled through the lamina arcus vertebrae under fluoroscopic monitoring and a 16G Kirschner wire is inserted. While drilling, lateral radiological monitoring should be used to ascertain that the Kirschner wire does not shoot past the target area. The RF cannula is then inserted through a 14G needle that was placed through the drilled hole until it reaches the proper position in the foramen intervertebrale. It is important that the 14G needle is kept properly in position by an assistant so that the drilled hole is not missed. The final position of the RF cannula is monitored with a lateral fluoroscopic view. The needle should be located in the craniomedial dorsal part of the foramen intervertebrale (Figures 3 and 4).

The cannula stylet is replaced by the RF electrode and stimulation at 50 Hz is started. The patient should notice tingling in the selected dermatome at 0.4 to 1.0 V. Stimulation at 2 Hz should cause muscle contractions of the intercostal muscles with a stimulation threshold that is lower than 1.5 times the sensory threshold. When the electrode is placed properly, 0.4 mL iohexol contrast agent is injected to see if there is intradural or intravascular spread. Then 1 to 2 mL of lidocaine (1 or 2%) is injected and a 60-second RF treatment at 67°C is made.

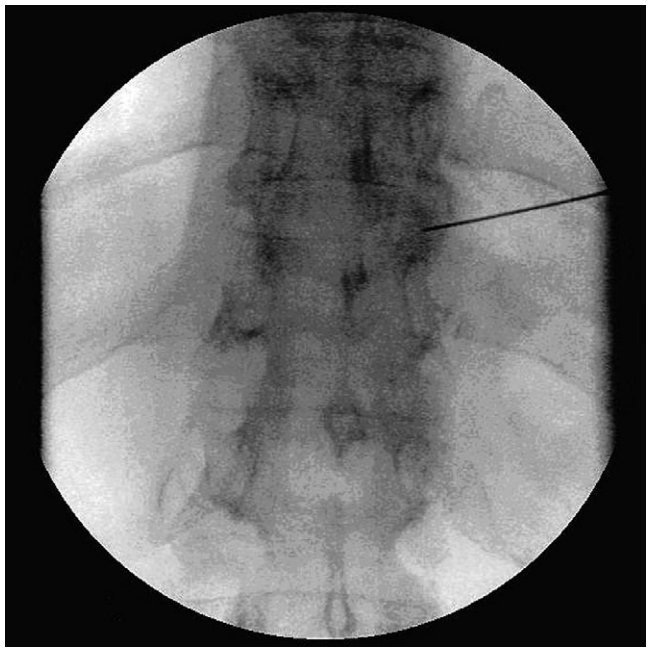

Figure 4. Radiofrequency treatment of the ganglion spinale (DRG) Th10: anterior posterior image. The needle is in the middle of the facet column.

RF Treatment of the Thoracic Ganglion Spinale (DRG) below Th7

For the low thoracic levels, one can treat the ganglion spinale (DRG) with a technique used at the lumbar level. The foramen intervertebrale is noted on the X-ray image at 15° oblique position. Under AP fluoroscopic monitoring, the tip of the 10-cm-long needle is noted to be caudal to the pediculus arcus vertebrae

at the lateral half. In transverse view, the tip is located in the craniodorsal part of the foramen intervertebrale. The stylet is removed and the electrode is placed. Upon stimulation at 50 Hz of current between 0.4 and 0.8 V, a tingling sensation is noted at the corresponding dermatome; motor stimulation is at 2 Hz with the threshold value at least twice as high as the sensory threshold value. The anesthetic lidocaine 2% is injected after the correct position of the needle is confirmed with a water-soluble contrast agent and an intravascular injection is ruled out. Subsequently, a RF treatment of 67°C for 60 seconds is made. In the event that one wants to perform a PRF treatment, there is a minimum for the sensory threshold value. Although this treatment is often not painful, a local anesthetic injection is still necessary because contractions may occur that can dislocate the electrode. If a RF treatment is applied, a minimum threshold value is needed, otherwise the electrode gets too close to the ganglion spinale (DRG), completely destroying the ganglion, especially in cases of RF of the thoracic ganglia spinalia (DRG). Percutaneous RF treatment of the ganglion spinale (DRG) in the upper thoracic segment (Th8-Th10) has always been difficult since an oblique approach is not possible because of the risk of pneumothorax.

PRF Treatment of the Thoracic Ganglion Spinale (DRG)

Presently, only retrospective studies are available on the effects of RF treatments of the ganglion spinale (DRG) at the thoracic level. The use of PRF increased in the 1990s probably to avoid the disadvantages of classic RF treatment, ie, destruction of the neural tissue possibly resulting in neuropathic pain. With PRF, it is possible to treat nervi intercostales. Above the Th7 level, no hole needs to be drilled for this technique because PRF could be applied to the segmental nerve that is located more peripherally. A cannula is used to insert the RF electrode (eg, SMK 10). Positioning is similar to that of a normal intercostal block. Subsequently, the electrode is placed in the cannula and stimulation current of 50 Hz is administered. Tingling sensation results from a stimulation of less than 0.6 mA. A tetanic contraction of the intercostal muscles sometimes occurs when the strength of the current is increased since the intercostals nerve is a mixed nerve. The effectiveness of this treatment is not completely known. If this technique is not effective, then a classic RF treatment can be considered.

A.IV SUMMARY

Thoracic radicular pain has an extensive differential diagnosis. Physicians should be aware of potentially malignant causes of this pain symptom and, in the event of an increase or change in symptoms, should perform adequate diagnostics tests. Usually, a CT or an MRI scan seems to be reasonable prior to starting symptomatic treatment (interventional treatment). Determination of the affected level should be carried out by a number of intercostal blocks of the suspected segments. The segment that provides the most temporary pain relief can be selected for treatment. Currently, limited results are known about PRF treatment of the ganglion spinale (DRG) at the thoracic level. However, it seems to be a reasonable choice at the present time in view of the less invasive character of this treatment. If the effect of PRF is short and the pain involves one or two segments, then RF treatment of the ganglion spinale (DRG) can be performed. Extensive skills are required to execute this procedure above the level of Th7 so this treatment should take place in specialized centers.

B. THORACIC FACET PAIN

It is known that thoracic facet joints can be a source of thoracic pain. A recent study showed that, in a population with localized thoracic pain, the prevalence of thoracic facet joint pain amounts to 42%. According to this study, the facet joints in the cervical region contribute to 55% of the spinal pain.[19] In contrast, facet-mediated pain accounts for 30% in the lumbar region.

The innervation of the thoracic facet joints has not been conclusively shown, consequently, the technique of RF facet treatment has not been finalized.[20,21] The technique that we describe will probably have to be altered in the future.

Thoracic facet joints are directed more vertically than the lumbar facet joints. As all facet joints, they are innervated by the rami mediales (medial branches) of the rami dorsales of the segmental nerves. Each facet joint shows a bisegmental innervation by the ramus medialis (medial branch) of the same level and the ramus medialis (medial branch) of the vertebral level above it. There is debate about the precise pathways of the nerves.[22,23] The thoracic rami mediales (medial branches) run through the space between the processus transversus and are in contact with the superolateral portion of the processus transversi. They then continue to run medially and inferiorly across the posterior surface of the processus transversus where they inner-

vate the musculi multifidi. While the arched course essentially remains the same, the nerves branch off at a point superior to the superolateral corner of the processus transversus (Figure 5).

B.I DIAGNOSIS

B.I.A HISTORY

There are two publications on the symptoms of thoracic facet pain,[22,23] wherein the authors investigated the patterns of referral pain associated with the thoracic facet joints. Both groups claim a typical radiation pattern of the several thoracic facet joints (Figure 6).

Our experience is that the diagnosis of thoracic facet pain should be considered if the patient complains of paravertebral pain that worsens with prolonged standing, hyperextension, or rotation of the thoracic spinal column. The pain is often bilateral and affects several segments. Sometimes, the patient reports that the pain is felt more ventrally; hyperesthesia sometimes occurs in the adjacent dermatomes.

B.I.B PHYSICAL EXAMINATION

Physical examination reveals no signs of neurological impairment. Pain can be elicited by paravertebral pressure. Analogous to the cervical and lumbar regions, paravertebral pressure pain could be a predictor of thoracic facet pain.[24] None of the symptoms noted on a physical examination appears to be specific for the diagnosis of thoracic facet pain.

Clinical Signs and Symptoms of Thoracic Facet Pain

- Nearly continuous unilateral or bilateral paravertebral pain in a distinct thoracic area of the back, without neurological findings;
- Paravertebral tenderness in the same area;
- X-ray: normal or minimal changes;
- Diagnosis local anesthetic blocks.

B.I.C. ADDITIONAL TESTS

CT or MRI scans are part of the standard tests for thoracic pain to rule out pathologies that have also been described for thoracic segmental pain. This could reveal disc and/or facet pathology, although these are not necessary for the diagnosis. The diagnosis can be established by diagnostic test blocks of the rami mediales (medial branches), at two levels per joint, innervating the facet joint that corresponds to the level of the paravertebral pressure pain.

B.I.D DIFFERENTIAL DIAGNOSIS

Thoracic pain: always exclude "red flags"

- Intrathoracic pathology (aneurysm, cancer);
- Intra-abdominal pathology (referred pain);
- Thoracic disc herniations.

B.II TREATMENT OPTIONS

B.II.A CONSERVATIVE MANAGEMENT

There are no known studies that investigated other conservative management of thoracic joint pain. The effects of medication, physical therapy, TENS, and perhaps manipulation are performed prior to an interventional treatment.

B.II.B INTERVENTIONAL MANAGEMENT

Percutaneous RF Facet Denervation

There are a limited number of studies on the efficacy of classic RF in thoracic facet-mediated pain. Stolker et al. evaluated 40 patients with thoracic pain symptoms who underwent 51 percutaneous RF facet denervations.[21] Twenty-four underwent the procedure on the left side, 21 on the right side, and six bilaterally. They showed that 82% of the patients had 50% to 75% reduction in pain symptoms 2 months after the intervention. The long-term relief was also considerable. In another study, Tzaan and Tasker noted a success rate of 40% in 15 patients who received one RF treatment of the ramus medialis (medial branch) of the thoracic rami dorsales.[25]

Cooled RF ablation of the thoracic facets medial branches is a promising technique. It provides relatively large lesions that compensate for the anatomic variability of the thoracic facets medial branches. Currently, the technique is under investigation and no RCT is available.

B.II.C COMPLICATIONS OF INTERVENTIONAL MANAGEMENT

Similar to all RF procedures, it is possible that the pain briefly increases after the procedure. One must constantly be aware of pneumothorax as a complication in the thoracic region. Observation of proper techniques should minimize this risk, while constant monitoring should result in immediate diagnosis and the institution of appropriate treatments.

B.II.D EVIDENCE FOR INTERVENTIONAL MANAGEMENT

A summary of the available evidence for interventional treatment of thoracic facet pain is given in Table 4.

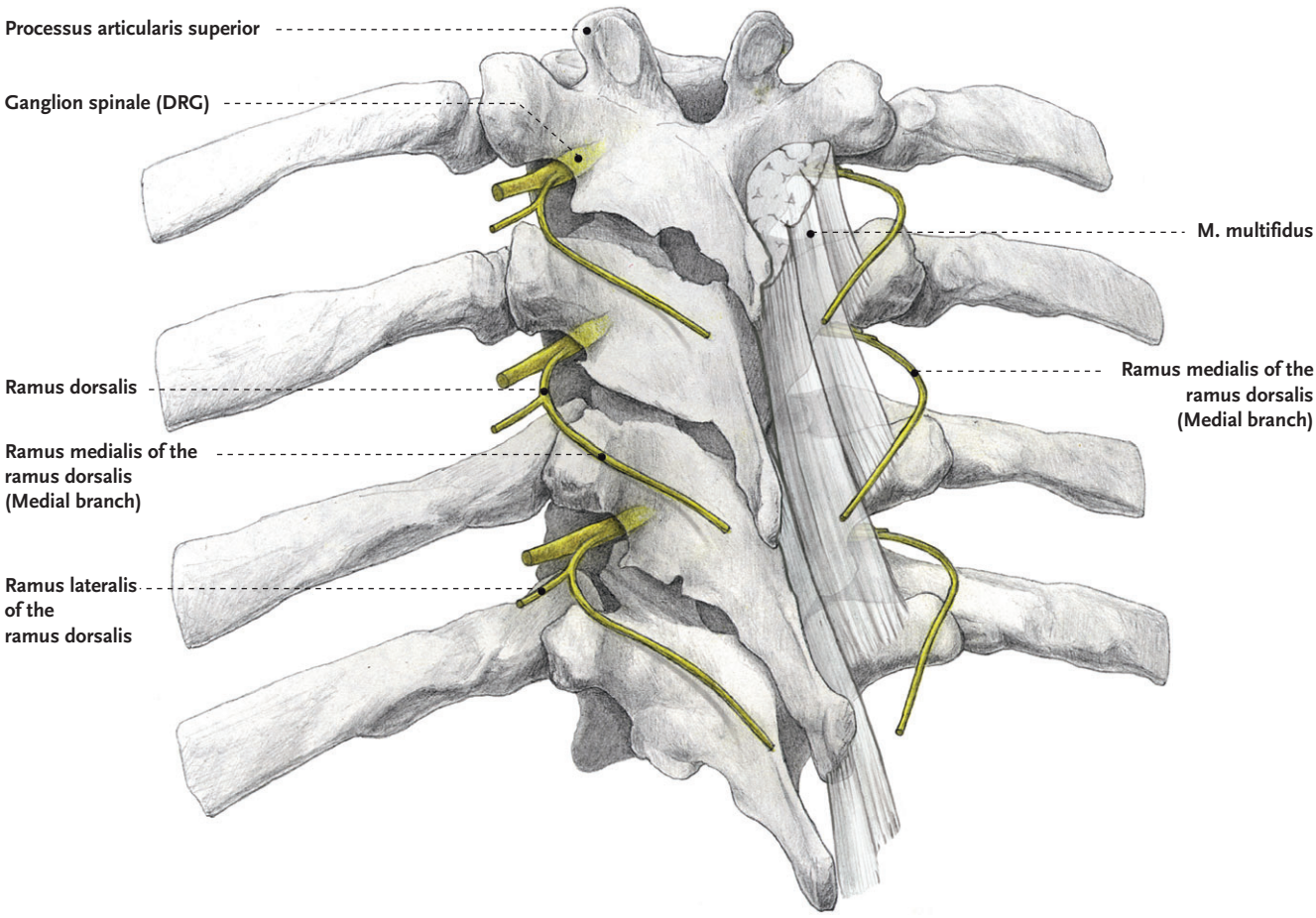

Figure 5. Anatomy and innervation of the thoracic spinal column. (illustration Rogier Trompert Medical Art www.medical-art.nl).

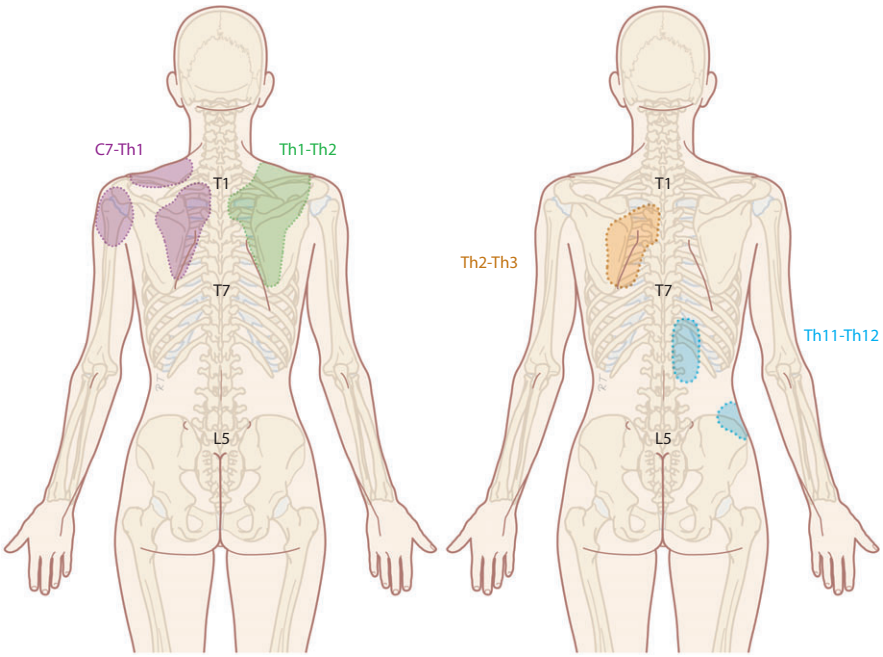

Figure 6. Radiation pattern of thoracic facet pain. (illustration Rogier Trompert Medical Art www.medical-art.nl).

Table 4. Evidence for Interventional Management of Thoracic Facet Pain

Technique	Evaluation
Radiofrequency treatment of the ramus medialis (medial branch) of the thoracic rami dorsales	2 C+

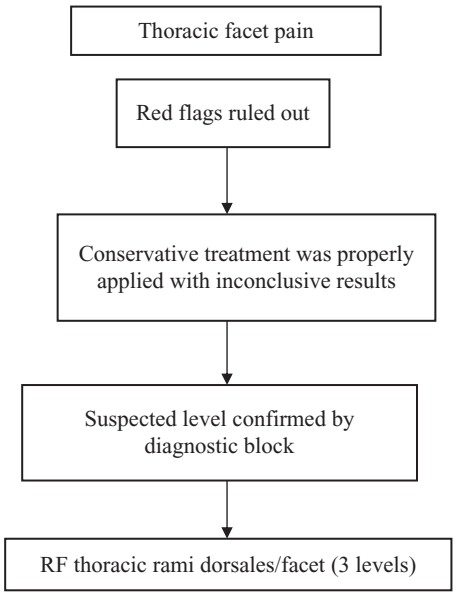

Figure 7. Decision algorithm for the treatment of thoracic facet pain. RF, radiofrequency.

B.III RECOMMENDATIONS

RF treatment of the rami dorsales of the thoracic segmental nerve can be considered for patients with thoracic facet pain who have a temporary reduction in pain symptoms after a diagnostic block of the nerves innervating the affected thoracic facet joint.

B.III.A CLINICAL PRACTICE ALGORITHM

The practice algorithm for management of thoracic facet pain is illustrated in Figure 7.

B.III.B TECHNIQUES

RF Treatment of Thoracic Facet Joints

The patient lies prone on the operating table. In contrast to the intra-articular diagnostic blocks, there is controversy surrounding the RF treatment of the rami mediales (medial branches) of the rami dorsales at the thoracic level. The following technique is recommended. The C-arm is positioned in the axial plane and the proper level is identified by a steel ruler. A perfect AP fluoroscopic view shows the end plates of the vertebrae to be neatly projected over each other. The C-arm is turned obliquely and the final position of the tip of the needle is the junction between the processus articularis superius of the facet joint and the processus transversus (Figure 8). The site of insertion of the needle is marked on the skin and a RF needle is inserted parallel to the C-arm until contact is made with the bone at the junction between the processus articularis superius and the processus transversus. The needle is then positioned slightly more cranially and laterally, monitored from a lateral position (Figure 9). The tip of the needle should be posterior to the line that connects the anterior aspects of the foramen intervertebrale. Subsequently, neurostimulation initially takes place with 50 Hz first, then with 2 Hz. The 2 Hz stimulation causes contraction of the paravertebral muscles at intensities below 0.5 to 0.7 V. After local anesthetic is injected, a 60-second 20 V RF treatment at 80°C is made. We usually carry out this RF treatment at three adjacent levels due to the multisegmental innervation of the facet joints.

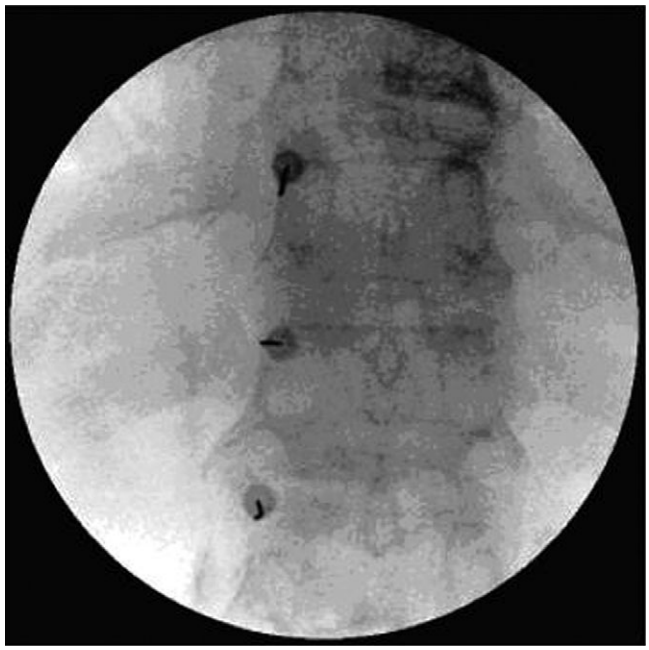

Figure 8. Thoracic radiofrequency facet denervation needle placement in anterior posterior view.

B.IV SUMMARY

Thoracic facet pain is not a clinical entity, it is determined as a diagnosis of exclusion. The diagnosis can be confirmed after the pain is temporary relieved after a diagnostic facet block. If the pain relief is at least 50%,

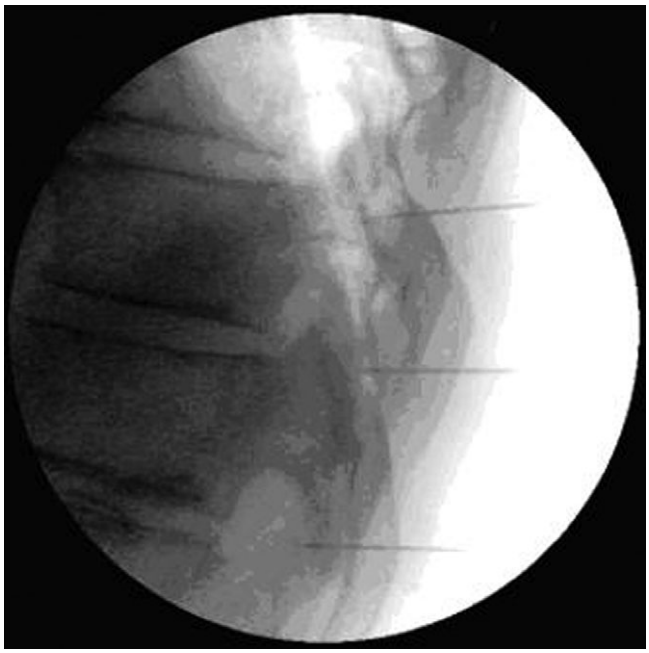

Figure 9. Thoracic radiofrequency facet denervation needle placement monitoring in lateral view.

then RF treatment of the innervation of these facet joints can be applied. The scientific evidence for this procedure is limited.

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