
Bogduk, Nikolai M.D., Ph.D., D.Sc.*

Newcastle, Australia

*Prepared on behalf of the International Spinal Injection Society with contributions from Anthony C. Schwarzer, M.B., B.S., Ph.D., Newcastle, Australia; Susan M. Lord, B.Med., Ph.D., Newcastle, Australia; Paul Dreyfuss, M.D., Tyler, Texas, U.S.A.; and William Wilson, M.D., Del Mar, California, U.S.A.

Address correspondence and reprint requests to Ms. Jordan Moncrieff, Executive Officer, International Spinal Injection Society, 1850 Sullivan Avenue, #110, Daly City, CA 94015, U.S.A.

THORACIC ZYGAPOPHYSIAL JOINT BLOCKS

I. Historical background
Thoracic zygaphophysial joint blocks are a relatively recent development. The literature is meagre, amounting to an abstract describing a case series,8 a paper describing technique,6 and a study in normal volunteers.5 Consequently, the prevalence of thoracic zygaphophysial joint pain is not known, and the utility of thoracic zygaphophysial joint blocks is, as yet, only conjectural.

II. Rationale
The thoracic zygaphophysial joints have been shown capable of being a source of thoracic pain and referred pain over the chest wall in normal volunteers.5 Consequently, they are possible sources of pain in patients presenting with thoracic or chest wall pain.

There is no evidence that thoracic zygaphophysial joint pain can be diagnosed by clinical examination or by medical imaging.

The principles established for cervical and lumbar zygaphophysial joint blocks apply. Controlled diagnostic blocks are the only means available of identifying this source of pain.1,7 Single blocks are not acceptable because of inordinately high false-positive rates.2

III. Anatomic basis
The anatomic basis for thoracic zygaphophysial joint blocks is outlined in a book chapter3 and primary research articles.4,5 The joints can be blocked either by intra-articular injections or by anaesthetising the medial branches of the dorsal rami that innervate the target joint.

IV. Face validity
The face validity of intra-articular blocks is self-evident. By infiltrating the target joint with contrast medium, radiography demonstrates that the target joint and only the target joint is infiltrated.

No studies have shown that thoracic medial branch blocks have good face validity. Indeed, attention is drawn to the fact that the medial branches of the thoracic dorsal rami do not assume the same course at different levels.4 The nerves at mid-thoracic levels do not run on bone. Instead, they are suspended in the intertransverse space. Consequently, the target points for blocks of these nerves are relatively intangible and require judgments about how far to withdraw a needle from bone rather than resting the needle onto a radiographically visible bony landmark. Furthermore, the spread of injectate at thoracic levels has not been studied, and it is not known if injected material spreads to anaesthetise other diagnostically relevant structures.

V. Indications
Thoracic zygaphophysial joint blocks may be performed in patients with thoracic pain for which no cause has been identified and whose pain pattern resembles that evoked in normal volunteers upon stimulation of their zygaphophysial joints.5
VI. Contraindications

Absolute

Bacterial infection: systemic or localised in the region of the blocks to be performed

Possible pregnancy

Bleeding diathesis: due to haematological disease or anticoagulants

Relative

Allergy to contrast media: may require cover with corticosteroid and H1 and H2 antagonists.

Allergy to local anaesthetics: may require identification of a class of anaesthetic to which the patient is not allergic.

On treatment with nonsteroidal anti-inflammatory medications, including aspirin, which may compromise coagulation.

VII. Objectives

The objective is to deliver a small volume of local anaesthetic either onto the nerves that innervate the target joint or into the joint itself to anaesthetise the joint and thereby test the hypothesis that the joint is source of the patient's pain.

VIII. Materials required

A. Radiological equipment

Fluoroscopy is mandatory to perform these procedures. The preferred equipment is a C-arm fluoroscope that allows the x-ray beam to be directed at any angle. Furthermore, to document the accurate placement of needles and the spread of contrast medium, a device must be available to obtain either hard-copy films or an image on specialised paper.

B. Needles, gowns, drapes, etc.

A 90-mm, 25-gauge needle is optimal, for it is minimally painful when passed through the skin and muscles overlying the target joint.

The needle may or may not have a Luer lock, but the latter is preferable.

A standard preparation tray may be used, which comes with cotton balls and gauze; but more elaborate trays can be custom made to come with needles and local anaesthetic.

Solutions for skin preparation may be an iodine-based solution (e.g., Povidone-Iodine), chlorhexidine, or an alcohol-based antiseptic (e.g., chlorhexidine 0.5% in 70% alcohol).

Sterile gloves are used.

C. Medications

Intravenous solutions, sedation, or antibiotics are not required.

D. Agents

1. Contrast medium

Radiographic contrast medium is essential for intraarticular injections. It is used to obtain an arthrogram of the target joint prior to any other injection. Any standard contrast medium can be used. One example is Omnipaque 240® (Winthrop, NY). Only a nominal amount (0.1-0.3 ml) is required to outline the target joint.

Contrast medium is not essential to confirm correct placement of needles for thoracic medial branch blocks, but it is advisable as a check against false-positive responses to demonstrate where the injectate spreads.
2. Local anaesthetics

Any conventional local anaesthetic can be used for diagnostic blocks. Agents most commonly used are bupivacaine 0.5% and lignocaine 2%. Other concentrations that can be used are bupivacaine: 0.75% and 0.25%, and lignocaine: 1% and 4%. Because small volumes are used, it is generally considered that high concentrations should be used to obtain the most effective anaesthetic effect.

For intra-articular injections, no more than 1.5 ml and generally not more 1.0 ml of local anaesthetic should be injected, to avoid bursting the synovial lining of the joint and having injectate disperse beyond the confines of the target joint.

For medial branch blocks, no more than 0.5 ml is required to block the target nerve adequately.

IX. Preliminary procedures

A. History and physical examination

A history and physical examination are required to exclude pain likely not to be of zygapophysial joint origin and to identify or exclude contraindications to blocks.

Pain maps are used to select the target joint in the first instance. These maps are not diagnostic, nor do they necessarily predict which joint will respond to blocks. However, they serve as a relatively reliable guide as to which joint is most likely to respond, in the first instance, if the patient actually does have thoracic zygapophysial joint pain.

Otherwise, a history and physical examination are required to record baseline data concerning the location and extent of pain, including a visual analogue score, and the movements and activities of daily living that are customarily prevented by the pain.

On the occasion of obtaining this baseline history, patients should be briefed as to how their response to blocks will be measured. They should be instructed in the use of any pain diaries or visual analogue scales that might be used.

B. Informed consent

Informed consent must be obtained. Zygapophysial joint blocks should be safe procedures, but like any invasive procedure, they carry the nominal risk of infection, bleeding, and allergic reaction. Furthermore, procedures around the thorax carry the nominal risk of pneumothorax, although this should not be the case if thoracic zygapophysial joint blocks are performed correctly. Nevertheless, patients should be warned about the risk, how pneumothorax will manifest itself, how it is managed, and what preparations are in place to manage it.

Patients should be advised that the procedure is essentially a diagnostic one and should not be confused with a therapeutic procedure. They should be advised that they may or may not obtain relief and that in particular they should be prepared for no relief ensuing. They should be advised that expecting any particular result confounds the purpose of the test and that they should report the result honestly and equanimously.

Other than to expect either relief or no relief, patients should not be informed of what duration of relief to expect. They should be prepared only to the effect that if relief ensues, they will need to monitor and record the duration and extent of any relief.

C. Premedication

No premedication is required.

X. Technique

A. Preparation

1. Physiologic monitoring

Not required.

2. Intravenous access

Not required.

3. Positioning

The patient lies prone on an x-ray table.
4. Sterility

The skin of the back of the thorax at the proposed entry point and surrounding area must be adequately prepared as for an aseptic procedure, using one of the solutions listed above. The prepared area must be allowed to dry to ensure sterility. A fenestrated drape made of cloth, paper, or plastic should be applied to cover the nonsterile areas surrounding the prepared area.

B. Target identification

Both for intra-articular blocks and for medial branch blocks, a posteroanterior view of the thoracic spine must be obtained. The thoracic zygapophysial joints are not themselves evident in these views, but their location can be estimated from the location of the thoracic pedicles. The joints lie behind the intervertebral foramina, and these foramina lie between the pedicles. The location of the target joint is determined by counting vertebrae and ribs from above.

For thoracic medial branch blocks, the target points are, in general, the superolateral corners of the thoracic transverse processes. The nerves to a particular joint are the ones that cross the transverse process above the joint and the transverse process below the joint. Numerically, if the joint to be blocked is the Tx-y joint, the transverse processes required are the Tx and Tx+1 transverse processes. Respectively, these are crossed by the Tx-1 and Tx medial branches. The numerical relationships between nerves, transverse processes, and joint are, therefore, like those of the lumbar region. Caution should be taken in interpreting and reporting the level to be blocked accurately both in terms of the joint anaesthetised and in terms of the nerves anaesthetised.

1. For intra-articular injections

The target joint will not be visible in posteroanterior views but can be gauged to lie between the two pedicles bearing the same segmental number as the target joint.

2. For medial branch blocks C8 to T10

The target transverse processes should be differentiated from the rib that lies in front and whose upper margin projects slightly above the transverse process.

4. For medial branch blocks T11, T12

At the T12 level, the medial branches of the thoracic dorsal rami assume a course that is lumbar in character. Instead of crossing the superolateral corner of the T12 transverse process, the T11 medial branch crosses the root of this transverse process. However, the T12 transverse process is short and may not be readily apparent on posteroanterior views. Nevertheless, it can be brought into relief by tilting the beam of the fluoroscope laterally so as to obtain an oblique view, not unlike that used for lumbar medial branch blocks. The target for the T11 nerve lies high on the "eye" of the "scotty dog" that appears, between 2 o'clock and 4 o'clock on the right, or between 10 o'clock and 8 o'clock on the left.

The T12 medial branch assumes a course exactly analogous to that of typical lumbar medial branches, and the target point for this nerve is the same as for typical medial branches. It lies on the junction of the superior articular process and the transverse process.

C. Needle placement

1. For intra-articular injections

Because the thoracic zygapophysial joints are oriented in the coronal plane, they cannot be entered directly from behind. Nor can they be entered from the side because of risk of pleural puncture.

Nevertheless, they can be entered from below. This requires an initial insertion of the needle one to two segments below the target joint.

A puncture point on the skin is selected one to two segments below the target joint and in line with the midline of the joint, such that on insertion, the needle will pass directly upwards to the joint.

The needle is inserted quickly through the skin and then carefully cephalad through the posterior thoracic muscles. Periodic screening is used to ensure that the needle does stray from a direct course straight toward the target point. The error margin in this regard should be no more that the width the target joint. The particular risks are passing the needle under a lamina into the epidural space and spinal cord or laterally into the pleura and lung.

The initial objective is to incur the lamina of the vertebra whose superior articular process contributes to the target joint, at a point within the silhouette of the pedicle immediately below the target joint, approximately midway between the centre of the pedicle and its 12 o'clock point. At this stage, with the needle in position, the C-arm is rotated so as to obtain a lateral view of the target joint. This appears as a longitudinal slit. The tip of the needle should be evident immediately below this slit. Once the slit is evident, the needle is carefully manoeuvred so as to just enter the bottom of the slit. A posteroanterior view is mandatory at this stage to ensure that the needle has not strayed medially or laterally. Ideally, in posteroanterior view, the tip of the needle should be opposite the midline of the
It is critical that the needle not be summarily inserted into the joint cavity once the latter is seen in a lateral view, for the needle may have deflected medially and be pointing to the epidural space. Taking a posteroanterior, check view ensures that this has not occurred. If it has, the needle is simply withdrawn and redirected to the joint. The check view enables the correction to be made before the needle has effectively entered the epidural space.

With the needle having been placed at the 6 o'clock position of the joint, it can next be advanced slowly for a short distance into the joint cavity. Correct passage will be indicated by lack of bony resistance and by the clamping sensation of the articular processes gripping the needle. Radiographically, the needle may exhibit a distinctive bend in its course.

Correct intra-articular placement will be indicated upon injecting a small amount of contrast medium, which on posteroanterior views will spread in a circular fashion, as a ring or a blush, as it outlines or fills the joint cavity. On lateral view, the slit of the joint cavity will be filled with contrast medium.

If an arthrogram is not obtained upon injecting contrast medium, the needle should be readjusted, following the steps outlined above until intra-articular placement is achieved.

Once successful placement of the needle into the joint cavity has been confirmed, 1 ml of local anaesthetic can be injected in an effort to anaesthetise the joint.

2. For medial branch blocks T1-4, T9-10

A puncture point on the skin is selected directly overlying the target point of the nerve. The needle is passed quickly through the skin and then slowly through the back muscles using frequent periodic screening. To avoid pleural puncture, the tip of the needle should never stray outside the boundary of the silhouette of the target transverse process. This ensures that there is always bone between the needle and the pleura.

If the transverse process is not clearly apparent or is short, its image can be accentuated by rotating the C-arm approximately 25° medially whereupon the transverse process will appear to elongate, and its superolateral corner will become more apparent.

The needle is advanced until it strikes the back of the target transverse process. If required, the needle is adjusted so as to rest on the back of the superolateral corner of the transverse process. At this point, 0.3-0.5 ml of local anaesthetic can be injected to anaesthetise the target nerve. Both the medial branches that innervate the joint should be anaesthetised.

3. For medial branch blocks T5-8

At these levels, the objective is to deliver the aliquot of local anaesthetic to a nerve passing dorsally and caudally in the intertransverse space just above and slightly dorsal to the typical target point on the superolateral corner of the transverse process. The depth of the injection is the same as the depth of the transverse process. The height of the injection is opposite the upper border of the rib at the target level.

A two-needle technique applies. The first needle is introduced as for typical thoracic medial branch blocks and is left in place on the superolateral corner of the transverse process. A second needle is next introduced parallel to the first but aiming at the back of the rib just above the corner of the transverse process. For introducing this second needle, the same precautions against pleural puncture apply as for the first needle. When the second needle strikes the rib, it will have been introduced more deeply than the first. After it has struck bone, the second needle is withdrawn until its hub is at the same height from the skin as that of the first needle. Its tip, therefore, will lie at the same depth as the back of the transverse process.

Once the second needle is in correct position and at correct depth, 0.3-0.5 ml of local anaesthetic can be injected.

4. For medial branch blocks T11, T12

The protocol to be followed should be the same as that for typical lumbar medial branch blocks.

D. Records

An image demonstrating the needle position must be obtained whenever a substance is injected. A plain radiograph may be obtained using conventional film or specialised paper. Such a record protects the operator in the event of alleged misadventure.

In the case of intra-articular injection, a hard copy of the arthrogram obtained should be retained to document accurate intra-articular injection.
XI. Postprocedural care

Upon removal of the needle, the skin is cleaned to remove the antiseptic and any blood. A small adhesive patch can be applied to the puncture sites but is probably unnecessary.

If the patient reports any untoward side effects following the procedure, appropriate action must be taken. A common reaction is a vaso-vagal response. This is managed with pulse and blood pressure observations and rest in the supine position. Rarely is any further intervention indicated.

Otherwise the procedure is usually well-tolerated, and the patient may be allowed to dress and await evaluation and discharge.

Discharge instructions include

To seek medical attention should any difficulty in breathing occurs.

To contact the doctor who performed the procedure if there is any unusual symptom or pain following the procedure. Fever and tenderness greater than that which might be ascribed to a needle track may be signs of infection.

To this end, an instruction sheet with a name and telephone number is useful. This sheet should be separate from any other data sheets given to the patient.

To monitor the extent and duration of any relief that ensues. To this end, a pain diary is helpful. However, it is critical to note when the pain starts to return and when it returns to its former, accustomed intensity.

If relief occurs, the patient should carefully attempt those movements and activities of daily living that customarily are restricted by pain, to determine if these movements and activities can be resumed while painfree. The patient should record those movements and activities that he or she has been able to resume.

XII. Evaluation

Evaluation of the patient's response should be face-to-face or by telephone, within 24 hours of the procedure so that the details of the response are fresh.

The assessor should record the topographic location and extent of any relief and its profundity (i.e., to what extent was the pain in that region relieved in percentage terms). The reliable ideals are 100% and 0%. Intermediate degrees of relief are indeterminate and probably negative.

The assessor should record the duration of relief in terms of when the pain started to return and when it resumed its accustomed intensity.

XIII. Interpretation

A positive response to a block is, prima facie, one in which there is greater than 90% of relief of that part of the patient's pain which the blocks might be expected to relieve, for a duration commensurate with the expected duration of action of the local anaesthetic used.

The figure of 90% is advocated to imply essentially complicate relief of the patient's usual pain, with the remaining 10% allowing for procedural pain such as that from the needle track.

If a single joint is responsible for all of a patient's pain, complete relief of all pain should be obtained.

However, it may be that a patient has pain from more than one joint or from more structures than a zygapophysial joint.

If more than one joint is symptomatic, and the one tested is one of these, the patient will obtain complete relief of that pain stemming from this joint, but no relief of pain from the other joints. An example might be bilateral zygapophysial join pain; but if only the left side is blocked, the pain on that side should be relieved, while the pain on the right will not. This nonetheless constitutes a positive response, for the intention was to relieve the left sided pain; there was no intention to relieve the right sided pain.

Another example might be at two consecutive segments. If a patient with T5-6 and T6-7 pain undergoes a successful T6-7 block, T6-7 pain will be relieved but not T5-6 pain. The response is nonetheless positive, for the target pain was indeed relieved.

These responses are partial topographically but complete physiologically.
If a comprehensive evaluation is required, each putatively symptomatic joint should be blocked serially. A positive response to each block will be indicated by complete relief of pain in a distinct topographic region attributable to that joint.

If all symptomatic joints are blocked simultaneously, the patient should obtain complete relief of all pain.

If the patient obtains no relief, the joint blocked is excluded as a possible source of pain.

If the patient obtains complete relief, the block must be repeated under controlled conditions to confirm that the response was true-positive.1,7

References


