

Ganglion Impar (Walther) sympathetic nerve procedures for coccydynia

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Cite: Foye, PM, Shenouda, MK. Ganglion Impar (Walther) sympathetic nerve procedures for coccydynia. In: Maigne JY and Doursounian L (eds) Coccyx Disorders. Proceedings of the First International Symposium on Coccyx Disorders, Paris, 2016. pp 106-116.

GANGLION IMPAR (WALTHER) SYMPATHETIC NERVE PROCEDURES FOR COCCYDYNIA

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INTRODUCTION

This paper will discuss the importance of ganglion impar procedures in patients with coccydynia (also called coccygodynia, coccyx pain, or simply tailbone pain). We will review the ganglion impar anatomy, historical perspectives and various technical approaches for performing these procedures, medical indications and outcomes in patients with coccydynia.

The importance of this topic is clear from Plancarte's statements that the ganglion impar has been fully «recognized as a key mediator to the sympathetically conveyed pain of the pelvic floor» [51] and «this tiny anatomical structure has been acknowledged as having a pivotal role as responsible for pain of sympathetic origin in the pelvic region.» [50] Ganglion impar blocks

are reported to be «useful and effective» in pain management. [5]

This paper will review ganglion impar injections relative to pelvic pain syndromes in general, but will primarily focus on their use specifically for coccydynia.

ANATOMY

Of all the sympathetic nervous system ganglia in the human body, the ganglion impar is located the lowest or most inferiorly. The word «impar» is Latin for solitary or unpaired, thereby designating that the ganglion impar is the only sympathetic nerve ganglion that is unpaired. All other sympathetic ganglia are arranged in pairs with both right and left locations, whereas the ganglion impar is unitary and located at the midline. It was historically believed to be located posterior to the rectum and anterior to the lower

sacrum or anterior to the sacrococcygeal joint (SCJ). However, Oh's 2004 cadaveric dissection study revealed that 82% of the time the ganglion impar is actually located inferior to the level of the SCJ (i.e., anterior to the coccyx rather than anterior to the SCJ). [46] This location has important implications since older procedural approaches were targeted to the level of the SCJ.

The ganglion impar is reported to provide sympathetic nervous system innervation to the perineum, distal rectum, anus, distal urethra, vulva, and distal third of the vagina. [1, 3]

The ganglion impar was reportedly first described by German anatomist Augustin Friedrich Walther in the early 1720s. [63] So it is sometimes referred to as Walther's ganglion.

PROCEDURAL VARIATIONS

There are several different approaches available for physicians performing injections at the ganglion impar. The differences in techniques vary by the site of needle insertion, the needle trajectory or pathway, the diameter (gauge) and length of needles used, the type of image-guidance used, as well as the volume and composition of the medications injected or the modality administered.

ANATOMICAL APPROACHES

Anococcygeal Approaches

In 1990, Plantcarte published the first ganglion impar injections. Plantcarte's anococcygeal approach involved inserting a needle (bent 25-30°) through the anococcygeal ligament (ACL) and advancing the needle superiorly (posterior to the rectum and anterior to the coccyx, under fluoroscopic guidance) until the needle tip reached just anterior to the SCJ.

In 1997, Nebab reported a similar ACL technique but used a curved (instead of bent) needle to allow easier use of the stylet within the spinal needle. [45] Subsequent publications have pointed out that the ACL-approaches were often done with the clinician placing a finger inside the patient's rectum to avoid rectal perforation by the needle [7, 24, 25, 65], although no such perforations have been reported.

Sacrococcygeal Approaches

In 1995, Wemm and Saberski first reported sacrococcygeal ganglion impar injection. A 22-gauge, 3.5-inch needle was inserted from posterior to anterior through the SCJ, until the tip is just anterior to the SCJ, with placement confirmed via fluoroscopy. [65, 56, 15] In addition to being a more direct (shorter) trajectory, this technique avoided the need for a clinician's finger inside the patient's rectum. [65]

In 2004, Munir et al. modified the SCJ approach by using a needle-inside-needle technique, passing a 22-gauge introducer needle through the SCJ and then inserting a thinner (25-gauge) needle. [44] Their goal was to decrease their instances of needle breakage.[44] Multiple subsequent authors also used the SCJ approach [9, 10, 21, 22, 31, 54, 59, 60] including needle-in-needle techniques [10, 31, 54, 59, 60].

One study comparing the ACL approach with the SCJ approach found similarly beneficial outcomes with both techniques. [21]

Intra-coccygeal (Trans-coccygeal) Approaches

In 2006, Foye first published approaching the ganglion impar through the «first intra-coccygeal junction,» passing the needle from posterior to anterior through the joint space between the first and second coccygeal bones. [18] This has been referred to as an intra-coccygeal joint (ICJ) approach or trans-coccygeal approach.

Compared with the SCJ approach, the ICJ technique has multiple potential benefits:

1) The resulting ICJ needle tip placement is closer to the actual ganglion impar location [12, 14, 15, 16] (as per Oh's cadaver study which show that 82% of cases have the ganglion impar inferior to the SCJ. [46])

2) Contrast/injectate most commonly flows cephalad (superiorly), implying that needle tip position should be at or below (but not above) the target location, which can be accomplished via the ICJ approach. [12, 14]

3) Radiology research has shown that the SCJ is fused in 51% of patients compared with the first ICJ being fused in just 12% (thus the SCJ is fused almost 5 times more frequently). [53] A skeleton study showed that SCJ fusion is as high as 68% in Scottish males. [57] Reig even reported needing to use a sterile mallet to hammer a very thick (15-gauge) introducer needle through the SCJ, [54] which would clearly be expected to cause musculoskeletal sacrococcygeal trauma. The ICJ approach avoids needing to traverse the commonly fused SCJ. [14, 15, 16]

4) It is easier to visualize the ICJ than the SCJ on the fluoroscopy lateral view, because the SCJ may be partially obstructed by the bilateral coccygeal cornua. [12, 14, 15, 16]

5) At the SCJ, needle passage may be obstructed by the bilateral coccygeal cornua. [12, 14]

6) Being slightly farther from the sacrum, the ICJ approach may decrease the chance of inadvertent sacral nerve blocks or ablation.

The ICJ approach also has some advantages over the ACL approach:

1) The ICJ needle is much shorter (2 inches versus 3.5 inches), thus resulting in less length of tissue trauma.

2) ICJ needle insertion is farther from the anus, which may theoretically decrease the risk of infection.

3) ICJ needle trajectory has proximity to far less of the length of the rectum, theoretically decreasing the risk of rectal perforation.

4) The ICJ approach does not require insertion of finger into rectum, improving patient comfort and amenability.

In 2007, Foye additionally reported other new approaches via the other intra-coccygeal joints (e.g. between the second and third coccygeal bones). [12]

Other authors have subsequently also published using the ICJ approach for ganglion impar injections. [9, 29]

Para-coccygeal Approaches

In 2003, Huang first published a para-coccygeal approach where the needle is advanced to touch the transverse process of the first coccygeal bone, and then directed slightly inferior and medial to that. [30] They used a 22-gauge 9-centimeter needle and their published image shows very substantial bending of the needle into a «U»-shape or fish-hook shape.

In 2004, McAllister published an alternative para-coccygeal approach, without targeting the coccygeal transverse processes. [39, 40, 41] He used a 22-gage 3.5-inch spinal needle prepared with two 110-degree bends (fish-hook shape).

In 2006, Ho published a far-lateral approach using two (bilateral) 22 gauge 5-inch needles. [28] Ho speculated that this approach might have less risk of needle breakage since the needles were passing through softer tissue structures. [27] But this technique was critiqued based on be very long lengths of needles used (thus increased lengths of tissue trauma) and the unnecessary bilateral approach to a solitary midline target structure. [13]

In 2009, Foye published another alternative para-coccygeal approach, using a «corkscrew» technique of contacting the lateral coccyx and rotating the bent tip of a 25-gage two-inch spinal needle with a slightly bent tip (20-30°). [19] Compared with Huang's technique, this approach used a shorter needle (thus less tissue trauma), much less bending of the needle (thus allowing easier use of the stylet), and avoided the need to contact the often-elusive coccygeal transverse process. [19]

IMAGE GUIDANCE

Ganglion impar procedures are performed with a variety of different image-guidance techniques. Image guidance allows the injecting physician to see the internal anatomical landmarks, needle placement, and contrast fluid flow. Image guidance for ganglion impar injection is typically provided via fluoroscopy [2, 12, 14, 16, 17, 18, 19, 22, 49, 58] or computerized tomography (CT) scanning [4, 13, 28]. Ultrasound has also been used [24, 25, 36, 63], although, «Ultrasound alone cannot be safely used because unlike fluoroscopy it is not a good indicator of needle depth.» [63] So, although ultrasound may be used as the guidance for the initial needle insertion, fluoroscopy was still needed to make sure the needle tip did not advance too far anteriorly (into the rectum). [36]

Most recently, MRI (magnetic resonance imaging) guidance was used for ganglion impar injection in six cadavers. [38] MRI-guided ganglion impar blocks do not expose the patient or clinician to additional ionizing radiation. [20, 38] But expensive cost may be a concern against MRI guidance. [38]

TYPES OF INJECTIONS

Diagnostic Sympathetic Blocks

Response to sympathetic nervous system blockade can provide diagnostic information regarding whether the patient's symptoms include a component of sympathetically maintained pain. [32] Further, response to ganglion impar blocks may indicate whether therapeutic procedures targeting those same nerve fibers may be clinically helpful.

Some of the typical ways to assess responses to sympathetic blockade may not apply at the coccyx. Three groups of tests for sympathetic nervous system (SNS) include: 1) testing sympathetic function (e.g., skin conduction and sweat tests), 2) testing blood flow (e.g., Doppler flowmetry, temperature, distal perfusion pressure, vascular oxygen tension, etc.), and 3) testing pain relief. [32]

However, those first two groups of SNS tests, although commonly used for peripheral limb evaluations, may be irrelevant at a midline axial location such as the coccyx, where no side-to-side comparisons can be made. So, pain relief is the primary outcome used to evaluate response to coccygeal sympathetic nerve block (ganglion impar block).

A diagnostic block is considered positive if the injected local anesthetic provides at least 50% relief of the targeted symptoms. [20] A more demanding threshold is to require at least 80% relief. [9]

Most ganglion impar diagnostic blocks involve injecting 1-10 mL of bupivacaine (0.25% or 0.5%) or lidocaine (1%). [8, 28, 36, 37, 44, 49, 52, 54, 60]

Deciding on Treatment via Ablation versus Non-ablation

If pursuing a therapeutic ganglion impar injection, options include ablation procedures (chemical ablation, radiofrequency ablation, cryoablation) versus non-ablation injections (local anesthetics with or without corticosteroids). For patients with

perineal pain, Toshinal's algorithm treated cancer pain with ablation and treated non-cancer pain with combined steroid/anesthetic injections. [60]

Therapeutic Anesthetic Injections

Some medical publications have documented that ganglion impar local anesthetic injections (without any steroid or ablation) can provide substantial and long-lasting relief for coccydynia. Datir documented a series of patients with coccydynia who failed conservative management. [4] They were then treated these patients with a 0.5% bupivacaine injection at the ganglion impar. 75% of patients obtained significant relief. [4] Buttaci and Foye published that a single ganglion impar lidocaine injection can provide a coccydynia patient with 100% relief which is still fully maintained beyond one year. [2]

Thus, sustained analgesic relief of coccydynia can be obtained after administering transiently-acting local anesthetics for a ganglion impar sympathetic block. Foye has referred to this as «resetting the thermostat» to a lower (or absent) level of pain. [17]

Therapeutic Injections of Steroids Plus Anesthetics

Various pelvic pain syndromes have been treated with ganglion impar injections using a combination of local anesthetics plus corticosteroids. [33, 39, 41, 43, 58, 60] These typically included 0.5 mL to 12 mL of bupivacaine (0.25% or 0.5%) combined with 20-40 mg of triamcinolone or methylprednisolone.

One publication described injecting the ganglion impar with bupivacaine (10 mL, 0.375%) mixed with 75 ug of clonidine in patients with coccydynia. [42] They reported that the clonidine presumably prolonged the duration of blockade by up to 14 days.

Chemical Ablation

Multiple authors have described chemical ablation of the ganglion impar, by injecting phenol [8, 10, 36, 37, 44, 49, 58, 60, 64], alcohol [25, 28, 29, 44], or formaldehyde [63].

Those phenol injections have ranged from 4% to 10% concentrations, sometimes in aqueous solutions or mixed with contrast or meglumine (an amino sugar). Typical phenol volumes for ganglion impar injections have ranged from 1-8 mL.

Alternatively, chemical ablation via alcohol at the ganglion impar involves injecting 1-2 mL of «absolute alcohol» [44], 4 mL of «100% dehydrated alcohol» [29], or a 4 mL mixture containing 1 mL of 0.5% bupivacaine plus 3 mL of «100% alcohol» [28].

Radiofrequency Ablation (RFA)

Reig in 2005 reported ganglion impar RFA for patients with coccydynia and other pelvic pain syndromes. [54] Demircay in 2010 reported a case series of patients with chronic coccydynia (pain > 6 months) treated with radiofrequency thermocoagulation of the ganglion impar. [9] Mean pain scores improved by more than 50%, and health-related quality-of-life assessments also significantly improved. Successful relief was still sustained six months later in 90% of patients.

Cryoablation

In 1998, Loev reported a single case of chronic anal and perineal pain treated with ganglion impar cryoablation (after diagnostic injection provided 100% relief but phenol ablations had provided only six weeks of 70-80% relief). [37] For the cryoablation, they used a very large (10-gauge, 5 inch) intravenous catheter/needle, to guide the cryoprobe through the sacrococcygeal joint. The patient obtained 80% pain relief for 6 weeks, with a 70% decrease in use of opioid analgesics. Repeat cryoablation provided similar results for 12 additional weeks.

Neuromodulation: Pulsed Radiofrequency

Kuthuru reported ganglion impar pulsed radiofrequency (PRF) providing good relief of coccydynia. [34] Usta reported ganglion impar PRF providing 80% sustained relief for coccydynia. [62] The goal of PRF is to provide non-destructive neuromodulation rather than neuro-ablation. [61, 62]

COCCYDYNIA-SPECIFIC OUTCOMES VIA GANGLION IMPAR INJECTIONS

Multiple published reports have documented relief of coccydynia (including cancer and non-cancer cases) via various types of ganglion impar injections. [3] Even a single injection of lidocaine at the ganglion impar for nonmalignant coccydynia has been reported to produce 100% relief still sustained one year later. [18] A case report of a 15-year-old boy with two years of coccydynia documented that a single ganglion impar injection of bupivacaine produced 50% relief that was still sustained at one year follow-up. [11]

A study of 20 ganglion impar anesthetic blocks

for nonmalignant coccydynia noted that the majority of injections produced 50-75% relief. [2] A study of 10 patients with nonmalignant chronic coccydynia (pain > 6 months) showed that ganglion impar RFA produced successful relief in 90% of patients for at least six months post-procedure. [9]

A study of 22 patients with coccyx pain showed that ganglion impar injection with bupivacaine/saline/methylprednisolone produced greater than 50% relief in 82% of patients, with a six month median duration of relief. [22]

A repeat (second) injection in nine of those patients gave much more substantial duration of relief, lasting for a median period of 17 months. [22]

A case report of coccydynia treated with ganglion impar pulsed radiofrequency (PRF) documented «good pain control.» [34] Another case report of coccyx pain treated with PRF documented 80% sustained relief at four months post-procedure. [62]

A case report of coccydynia reportedly due to pre-coccygeal calcific tendinitis documented that a single anesthetic plus corticosteroid injection anterior to the SCJ not only relieved the pain but also seemed to reduce the size of the pre-coccygeal calcification six weeks post-injection. [43] It seems likely that the helpful injection at this site included ganglion impar blockade.

A research study of 42 patients with nonmalignant pelvic pain included three patients with coccydynia. [64] All were treated with ganglion impar chemical ablation (using 4% phenol) and good relief (defined as an absolute decrease of at least three points on the visual analog scale) was obtained in two of the three coccydynia patients (67%).

NON-COCCYDYNIA INDICATIONS

Non-coccydynia indications for ganglion impar injections are not the focus of this article. But it is worth noting that these injections have been reported as helpful for various pelvic-region pain syndromes due to malignant causes [7, 10, 21, 25, 49] and non-malignant causes [33, 37, 48]. These typically include pain syndromes in the anal, rectal, perineal, and other lower pelvic regions.

COMPLICATIONS

Multiple authors have explicitly pointed out that there had been no reported complications from ganglion impar injections. [1, 3, 7, 8] Theoretical complications include needle breakage, rectal perforation and inadvertent epidural injection. [3]

Ganglion Impar injections have a very low rate of inadvertent vascular uptake (1%). [35] Fluoroscopic detection of such a vascular contrast flow pattern allows appropriate modification of the needle tip position to successfully achieve an appropriate non-vascular deposition of injectate.

SUMMARY AND CONCLUSIONS

Within many medical publications over many years, ganglion impar injections have been documented to be beneficial in patients with coccydynia. While many of the medical publications are case reports or small case series, as a collective body of work those which addressed coccyx pain almost universally report benefit from ganglion impar procedures. The cumulative evidence from published outcomes throughout the literature supports the use of ganglion impar injections in the treatment of coccyx pain.

The following is a sampling of direct quotes from the published medical literature regarding ganglion impar injections specifically for patients with coccydynia:

- «The ganglion [impar] receives nociceptive and sympathetic fibers from the pelvis and is thought to play a major role in coccyx pain syndrome.» [20]

- «Conclusion: The use of ganglion impar blocks is a well-documented technique to relieve the coccyx or perineal pain.» [4]

- An «evidence-based medicine» review of sympathetic blocks assessed the literature and concluded that ganglion impar injections received a grade of «strong recommendation.» [6]

- A different «evidence-based medicine» review was similarly favorable, concluding that ganglion impar treatment belongs in the «algorithm for the treatment of coccydynia.» [47]

- Ganglion impar injections are described as being «highly effective in treating coccydynia (coccyx pain).» [16]

- The published medical literature has been summarized as having «previously described effective treatment for coccydynia via interventional pain management procedures including focal block of a ganglion impar (ganglion Walther).» [35]

- Ganglion impar injections have been described as «useful for coccygeal or sacrococcygeal pain syndromes.» [55]

- Indeed, from the initial ganglion impar injections being done for non-coccyx related conditions, the pendulum has now swung so far in favor of using these injections for coccydynia that recent authors feel the need to point out that «ganglion impar blocks are for more than coccydynia.» [23, 26]

In conclusion, ganglion impar injections play an important role in the clinical care of patients with coccydynia.

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