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The importance of a thorough clinical examination in the evaluation of lame horses is well recognized. However, the results of the clinical examinations often do not identify the source of the lameness and in some instances, the clinical examination may be misleading as to the cause of the lameness. The use of diagnostic anesthesia to identify or confirm the source of lameness is commonly used by most equine practitioners. In many cases diagnostic anesthesia can provide more useful information about the source of lameness than other diagnostic modalities such as radiographs and ultrasound. Diagnostic anesthesia has limitations, and although the majority of horses have a reliable response, variations are occasionally encountered and confusing or inaccurate results are obtained. Limitations of diagnostic anesthesia that warrant consideration are mechanical lameness that does not respond to anesthesia, difficulty in accurately determining the extent of anesthesia (e.g., the skin can be desensitized without deeper structures being desensitized), and partial responses to anesthesia. Some lame horses simply do not respond to appropriately applied diagnostic anesthesia procedures as one would think they should and this can add confusion to the lameness examination. Despite some limitations in performing and evaluating diagnostic anesthesia, it is the author’s opinion the most definitive method of localizing lameness in the majority of horses.

Diagnostic anesthesia can be either intra-articular, intrasynovial or perineural. Although intra-articular and intrasynovial injections have the advantages of being more specific, they also have the disadvantages of being more invasive and more time consuming in preparation and time for effect. Obviously there are certain situations where intra-articular or intrasynovial anesthesia is preferential to perineural anesthesia, and in many situations intra-articular anesthesia is used as an important complementary procedure to perineural anesthesia. This author routinely uses perineural anesthesia distal to the carpus and hock, then if more information is required, specific intra-articular or intrasynovial anesthesia is performed. From the carpus and tarsus proximal this author routinely utilizes specific intra-articular anesthesia. Occasionally an ulnar or tibial nerve block is performed to rule out proximal soft tissue injuries.

### I. NERVE BLOCK PROCEDURE

Many of the more commonly anesthetized nerves lie in close proximity to synovial structures which could be contaminated while performing the procedure, particularly if the animal is difficult to inject. For example, the deep digital flexor tendon sheath is in close proximity to where the palmar digital nerve is blocked. Although the probability of initiating a serious infection from performing perineural anesthesia is low, the possibility exists and the consequences could be severe. Therefore it is advisable to thoroughly cleanse the area prior to injection. The author prefers to scrub the area with a povidone iodine surgical scrub and wipe the area with 70% isopropyl alcohol until all traces of dirt and soap are removed. All intra-articular and intrasynovial injections receive a surgical scrub prior to performing. It is rarely necessary to clip the hair over the injection site, but unusually long or soiled hair may be removed to facilitate cleaning the area and identifying anatomical landmarks.

The restraint required will vary with the animal. Most animals will allow perineural anesthesia with minimal restraint. However, others require significant restraint and superior athletic ability of the clinician to perform the injection. An experienced handler and common sense application of a variety of restraint procedures is helpful in achieving diagnostic anesthesia with minimal excitement or problems.

Sedation to perform the injections should be avoided in most cases, particularly in subtle lamenesses. Sedation can alter the
horses gait and response to pain enough to affect interpretation of the response to a nerve block. Horses that are very difficult to inject and have a significant lameness may be tranquillized without seriously complicating interpretation of response to a nerve block. If tranquillization is indicated, the author routinely uses 10 mg of acepromazine⁶ in a standard size horse.

The most commonly used anesthetic solutions for diagnostic nerve blocks are mepivacaine hydrochloride 2%⁴ and lidocaine hydrochloride 2%.⁴ Both of these drugs have a rapid onset of action and are minimally reactive. Because mepivacaine is reportedly less reactive and longer lasting than lidocaine,⁵ this author commonly uses it for most diagnostic purposes.

Practitioners vary in their preference for performing nerve blocks while the animal is weight bearing or non-weight bearing. The author feels that control of the limb is better achieved by holding the limb in a non-weight-bearing position. However, the anatomy of the area is often more readily recognized when the limb is in a weight-bearing position.

Diagnostic anesthesia is most commonly started at the most distal aspect of the limb and proceeds sequentially proximal in an organized fashion. Following this sequence will allow a more specific localization of pain. Occasionally it is more applicable to start at a more proximal point to expedite the examination, for example, performing anesthesia above the fetlock in the rear limb to rule out lower limb pain.

To determine if a nerve block is effective, check the skin sensation distal to the site of the nerve block by applying firm pressure with a blunt object like a ball point pen or a pair of hemostats. It is not uncommon to desensitize the skin without the internal structures being completely anesthetized. Therefore, this author routinely re-evaluates the area of sensitivity (e.g. hoof tester response or response to fetlock flexion) before observing for a change in the lameness. Failure to allow for complete anesthesia of an area before performing the next block can lead to confusion in establishing an accurate diagnosis. Adequate anesthesia can be achieved in as little as 3 min but generally requires 10-15 min to take full effect.⁴

II. DIAGNOSTIC ANESTHESIA OF THE FOOT

Much has been written about lameness originating from the foot and its response to diagnostic anesthesia.⁵-⁷ Since clinicians have encountered cases that responded differently than what was classically described and expected from diagnostic anesthesia, several studies have been conducted to better understand the confusing circumstances encountered when performing diagnostic anesthesia.⁸-¹⁰ Different anesthetic protocols have been used to help localize the lameness within the foot.¹¹,¹² Clinicians often utilize and interpret data based upon clinical studies and research projects, to best suit their clinical experiences. This has resulted in development of beliefs and protocols that may lead to an inaccurate diagnosis. The fact that animals are biologic systems with individual variations and responses as well as different levels of pathology should warrant caution when interpreting results of diagnostic blocks. Individual variation in response and overlap of areas desensitized by anesthetic procedures may fail to accurately characterize clinical cases.

Historically, lameness that significantly improved after a palmar digital nerve block (PDNB) was considered to originate from the palmar one third of the foot.¹³ Numerous anatomic structures can be involved in lameness that respond to the PDNB leading to terminology such as caudal heel syndrome, palmar heel pain, navicular syndrome, or navicular area pain.¹⁴ The belief that the PDNB was specific for that part of the foot has led to misinterpretation of response to this block, for example, mild cases of laminitis with sole pain being treated as navicular disease. Anesthesia of the palmar digital nerve will attenuate or eliminate pain originating from the sole depending on the severity and location of the origin of the pain.⁸ A report describing the results of 164 horses that responded to the PDNB demonstrates the imprecision of this block in localizing lameness within the foot.¹⁵ In that study, pathologic conditions involving the third phalanx, distal interphalangeal (DIP) joint, proximal interphalangeal (PIP) joint and first phalanx responded to palmar digital nerve anesthesia. Horses with disease in the DIP joint that responded to a PDNB led to a study by Easter et al.¹⁰ which demonstrated anesthesia of the palmar digital nerve just proximal to the bulb of the heel alleviated lameness caused by endotoxin induced pain in the DIP joint, indicating that the palmar digital nerve innervates the DIP joint. The conclusions of this study confirmed a previous anatomical study.¹⁶ Some lame horses with disease in the PIP joint had a positive response to anesthesia of the palmar digital nerves, presumably from proximal diffusion of the local anesthetic solution.¹⁵ The proper site for anesthesia of the palmar digital nerve has been described as halfway between the fetlock and the coronary band in the pastern area.¹³ Others believe it is important to anesthetize the nerve near or distal to the proximal margin of the ungual cartilages.¹⁷,¹⁸ A recent study demonstrates that anesthesia of the PIP joint is unlikely to occur when local anesthetic solution is administered at the junction of the proximal margin on the ungual cartilage and the palmar digital nerve, but lameness originating within the PIP joint can be alleviated when the palmar digital nerves are anesthetized proximal to this location.¹⁸

Resolution of lameness by anesthesia of the DIP joint was once thought to localize the cause of lameness to that joint.¹⁷ However, lameness caused by navicular syndrome was also found to respond to anesthesia of the DIP joint.¹¹ The results of a prospective study led one author to conclude that the best block to confirm navicular region pain was a DIP joint block.¹² Some clinicians have assumed lameness which resolves in 5-10 minutes after DIP anesthesia to originate from the DIP joint and lameness that takes longer to improve to originate from the navicular region. This theory was disproved in a study where lameness induced by amphotericin B injected into the navicular bursa was alleviated within five minutes after DIP joint injection of anesthetic solution.¹⁹ Clinical observation of relief of hoof tester response over the sole after DIP joint anesthesia led to a study using induced solar pain created by a special shoe. This lameness was alleviated by DIP joint anesthesia.²⁰ A later
study by the same group showed variability in response to pain initiated at the toe of the foot versus the heel of the foot and found that it took more time and anesthetic to anesthetize the heel of the foot, than the toe.21 Other authors have found that DIP joint anesthesia was effective in abolishing lameness in horses with deep digital flexor tendonitis confirmed by magnetic resonance imaging (MRI).22 Navicular bursal injection has been proposed to block those structures in direct contact with the navicular bursa.23 However, reports of research projects as well as clinical studies have demonstrated that many sources of lameness may respond to navicular bursal anesthesia over time.9,24 All of the studies about anesthesia of the foot demonstrate that considerable overlap of the structures anesthetized by the various blocks exists, and with time, the structures that are desensitized by diffusion of the anesthetic solution becomes uncertain. Pathologic conditions and individual variations may exist that affect diffusion rates, thus the exact location of pain within the foot based upon diagnostic anesthesia becomes less and less certain as more information is gained. Evaluation of MRI has already provided us with enough information to disprove many of our previous assumptions concerning pathology within the foot.22,25

Although properly performed diagnostic blocks may anesthetize structures proximal to the point where the nerve block was performed, they are an important part of the lameness examination and should be performed in a manner which minimizes confusing results. This author routinely performs a palmar digital nerve block with a 5/8 in x 25 gauge needle inserted just distal to the proximal edge of the collateral cartilage. The needle is directed distally and 1½ ml of local anesthetic is deposited. Using the described technique, the author has rarely encountered unexpected results. A technique performed differently in the same location has also resulted in reliable results according to the author.26

III. ABAXIAL SESAMOID NERVE BLOCK

The abaxial sesamoid nerve block anesthetizes the lateral and medial branches of the palmar nerves at the level of the proximal sesamoid bones and is commonly employed to rule out lameness in the foot. It also blocks out lameness from the PIP joint as well as the soft tissue distal to the fetlock such as the deep and superficial digital flexor tendons and the distal sesamoidean ligaments. Anesthesia of these structures makes sense and would be expected. However, other structures may also be desensitized by this block. Fractures of the proximal sesamoid bones, axial sesamoid lesions, lameness originating within the fetlock, and suspensory branch desmitis have been observed to respond to a properly applied abaxial sesamoid nerve block. If lameness is improved by this block and an etiology for the lameness cannot be determined distal to the fetlock, further investigation of the fetlock area is warranted.

When the author is performing these blocks as part of the lameness exam, care is taken to perform the block at the basisesamoid level, use a minimal volume of anesthetic (1½ ml) and direct the needle in a distal direction.

IV. LOW FOUR POINT BLOCK

The low four point block is performed just proximal to the fetlock joint and digital sheath. It is utilized to block the lateral and medial branches of the palmar and palmar metacarpal nerves, or in the rear limbs the plantar and plantar metatarsal nerves and to localize lameness distal to the point of performing the block such as the fetlock joint and surrounding soft tissues. This block may anesthetize structures and alleviate lameness originating more proximal than one would think, particularly if the block was placed higher than is ideal. Although a contrast study does not support significant proximal diffusion of mepivacaine hydrochloride and iohexol solution.27 The author has found this block to anesthetize lesions of the suspensory ligament as far proximal as the origin, as well as tendon lesions several centimeters proximal to the point of performing the block. Anesthesia of structures proximal to this block occurs commonly enough that the author performs an ultrasound of the palmar metacarpal or metatarsal area if the cause of the lameness is not found distal to the block. Limbs should be aseptically prepared because intrasynovial injection may occur.

V. PROXIMAL METACARPAL/METATARSAL ANESTHESIA

Local and regional analgesia of the proximal metacarpal area is accomplished by three different methods depending on individual preference. The origin of the suspensory ligament can be desensitized by direct infiltration17 or by blocking the lateral palmar nerve before the origin of lateral and medial palmar metacarpal nerves.28 The origin of the suspensory ligament and the other structures in the palmar metacarpal area can also be desensitized with palmar and palmar metacarpal blocks placed just distal to the carpus (high four point block).29 The distal palmar out pouches of the carpometacarpal joint located between the axial surface of the second and fourth metacarpal bones and the abaxial surface of the suspensory ligament extend distally a mean distance of 2.5 centimeters.30 These out pouchings lie in close proximity to the palmar metacarpal nerves in the proximal metacarpal region. Deep injections in the proximal metacarpal regions such as infiltration of the origin of the suspensory ligament or a palmar metacarpal nerve block could inadvertently penetrate these out pouchings and desensitize the carpometacarpal joint. Because the middle carpal joint always communicates with the carpometacarpal joint30 infiltration and desensitization of the middle carpal joint could also occur. Thus the potential for inadvertent desensitization of a carpal lesion when performing proximal metacarpal analgesia exists and can lead to confusion about the source of lameness. The author has inadvertently anesthetized a carpal chip fracture by infiltration of the origin of the suspensory ligament. A study to determine the frequency of inadvertent infiltration of the distal carpal joints when performing proximal palmar metacarpal analgesia compared the three different methods of proximal palmar metacarpal analgesia.31 When infiltration of the origin of the suspensory ligament was performed, inadvertent injection into the distal carpal joints occurred in 37% of the cases. The palmar and
palmar metacarpal nerve blocks (a high four point block) resulted in inadvertent injection of the distal carpal joints in 17% of the cases. Anesthesia of the lateral palmar nerve at the distal aspect of the accessory carpal bone did not result in desensitization of distal carpal joints. The results of this study and personal experiences of inadvertently blocking the carpus by infiltration of the suspensory ligament has led the author to routinely perform a high lateral palmar nerve block just distal to the accessory carpal bone and proximal to the palmar metacarpal branches. Because the distal palmar out poughings of the carpometacarpal joints lie in close proximity to the suspensory ligament, and because the carpometacarpal joint and middle carpal joint always communicate, injection of anesthetic solution into the middle carpal joint can anesthetize lesions in the proximal suspensory ligament. The author has seen horses that responded to middle carpal anesthesia that had lameness originating from the origin of the suspensory ligament. Therefore, if a horse blocks to the middle carpal joint but no apparent etiology for this lameness can be identified within the hock, evaluating the proximal palmar metacarpal area for pathology is advisable.

In the rear limb, proximal plantar metatarsal analgesia is less well defined than the forelimb. Diagnostic analgesia of this area is commonly utilized in lameness examinations and the origin of lameness in many horses can be identified by anesthesia of this area. For example, proximal suspensory desmitis in the hind limb is not an uncommon diagnosis and diagnostic analgesia of this area is important. However, some overlap of anesthesia exists between local infiltration of the origin of the suspensory and injections of the tarsometatarsal joint. A close relationship exists between the distal plantar outpouchings of the tarsometatarsal joint and the proximal aspect of the suspensory ligament. A relatively high incidence of proximal diffusion of radiographic contrast material occurs when it is infiltrated subtarsally, with occasional spread to the tarsometatarsal joint. Therefore, it is believed that subtarsal analgesia may improve or alleviate pain associated with the tarsometatarsal joint. Similarly, horses with lamenesses originating from the suspensory ligament can, in the author’s experience, be improved by intraarticular injection of local anesthetics into the tarsometatarsal joints.

A recent study to evaluate two approaches to block the deep branch of the lateral plantar nerve support using a small volume of anesthetic solution (1½ ml) placed over the deep branch of the lateral plantar nerve, resulted in less proximal diffusion and decreasing the possibility of anesthetizing the distal tarsus.

VI. Diagnostic Anesthesia of the Hock

Communication of the tarsometatarsal and distal intertarsal joints occur in approximately 23-35% of horses. The possibility that local anesthetic solution injected into the tarsometatarsal joint may alleviate pain from the distal intertarsal joint is recognized by most clinicians. However, anesthetic solution injected into the tarsometatarsal joint may also desensitize the proximal intertarsal and tarsocrural joints.

The author has observed proximal intertarsal joint arthritis response to tarsometatarsal joint anesthesia. This finding could be confusing if the potential for communication and diffusion of local anesthetics between all joints of the hock exists. The author routinely injects local anesthetic into the tarsometatarsal and distal intertarsal but will only anesthetize the tarsocrural joint if effusion exists.

VII. Diagnostic Anesthesia of the Stifle

Communication between joint compartments of the equine stifle has been studied using a variety of methods. In a latex injection study, Vacek et al showed that injection of latex into the medial femorotibial joint demonstrated communication with the majority of the femoropatellar joints and only a small percentage of the lateral femorotibial joints. Injection of mepivacaine into cadaver joints showed a high degree of diffusion between synovial structures within the stifle, thus concluding that intrasynovial injections of anesthetic into specific joints, are not as specific as first thought. Since most clinically important injuries involve the medial femorotibial joint and areas desensitized by injection of that joint, many clinicians only anesthetize the medial femorotibial joint when evaluating the stifle. However, the author has evaluated several horses that failed to respond to intraarticular anesthesia of the medial femorotibial joint, but responded to concurrent medial femorotibial and lateral femorotibial joint analgesia. Intraarticular lesions were subsequently identified in both the medial and lateral femorotibial joints arthroscopically in these cases. Thus the author recommends always evaluating the lateral femorotibial joint either in conjunction with or soon after the medial femorotibial joint is evaluated. Femoropatellar joint lameness is almost always associated with effusion of that joint; however, for a complete evaluation that joint is also blocked.

VIII. Diagnostic Anesthesia of the Elbow, Shoulder and Hip Joints

Although lameness originating from these joints is uncommon in adult horses, it does occasionally occur. When performing injections of local anesthetics into these articulations, it is very important to ensure that the needle is within the joint space. The author uses methods previously described and always confirms proper needle placement by retrieval of synovial fluid. Failure to confirm location of the injection within the joint could result in blocking of the radial nerve with the elbow, suprascapular nerve with the shoulder and the sciatic nerve in the case of the hip. Blocking of these peripheral nerves will necessitate discontinuing the lameness examination and creates a dangerous situation in the case of anesthesia of the sciatic nerve.

IX. Time Effect on Diagnostic Anesthesia

The volume of anesthetic injected as well as the time between performing an anesthetic block and evaluation of the lameness affects the results. If a lameness is evaluated too soon after performing a block, incomplete desensitization could give...
misleading results. One may also desensitize the skin without internal structures being completely desensitized. Therefore, the author routinely reevaluates the areas of sensitivity (e.g. hoof tester response or response to fetlock flexion) before observing for a change in lameness. Failure to allow for complete anesthesia of an area before performing the next block can lead to confusion in establishing an accurate diagnosis. Adequate anesthesia can be achieved in some cases in as little as three minutes but often require 10 to 15 minutes to take full effect.\textsuperscript{19} In a study on the durational effect of the equine palmar digital nerve block, Bidwell et al found that a palmar digital nerve block was fully effective between 15 minutes and one hour.\textsuperscript{40} Conversely, excessive time after an intraarticular injection of anesthetic allows for diffusion of anesthesia into additional compartments of the joint, or out of the joint which could anesthetize other areas, for example, anesthetics injected into the DIP joint.

X. SUMMARY

Although diagnostic analgesia is an integral and most important part of lameness evaluations, there are certain circumstances where confusing results can be obtained. Recognizing this potential for confusion and misinterpretation as well as being observant and thoughtful when clinical signs do not match local analgesia results can assist the practitioner in arriving at an accurate diagnosis of the lameness. When results are confusing, reevaluation of the circumstances will often clarify the situation. Despite incongruous results that are occasionally obtained, the author still strongly believes that diagnostic analgesia is a most important part of the lameness evaluation and an invaluable assistance in most cases.

REFERENCES AND FOOTNOTES

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