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Radiographic comparison of five different techniques for injection into the distal sesamoid bursa in cattle

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Summary

Numerous techniques for injection into the distal sesamoid bursa (navicular bursa) have been described, especially in equine, but there are few specific descriptions regarding this practice being done in cattle. Five different techniques were compared for injection into the distal sesamoid bursa in cattle including distal plantar approach parallel with the coronary band, proximal plantar approach, distal plantar approach parallel with the sole, abaxial approach, and distal interphalangeal joint injection. The results revealed that the numbers of needle insertion until proper placement is significantly less in the DIPJ and the DPPS techniques compared to the others ($P<0.05$). Also, based on the times of contrast agent injection after the correct successful needle insertion, there were significant differences between DIPJ with DPPCB, PP30 and the Ab45 techniques ($P<0.05$). According to the absence of direct communication between the distal sesamoid bursa and distal interphalangeal joint, the placement of the needle through distal plantar approach parallel with the sole was suggested.

Key words: Cattle, Distal sesamoid bursa, Technique, Contrast radiography

Introduction

Lameness in dairy cattle is both an economic and a welfare issue. It is the third and most important health related economic loss facing the dairy industry, following fertility and mastitis (Booth *et al*., 2004). It also presents an animal welfare problem of concern since pain and prolonged discomfort for cows occur (Scott, 1989). Ninety percent or more of lameness in dairy cattle involves the foot (Shearer and Van Amstel, 2000). A common area of lameness in cattle is the digital region, especially the distal sesamoid area. The presence of pain in this area, or caudal heel pain, can be related to the distal sesamoid bone directly or related structures. Many patients with this condition are commonly treated with anti-inflammatories, hoof correction, and injection into the distal interphalangeal joint and distal sesamoid bursa. Intra-articular analgesia to the distal interphalangeal joint (DIPJ) or the distal sesamoid bursa (DSB) can provide useful adjunctive information and help to differentiate the distal sesamoid bone lesion from other painful conditions in the palmar half of the foot (Pool *et al*., 1989). Numerous techniques for injection into the bursa have been described in the horse (Willemen *et al*., 1999; Schramme *et al*., 2000; Rossignol and Perrin, 2004; Smith *et al*., 2007), but there is little and/or nonscientific information about it in cattle. The aim of this study was to evaluate the reproducibility and accuracy of five different approaches into the distal sesamoid bursa.

Materials and Methods

This study was carried out on 30 fresh, normal hind-limb feet with no gross abnormalities of digits collected from Marvdasht slaughterhouse, Shiraz, Iran. Samples were transferred to the clinical department immediately where they were then cleaned and standard radiographs with lateromedial and dorsoplantar views were taken from each sample as the base images. Exposure factors of 10-20 mAs, 65-80 kV and 70 cm FFD were used. The limbs were divided randomly into 5 groups. A different technique for injection into the distal sesamoid bursa was assessed for each group. A 19 gauge spinal needle was used for all injections. In order to ascertain conformity with the description of the techniques, radiographs were taken immediately after the needle placement. Once the needle was inserted in accordance with the relevant description, about 1.5 ml meglumine compound (600 mgI/ml, Darupakhsh, Iran) was injected and another radiograph was taken. The presence of contrast medium in the navicular bursa was interpreted as a successful injection.

1) *Distal plantar approach parallel with the coronary band (DPPCB) (Fig. 1)*

This technique was defined by Scrutchfield (1977), Stashak (1987) and Turner (1989) in the horse. Placement of the needle was at the middle part of the heel bulb just proximal to the coronary band and advanced dorsally in the sagittal plane of the limb, parallel with the coronary band, until hard resistance was felt where the flexor surface of the navicular bone, actually into the navicular bursa.

2) *Proximal plantar approach (PP30) (Fig. 2)*

This technique was described by Bishop (1960) in the horse. A needle was inserted into the most concave part of the heel and advanced dorsally in the sagittal plane, at an angle of 30° to the horizontal plane. The spinal needle advanced until the tip of the needle contacted bone and then the stylet of the needle was removed for the administration of the drug. The tip of the needle was determined to be within the navicular bursa by low resistance of injection and the ability to aspirate the injected contents of the syringe.

3) *Distal plantar approach parallel with the sole (DPPS) (Fig. 3)*

This technique was first described in horse (Turner, 1989; Grant, 1996; Piccot-Crézollet *et al*., 2005). A needle was inserted at the middle of the heel bulb just proximal to the coronary band and advanced dorsally in the sagittal plane, parallel with the solar surface of the foot.

4) *Abaxial approach (Ab45) (Fig. 4)*

This technique was described in the horse (Dietz and Weisner, 1984; Turner, 1989; Grant, 1996). A needle was inserted proximal to the lateral cartilage of the third phalanx, between the second phalanx and deep digital flexor tendon and advanced distally at an angle of 45° in the frontal plane until significant resistance was encountered.

5) *Distal interphalangeal joint injection (DIPJ) (Fig. 5)*

In several studies the presence of communication between the distal interphalangeal joint and the distal sesamoid bursa have been mentioned in the horse (Honnas *et al*., 1992; Müller *et al*., 2002; Pauwels *et al*., 2008). The site of needle insertion was on the dorso-lateral wall of the hoof, 1 cm above the coronary band, lateral to the common digital extensor tendon. The needle is inserted obliquely at 45 degrees laterally and may contact the distal condyle of the second phalanges at 2 cm depth. Gentle manipulation can release the needle and insertion is continued until significant resistance is encountered. Aspiration of synovial fluid can confirm suitable insertion of the needle.

In each procedure, a deviation of slightly more than 5° from the described angle was scored as a failure of the needle placement. The number of necessary attempts to achieve the correct needle positioning to the description of the relevant injection technique was recorded.

Results

The details for the times of needle insertion until correct placement are summarized in Table 1. This revealed that the number of needle insertions until proper placement is significantly less in the DIPJ

Fig. 1: Lateral view of cattle digits. Distal plantar approach parallel with the coronary band (DPPCB). Insertion of injection needle with distal plantar approach and parallel with the coronary band, The blue line shows the place of the coronary band, The yellow line shows the sole line, P1: first phalanx, P2: second phalanx, and P3: third phalanx

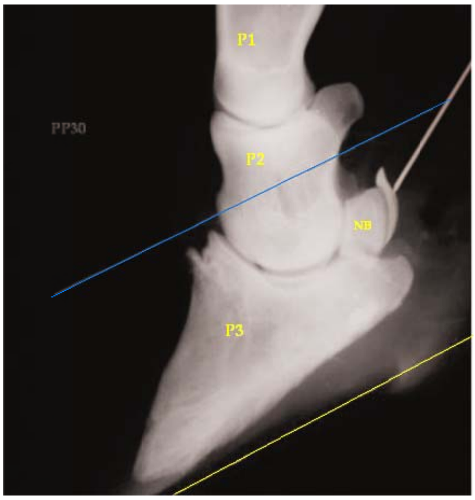

Fig. 2: Lateral view of cattle digits. Proximal plantar approach (PP30). The needle was inserted into the mid-part of the heel and advanced dorsally in the sagittal plane, at an angle of 30° to the horizontal plane. The blue line shows the place of the coronary band, The yellow line shows the sole line, P1: first phalanx, P2: second phalanx, and P3: third phalanx

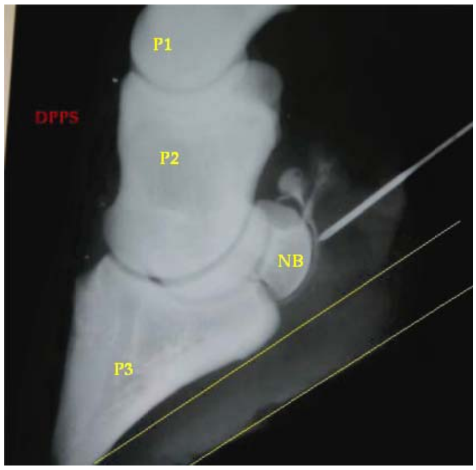

Fig. 3: Lateral view of cattle digits. Distal plantar approach parallel with the sole (DPPS). The needle was inserted in the middle of the heel bulb, just proximal to the coronary band and advanced dorsally in the sagittal plane, parallel with the solar surface of the foot. The yellow line shows the sole line, P1: first phalanx, P2: second phalanx, and P3: third phalanx

Fig. 4: Dorsoplantar view of cattle digits. Abaxial approach (Ab45). The needle was inserted lateral to the deep digital flexor tendon and advanced distally at an angle of 45° in the frontal plane. P2: second phalanx, NB: navicular bone, and P3: third phalanx

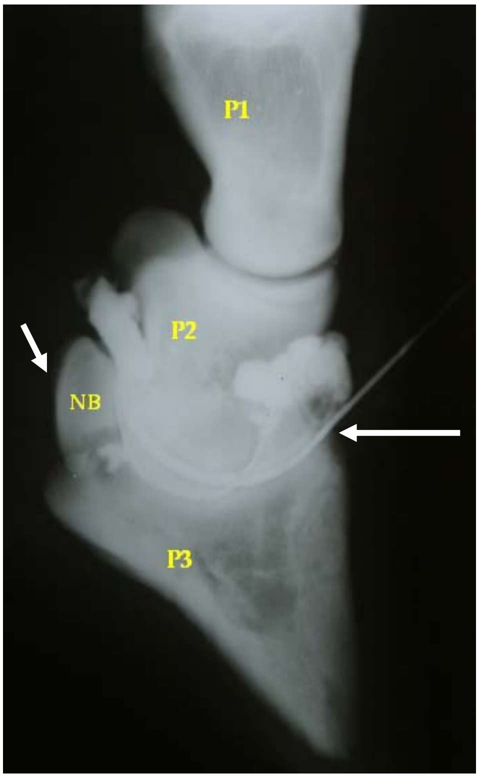

Fig. 5: Lateral view of cattle digits. Distal interphalangeal joint technique (DIPJ). Absence of the contrast agent on the flexor surface of the navicular bone (NB) (short white arrow), presence and injection site of contrast agent into the distal interphalangeal joint (long white arrow), P1: first phalanx, P2: second phalanx, and P3: third phalanx

and the DPPS techniques rather than the other used techniques (pair t-test, $P<0.05$). In the details, there is a significant discrepancy between the number of needle insertions of the medial claw by the DIPJ technique with the Ab45 technique in the same claw.

Although the results for successful times of injection of the contrast agent after correct needle insertion were based on the medial or lateral claw and the type of different techniques is shown in Table 2, there were no significant differences among the times (percentage) of contrast agent injection after the correct successful needle insertion based on the medial or lateral claw in each technique (pair t-test, $P<0.05$). Cochran Q-test showed a significant effect on the number of injection times of the different techniques which were performed into the distal sesamoid bursa ($P=0.001$). There were significant differences between DIPJ with DPPCB, PP30 and the Ab45 techniques (Wilcoxon). Also, there was a significant difference between DPPS and PP30 injection techniques (Wilcoxon). However, among the three techniques of DPPCB, PP30 and Ab45 there were no significant differences. Further, no significant difference was found between the mean of the needle length in the correct placement in each technique either (pair t-test).

Table 1: Number of needle introduction for correct placement of needle

Total	Claw (medial/lateral)		Technique
3.0 ± 0.57^{aec}	1.42 ± 0.53^{ac}	M	DIPJ
	1.57 ± 0.53	L	
$4.71\pm1.38^{\acute{a}}$	$2.28\pm0.75^{\acute{a}}$	M	Ab45
	2.42 ± 1.13	L	
$4.85\pm1.46^{\acute{e}}$	$2.71\pm0.95^{\acute{c}}$	M	PP30
	2.14 ± 1.06	L	
3.57 ± 0.78	1.85 ± 0.69	M	DPPS
	1.71 ± 0.75	L	
$4.28\pm0.95^{\acute{c}}$	2.28 ± 0.95	M	DPPCB
	2.00 ± 0.81	L	

^{abcd}: The different letters show significant differences between the different methods (Wilcoxon) and medial/lateral claw in each column (Mean±SD) (pair t-test, $P<0.05$)

Discussion

Some of the common digital lesions of cattle such as sole ulcer, white line disease and posterior tracks may progress toward a deeper structure, and the infection spreads proximally to involve the navicular bursa. Also, in some situations such as anterior tracks, the distal interphalangeal joint can be infected directly. So lesions in NB may spread into the DIJ space and *vice versa*. The neighborhood of these spaces may help one to choose the most simple and less complicated route to collect the synovial fluid of these spaces and to administrate suitable drugs (Vittanen *et al*., 2001).

Although numerous techniques for injection of the NB have been described, especially in equine, there are few specific descriptions regarding this practice being done in cattle. Since the bursa is not only a small space but is also proximal to other synovial structures such as the distal interphalangeal joint or distal tendon sheath, easy and correct injection into it is quite difficult in the horse and cattle. The use of

Table 2: Successful times of injection of contrast agent after correct needle insertion

Mean of length of inserted needle in successful placement (cm)	Number of successful times of contrast agent injection after correct needle insertion based on type of technique	Number of successful times of contrast agent injection after correct needle insertion based on medial or lateral claw	Claw (medial/lateral)	Technique
1.8	8^{a} (57%)	5 (71.5%)	Lateral	DPPCB
1.9		3^{c} (43%)	Medial	
2.4	11^{e} (78.6%)	6 (86%)	Lateral	DPPS
1.9		5 (71.5%)	Medial	
2.3	7$^{\text{cé}}$ (50%)	4 (57%)	Lateral	PP30
2.8		3^{a} (43%)	Medial	
1.9	8^{o} (57%)	4 (57%)	Lateral	Ab45
2.4		4 (57%)	Medial	
1.5	14$^{\text{áčó}}$ (100%)	7 (100%)	Lateral	DIPJ
1.44		7$^{\text{áč}}$ (100%)	Medial	

^{abcd}: The different letters show significant differences between different methods (Wilcoxon) in each column (P<0.05)

navicular bursography has been described by Willemen *et al*. (1999) as a diagnostic method for the evaluation of flexor fibrocartilage of the navicular bone. Usually navicular bursography is devised to confirm an injection of local anesthetic into the bursa in equine practice. Several studies about navicular bursoscopy have shown a suitable approach to the navicular bursa (Rossignol and Perrin, 2004; Smith *et al*., 2007).

Turner's (1998) approach was used just proximal to the central sulcus of the frog as landmarks for the needle insertion of the navicular bursography in 97 horses. Piccot-Crézollet *et al*. (2005) compared two techniques for the injection of the podotrochlear bursa in horses and suggested that the distal palmar approach to the navicular position (DPNP) technique can be used successfully for injection into the space. Also, the study done by Schramme *et al*. (2000) showed that the DPNP technique was superior to other injection techniques.

Our results showed two techniques of DIPJ and DPPS had the fewest times of needle insertion for correct placement. Anatomical communication between the distal sesamoid bursa and the distal interphalangeal joint is controversial. Bowker *et al*., (1993) reported that the communication between the distal sesamoid bursa and the distal interphalangeal joint in horses is rare and Gibson *et al*. (2005) described no communication between the joint and bursa in fresh horse foot cadavers. But, in several studies the presence of communication between the distal interphalangeal joint and the distal sesamoid bursa was demonstrated (Honnas *et al*., 1992; Müller *et al*., 2002; Pauwels *et al*., 2008). There are many studies suggesting different approaches into the distal interphalangeal joint (Mercado and Stover, 1998; Gibson *et al*., 2005; Vacek *et al*., 2008). Often DIP joint therapy is chosen simply because of lack of experience in performing distal sesamoid bursa (navicular bursa) injection. According to the mentioned reports, it seems that there is an indirect (infiltrative) communication between these spaces, but further studies are needed to assess the exact level and type of this communication. So, a practical approach to DIPJ is easy and the injection of a contrasting agent to study this area is reliable in cattle. Our study showed that the number of successful times of contrast agent injection after correct needle insertion based on the type of technique is more significant in DIPJ and DPPS techniques. So, the choice of DPPS technique is suggested, as the usage of the DIPJ technique is clearly not practical for the assessment of the navicular bursa. The needle penetration in DPPCB, PP30 and DPPS techniques may damage the deep digital flexor tendon resulting in undue adhesion. So, correct needle insertion with the fewest number of times is desirable.

The minimum and maximum length of the introduced needle was 1.44 and 2.8 cm, respectively, but there are no significant differences between the mean of the needle length in correct placement in each technique. If the needle can be inserted to a depth more than 2.8 cm, in every technique, the needle will have too much angle and travel to the distal region of the navicular bursa, located within the digital cushion. Insertion of the needle with less than 1.44 cm and feeling hard resistance may show the contact of the needle with the distal ridge of the second phalanx and the improper angle of the needle.

Finally, we suggest the use of these techniques in a semi-flexion condition for removing deep digital flexor tendon pressure on the navicular bursa.

It was concluded that several approaches into the navicular bursa were feasible; however, the DPPS technique is preferred in cattle.

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