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1 **Practical Approach to Caudal Epidural Anaesthesia and sedation for flank and other** 2 **surgeries in Ruminants**

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11 12 Introduction

13 In practice, anaesthesia of cattle under field conditions involves the application of local
14 anaesthetic techniques such as flank anaesthesia, regional limb perfusion and caudal epidural
15 anaesthesia in order to obtain suitable operating conditions without having to perform general
16 anaesthesia. Caudal epidural anaesthesia can be divided into 2 different categories: High dose
17 and low dose. High epidural anaesthesia involves administration of a relatively large volume
18 of local anaesthetic to provide analgesia to more cranial body regions and is therefore used for
19 surgeries on the hind limb and flank. The more common method is low epidural analgesia
20 which differs only in the volume of the local anaesthetic injected. This technique is
21 inexpensive, effective and practical and requires no sophisticated equipment. It is therefore
22 relatively easy to perform under field conditions.

23 24 Technique for epidural anaesthesia.

25 In ruminants, the end of the spinal cord extends from the lumbar region into the midsacral
26 region and entrance into the spinal canal is achieved at the first coccygeal interspace (Co1-
27 Co2). The other interspace that can be used is the sacrococcygeal space (S5-Co1), but this
28 space calcifies in older cattle. To identify the correct location, the tail is moved up and down
29 in a 'pump-like' fashion. The most proximal moving space palpable is the preferred location
30 for injection. After identification of the space, the skin is clipped and disinfected and an 18
31 gauge needle is used to penetrate the interspace directly in the dorsal midline in the adult cow.
32 The needle is directed in a slightly cranial direction and advanced until a 'popping' sensation
33 is felt. This pop indicates entrance into the epidural space. If the needle is advanced too far it
34 may contact the ventral floor of the spinal canal. If this occurs the needle should be
35 withdrawn slightly to ensure correct placement in the epidural space. Correct positioning of
36 the needle can be checked by placing a few drops of sterile water or lidocaine into the needle
37 hub during insertion and observing aspiration of the drop into the epidural space, which has

38 negative pressure ('hanging drop technique'). Prior to injection it is important to **apply**
39 **negative pressure** to the syringe to ensure blood is not aspirated. If this occurs, the needle
40 should be withdrawn slightly and the syringe re-aspirated. Injection into the epidural space
41 should encounter no resistance.

42

43 Low dose epidural anaesthesia

44 Low dose epidural anaesthesia aims to desensitize the last three pairs of sacral nerves within
45 the spinal canal without impairment of motor function to the pelvic limbs. The anaesthesia
46 obtained by this low dose technique involves the tail and caudal reproductive tract and can
47 therefore be used in surgery of the vagina, vulva, anus, rectum, caudal prepuce, scrotum and
48 to perform urethrostomies. It can also be useful to control tenesmus and uterine contractions
49 during repair of a prolapsed rectum or vulva, repositioning of a prolapsed uterus, dystocia
50 with repositioning.

51

52 High dose epidural anaesthesia

53 High dose epidural anaesthesia aims to desensitise nerves further cranially and can lead to
54 anaesthesia as far cranial as the diaphragm, depending on the amount of local anaesthetic
55 used. This type of anaesthesia will lead to the animal becoming recumbent and it can be used
56 for surgery of the hind legs. It has also been used for umbilical surgery in calves. The
57 technique and injection site are the same as for the low dose epidural, but the volumes are
58 higher than with the low dose. The positioning after the administration of the epidural will
59 determine the response of the animal as well as the distribution of the anaesthesia. Elevation
60 of the front of the animal will mean that the local anaesthetic will not distribute further than
61 the caudal end of the epidural space and elevation of the hind quarters will lead to the
62 anaesthetic solution being distributed more cranially. With most local anaesthetic solutions,
63 when the animal is positioned in lateral recumbency the anaesthetic will distribute better to
64 the side the animal is positioned on (the lower side), whereas dorsal recumbency will lead to
65 bilateral distribution of the anaesthetic solution. The major risk for this type of epidural is that
66 incorrect positioning or a volume that is too high can lead to the anaesthetic travelling too far
67 cranially with a chance of respiratory paralysis and death. Due to residual paralysis and
68 muscle weakness, it is also advisable to hobble the hind legs of animals recovering from this
69 type of anaesthesia as this will prevent abduction of the hind legs and as such unwanted
70 damage or paralysis of the obturator nerve.

71

72 Drugs

73 The most commonly used drug for low dose epidural anaesthesia is 2% lidocaine at a dose
74 rate of 0.2mg/kg (1ml/100 kg). Depending on the size of the animal cow the total volume that

75 is injected should be greater than 6 mls. There is a risk of paralysing the spinal nerves to the
76 hind limbs when the dose is too large leading to unwanted recumbency. Anaesthesia using
77 this technique usually occurs within 5 minutes and will last between 30 and 150 minutes
78 depending on the dose. Mild ataxia can occur. No anaesthetic effect after 10 minutes usually
79 indicates that the injection was not made into the epidural space. For high dose epidurals the
80 drug of choice is 2% lidocaine on its own in a maximum dosage rate of 2mg/kg bodyweight
81 (1ml/10kg).

82

83 Xylazine alone or added to lidocaine provides a longer duration of anaesthesia using the low
84 dose epidural technique. The dose used for xylazine anaesthesia on its own is 0.05 mg/kg (2%
85 xylazine) diluted into 5 ml sterile water. Onset of anaesthesia will be within 10 minutes and
86 the anaesthesia will last between 3-4 hours. Xylazine in combination with lidocaine gives a
87 longer lasting anaesthetic effect. The dose of the xylazine in this mixture is 0.03-0.05mg/kg
88 made up to 5 ml with 2% lidocaine. Onset of anaesthesia will be within 5 minutes and the
89 duration of anaesthesia up to 6 hours. The use of xylazine in an epidural not only gives longer
90 anaesthesia, but also gives mild to moderate sedation of the animal as well as mild ataxia with
91 an increased risk of recumbency, decreased ruminal motility and bradycardia.

92

93 The effectiveness of all epidurals can vary between animals due to minor differences in
94 distribution of the drugs in the epidural space. These differences in distribution are due to the
95 degree of negative pressure in the epidural space as well as variations in epidural fat content
96 between different animals; these factors can affect both the spread and pharmacokinetics of
97 the drugs used.

98

99 Applications

100 Low dose epidural anaesthesia gives regional analgesia of the tail, anus, vulva, perineum,
101 thighs and mid sacral region as well as relaxation of the anal sphincter and vagina and
102 cessation of straining. The aim of the anaesthesia is to leave the motor function of the hind
103 legs unaffected so that the animal remains standing. Applications for low dose epidural
104 analgesia are shown in table 1. The choice of drug depends on the desired effect. In
105 castrations analgesia is required, not only during the procedure but also during recovery. A
106 combination of xylazine and lidocaine is therefore the best option. For caesarean sections and
107 fetotomies it is necessary that the animal stops straining during the procedure. Lidocaine on
108 its own can be sufficient in these cases depending on the length of the procedure. However, it
109 is essential to ensure flank anaesthesia in addition to the epidural anaesthesia – epidurals do
110 not fully anaesthetise the flank skin, muscles or peritoneum.

111

112 Sedation via epidural injection

113 As described above, the epidural use of xylazine on its own or with lidocaine gives mild to
114 moderate sedation in animals. This knowledge was used by the authors to develop a method
115 in which the animal is sedated by epidural injection. Most procedures, such as flank
116 laparotomies and caesarean sections that are performed in the standing animal require the
117 animal to stand quietly with appropriate restraint. Sedation of the animal by intramuscular
118 injection can be helpful in this situation, but can be unpredictable also may have the
119 undesired effect of the animal becoming recumbent and in the case of a caesarean section
120 will sedate the calf. The use of xylazine administered into the epidural space for sedation
121 purposes only requires a small dose of xylazine and results in an animal that is
122 moderately sedated which will remain standing . Epidural xylazine also provides a
123 degree of flank analgesia which makes injection of regional lignocaine less painful
124 and therefore less difficult. The dose of xylazine that was used was 0.016-0.018
125 mg/kg (0.4-0.5 ml of 2% xylazine made up to 5 ml with 0.9% saline for a 600 kg animal).
126 Compared with the intramuscular dose of 0.05 - 0.3 mg/kg this is a much lower dose. The
127 authors have used this method effectively in caesarean sections, in combination with flank
128 anaesthesia. All cows remained standing in all cases and were effectively sedated. The calf
129 remained unaffected by the low doses of sedative used. This sedation method has also been
130 used in castrations and - flank surgery - in fractious animals.

131

132 Table 1: Applications of low dose epidural anaesthesia in cattle and the most common drugs
133 used for the different applications.

134

	Lidocaine	Lidocaine/Xylazine
Castration	Common	Most common
Vaginal prolapse	Common	Common
Uterine prolapse	Common	Common
Foetotomy	Most common	
Caesarian	Most common	

135

136

137 Epidurals in sheep and goats

138 Caudal epidural anaesthesia also has many applications in sheep and goats, but the main
139 practical use for an epidural in these animals would be correction of dystocia and
140 replacement/retention of a vaginal and/or rectal prolapse. However, since caesarean section in
141 these animals is usually performed in lateral recumbency and it is not necessary for the animal

142 to remain standing, a higher dose epidural could also be used for this procedure as well as for
143 surgery on the hind limbs. The epidural technique used is much the same as the one used in
144 cattle, but as it is sometimes harder to find the first intercoccygeal space (Co1-Co2), the most
145 common place used is the sacrococcegeal space (S5-Co1). Both these sites can be identified
146 in standing animals as well as animals in lateral recumbency. After identifying the space by
147 movement of the tail and palpation the area should be clipped and surgically prepared. With
148 the tail held horizontally, a 20 gauge needle should then be inserted at an angle of
149 approximately 20-30° towards the tail. The insertion should be done very gently as the 'pop'
150 sensation that is felt in cattle is not as clear in small ruminants which could lead to penetration
151 of the nerves in the epidural space. This has the effect of making the animal jump with
152 movement of the needle and possible unwanted bleeding as a consequence. Anaesthetic
153 solution should be injected slowly as in small ruminants the total volume of spinal fluid is a
154 lot less than in cows and fast addition of extra fluid can lead to a dangerous increase of
155 intracranial pressure followed by CNS and cardiovascular collapse. Again, the position of the
156 animal after injection is important when dealing with the higher dose type of anaesthesia.
157 Higher dose anaesthesia involves the administration of 1ml/7kg bodyweight of 2% lidocaine
158 with or without adrenaline which will give flank analgesia for a maximum of 2 hours. With
159 these high doses it will take at least 3.5 hours of recovery time before the animal has regained
160 total control of its legs and is standing again.
161 For the correction of dystocia and retention of prolapses, the volume of the local anaesthetic is
162 reduced but care should still be taken during injection and recovery. Drugs used for these
163 procedures are again 2% lidocaine alone or a combination of 2% lidocaine with 2% xylazine.
164 Dosage for the lidocaine alone is 0.5mg/kg with a maximum volume of 2 mls/animal. Dosage
165 for the combination is 0.07mg/kg of 2% xylazine and dose of 0.5mg/kg of 2% lidocaine.

166

167

168 **Additional reading**

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