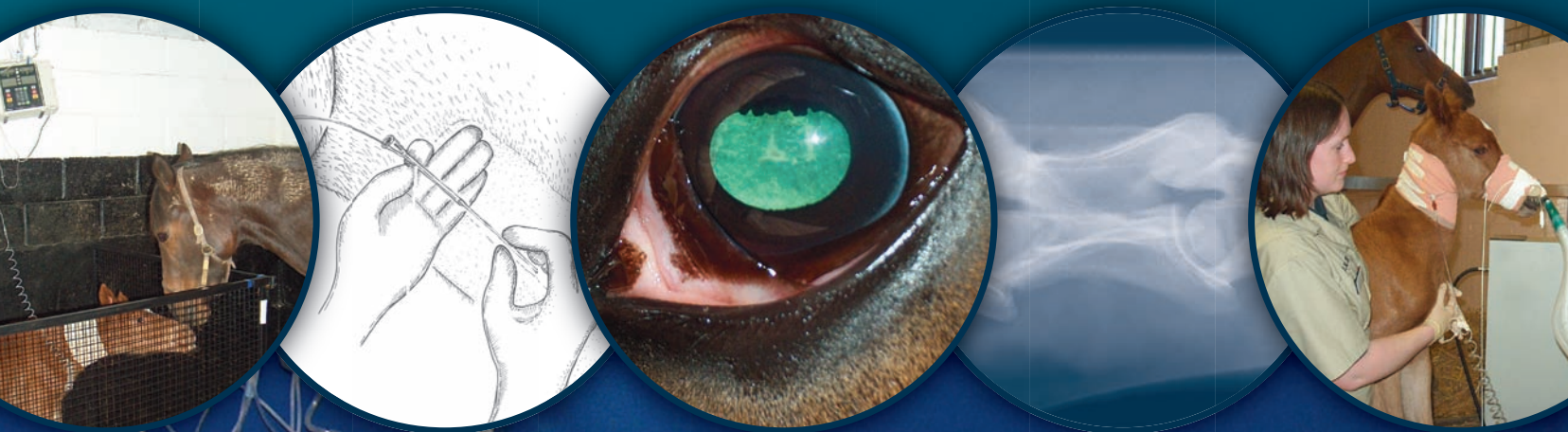


THE EQUINE HOSPITAL MANUAL

Edited by Kevin Corley and Jennifer Stephen



Blackwell
Publishing

The Equine Hospital Manual

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To our wonderful family, especially our parents, David, Ros, Roger, and Brigitte, for their unfailing love and support.

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Preface

The idea of a text covering all aspects of equine hospital management stems from our experiences as students, interns, residents and clinicians. We have had the benefit of working and visiting many excellent institutions around the world, and we wanted a book that would bring together all the practical tips and information that clinicians gain from years of personal experience that are often not to be found in texts. We wanted this book to be easy to use and extremely practical and yet still have a sound basis in evidence-based medicine.

We hope that this book will be useful to all who work in specialist equine practice from students in clinics to experienced clinicians. We were frustrated that no one text covered all the routine procedures necessary in the workup and management of both medicine and surgery cases. How often have we all struggled to find that excellent description of a technique that we think we remembered among a huge stack of textbooks? Or been stuck for a dose rate because the key book is back at the practice?

This book is not a complete guide to equine medicine, nor is it intended to be a complete equine surgical manual. Instead, it covers all the vital practical areas where information is so often difficult to find in one place—from the very basics such as bandaging, to more difficult procedures such as arterial blood sampling, to the very advanced such as mechanical ventilation of the neonatal foal. This book includes quick reference sections for all major procedures, reference ranges and drug doses combined with in-depth chapters. It also aims to address some of the practical con-

cerns in designing and setting up an equine facility suitable for the care of inpatients.

We are very grateful to all our contributors who have been generous enough to share their hard-earned experience and knowledge to create this book. We give special thanks to Stephen Cahalan for creating such beautiful and clear illustrations for us. Editing a book for the first time proved to be a very challenging experience, and we must thank all the staff at Wiley-Blackwell for their support, advice and patience, especially Sophie Gillanders, Adam Burbage, Justinia Seaman, Samantha Jackson and Allison Frank Esposito.

Many other people deserve our thanks, not least our fantastic family and friends, who deserve the highest praise for their constant support. Of course, we both owe a huge debt of gratitude to all the students, interns, residents, colleagues, clients and patients we have worked with who have made life so interesting. Jen would particularly like to thank Angus Callegari, Keith Baptiste, Dean Richardson, Anna Hammond, Renate Weller, Angus Adkins and Marie Harty. Kevin would like to thank all those who inspired and challenged him, particularly Robert Livie, Celia Marr, Lydia Donaldson, Martin Furr, Harold McKenzie and Jane Axon. We would both like to thank all the staff at Anglesey Lodge Equine Hospital for providing such a happy workplace where we have learnt so much.

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Abbreviations

Drug doses and frequency of administration used in this book

Abbreviation	Meaning	Comments
IV	intravenously	Administer into a vein or a venous catheter
IM	intramuscularly	Administer into an appropriate muscle (see Chapter 1.6)
PO	<i>per os</i> (by mouth)	Administer into the mouth
pNGT	per nasogastric tube	Administer via a previously placed nasogastric tube (see Chapter 1.7)
SQ	subcutaneously	Administer by injection into the subcutaneous tissue
MDI	metered-dose inhaler	Administer via metered-dose inhaler and appropriate mask (see Chapter 10.2 and Figures 10.18 and 10.19)
mg/kg	milligrams per kilogram	Dose per kilogram body weight
mg/450 kg	milligrams per 450 kg	Dose for a 450-kg (1000-lb) horse
μg/kg	micrograms per kilogram	Dose per kilogram body weight
mcg/kg	micrograms per kilogram	Dose per kilogram body weight
U/kg	units per kilogram	Dose per kilogram body weight
IU/kg	international units per kilogram	Dose per kilogram body weight
μg/kg/min	micrograms per kilogram per minute	Dose per kilogram body weight per minute
IU/kg/hr	international units per kilogram per hour	Dose per kilogram body weight per hour
PRN	<i>pro re nata</i> (as necessary)	Give drug when clinical signs dictate
q	<i>quaque</i> (every)	Frequency of drug administration (e.g., q12h = every 12 hours)
SID	<i>semel in die</i> (once daily)	Give the drug once daily (at 24-hour intervals)
BID	<i>bis in die</i> (twice daily)	Give the drug twice daily (at 12-hour intervals)
TID	<i>ter in die</i> (three times daily)	Give the drug three times daily (at 8-hour intervals)
QID	<i>quater in die</i> (four times daily)	Give the drug four times daily (at 6-hour intervals)

The Equine Hospital Manual

1

Procedures in the adult horse

- | | |
|---|--|
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| 1.2 Cardiopulmonary resuscitation | 1.30 Nebulisation |
| 1.3 Physical examination | 1.31 Endoscopy of the respiratory tract |
| 1.4 Examination per rectum | 1.32 Endoscopy of the guttural pouch |
| 1.5 Collection of blood samples and intravenous injection | 1.33 Tracheal aspiration |
| 1.6 Intramuscular injections | 1.34 Bronchoalveolar lavage |
| 1.7 Passage of a nasogastric tube and indwelling nasogastric tube | 1.35 Pleurocentesis |
| 1.8 Abdominocentesis | 1.36 Evacuation of pneumothorax |
| 1.9 Peritoneal lavage | 1.37 Lung biopsy |
| 1.10 Gastroscopy | 1.38 Sinocentesis |
| 1.11 Percutaneous trocharisation | 1.39 Lumbosacral spinal fluid collection |
| 1.12 Rectal mucosal biopsy | 1.40 Atlanto-occipital cerebrospinal fluid collection |
| 1.13 Liver biopsy | 1.41 Epidural injection and catheterisation |
| 1.14 Jugular catheterisation | 1.42 Urinary catheterisation |
| 1.15 Catheterisation of the cephalic and lateral thoracic veins | 1.43 Endoscopy of the bladder and ureters |
| 1.16 Fluid administration sets | 1.44 Endometrial biopsy |
| 1.17 Electronic infusion pumps and syringe drivers | 1.45 Uterine lavage |
| 1.18 Blood and plasma transfusion | 1.46 Renal biopsy |
| 1.19 Collection of arterial blood gas samples | 1.47 Bone marrow biopsy |
| 1.20 Arterial catheterisation | 1.48 Regional anaesthesia of the eye |
| 1.21 Indirect arterial blood pressure measurement | 1.49 Placement of a subpalpebral lavage catheter |
| 1.22 Direct arterial blood pressure measurement | 1.50 Regional analgesia of the limb |
| 1.23 Central venous pressure measurement | 1.51 Bandaging of the limb |
| 1.24 Electrocardiography | 1.52 Application of splints |
| 1.25 Echocardiography | 1.53 Application of a tourniquet and regional limb perfusion |
| 1.26 Cardiac output measurement | 1.54 Bandaging of the head |
| 1.27 Pericardiocentesis | 1.55 Muscle biopsy |
| 1.28 Emergency tracheotomy | 1.56 Suture materials and suture patterns for skin closure |

1.1 Endotracheal intubation

Kevin Corley

Intubation of the adult horse is a routine procedure for maintenance of anaesthesia for surgery. It is also required for cardiopulmonary resuscitation. Compared to other species, it is relatively easy and unlikely to result in complications. The animal should be anaesthetised (see Chapter 4) or unconscious prior to endotracheal intubation, which is not possible in the conscious animal. Nasotracheal intubation can be performed in the conscious adult horse in a

similar manner to that described for the foal (see Chapter 2.1) but is rarely used in the adult. One indication for nasotracheal intubation is protection of the airway during vigorous lavage to relieve oesophageal obstruction (choke).

Equipment required

The equipment required is listed in Box 1.1. The internal diameter of the tube should be matched to the size of the horse (Table 1.1).

Table 1.1. Matching the size (internal diameter) of the endotracheal tube to the weight of the horse

Weight of foal	Typical breeds	Typical sizes for orotracheal intubation
150–350 kg	Pony	18 mm
	Yearling Thoroughbred	20 mm
		22 mm
350–500 kg	Arabian	22 mm
	Larger pony breeds	24 mm
		26 mm
450–600 kg	Thoroughbred	26 mm
	Warmblood	30 mm
600–800 kg	Draft breeds	30 mm

Smaller tubes are easier to pass but provide more resistance to airflow.

Box 1.1. Equipment for endotracheal intubation of the adult horse

Required

Endotracheal tube* (see Table 1.1)
50–60-ml syringe to inflate endotracheal tube cuff
Gag or bite block to open mouth

Optional

End-tidal carbon dioxide monitor

*Bivona Inc., Gary, IN, USA.

Procedure

With the horse on the ground, the mouth should be opened with a gag or bite block (Figure 1.1). The head should be stretched out so that it is almost in line with the neck (Figure 1.2). It may be helpful to have a second person kneel or push against the poll of the animal, to help straighten the head relative to the neck. The tongue is grasped and gently pulled out to one side of the mouth (Figures 1.2 and 1.3). The endotracheal tube is held so that any curve points towards the bottom of the mouth. The tube is pushed over the middle of the tongue towards the back of the mouth (Figure 1.2). As the tube approaches the larynx, it may be necessary to gently twist it, so that the bevel passes between the arytenoid cartilages of the larynx. If resistance to being passed is felt, the tube should be withdrawn slightly, twisted and readvanced.

Once the tube is believed to be in the trachea, it should be checked. The usual method for checking the tube is by one person pressing on the thorax, whilst another feels for expiration of air from the end of the tube. It is also possible to connect the tube to an end-tidal carbon dioxide monitor. If the tube is in the trachea, carbon dioxide should be detected on expiration. If the tube is in the oesophagus, no carbon dioxide will be detected.

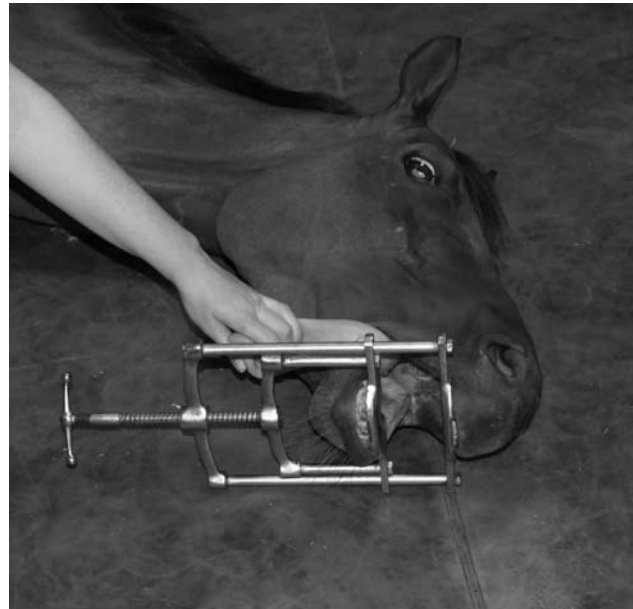


Figure 1.1 Opening the mouth of a horse with a gag, prior to intubation. The tongue is grasped to steady and control the larynx, and to stop the tongue interfering with the passage of the endotracheal tube. ©Kevin Corley 2007.



Figure 1.2 The head should be stretched out, so that it is almost at a straight line with the neck. ©Kevin Corley 2007.



Figure 1.3 The tube may have to be twisted to pass past the larynx. ©Kevin Corley 2007.

Difficult intubations

Difficult intubations are extremely rare in the adult. If the tube cannot be passed, and the situation is not emergent, an endoscope should be passed down the nasal passage to inspect the pharynx and larynx (see Chapter 1.31). For example, if this occurs in a horse undergoing routine surgery, anaesthesia can be maintained with injectable anaesthetic agents (see Chapter 4) until the larynx can be inspected. If the larynx appears normal, the endotracheal tube should be advanced whilst observing the nasopharynx and larynx with the endoscope. If the larynx is grossly abnormal, or it is vital to intubate the horse immediately, an emergency tracheotomy should be performed (see Chapter 1.28).

1.2 Cardiopulmonary resuscitation

Kevin Corley

Cardiopulmonary resuscitation (CPR) in the adult horse, as opposed to in the neonatal foal (see Chapter 2.2), is technically challenging and rarely clinically worthwhile. The few horses that are successfully resuscitated usually rearrest very shortly afterwards, as a result of the primary pathology that caused the initial arrest. The one exception to this is horses that arrest during anaesthesia, which can often be saved. These horses are intensively monitored and already intubated and connected to a circuit with a rebreathing bag, meaning that the arrest is immediately identified and precious time is saved. Furthermore, horses may arrest during anaesthesia as an effect of the anaesthetic protocol (drugs, positioning etc.) with no underlying life-threatening pathology.

Equipment required

The equipment needed is given in Box 1.2. Self-inflating resuscitation bags (Ambu bags) of sufficient size for adult

horses are not available commercially. For this reason, most clinicians use the anaesthetic circuit to ventilate horses, using the rebreathing bag (see Figure 4.5) to manually inflate the lungs.

CPR for the anaesthetised horse

Recognising the need for CPR

If the horse is being monitored with an electrocardiogram (ECG), the ECG trace may show abnormalities, such as asystole (Figure 1.4), ventricular rhythm (Figure 1.5) or ventricular fibrillation (Figure 1.5). Markedly irregular or slow ECG activity may possibly be the sign of a possible impending arrest (Figure 1.4). The significance of irregular rhythms during anaesthesia is discussed in Chapter 4, and treatments for dysrhythmias are discussed in Chapter 9.2. If an unusual ECG rhythm is noted, the pulse rhythm and quality should be immediately checked.

Box 1.2. Equipment for cardiopulmonary resuscitation of the adult horse

Required

Nasotracheal tube (see Table 1.1)
50-ml syringe to inflate nasotracheal tube cuff
Anaesthetic machine with 5-L or larger rebreathing bag
Small pen torch (flashlight)
Epinephrine (adrenaline) bottle*
Five 10-ml sterile syringes
18-Gauge 1½-inch needles

Equipment that should be available if possible

Oxygen supply
Direct arterial pressure monitor
End-tidal carbon dioxide monitor

*Epinephrine injection 1:1000, Butler, Dublin, OH, USA.

irregular sinus rhythm



asystole



Figure 1.4 Irregular sinus rhythm progressing to asystole in a horse. Asystole is recognised by the complete absence of discernable QRS complexes. ©Kevin Corley 2001.

ventricular rhythm



ventricular fibrillation



Figure 1.5 Ventricular rhythm progressing to ventricular fibrillation in a horse. The ventricular rhythm is recognised by the slow rate (typically 18 to 22 bpm) and wide QRS complexes, showing that they originate from the ventricle. The ventricular fibrillation is characterised by jagged undulating electrical activity with no discernable QRS complexes. ©Kevin Corley 2001.

Box 1.3. Triggers for initiating CPR during anaesthesia

Two or more of the following occurring simultaneously should trigger immediate CPR

- No palpable pulse or weak, intermittent pulse
- No arterial waveform on arterial pressure monitor
- Asystole or ventricular fibrillation on the ECG
- End-tidal carbon dioxide less than 10 mm Hg (1.33 kPa)
- No palpebral or corneal reflex despite light plane of anaesthesia

The horse may also stop spontaneously breathing. This should be viewed in the context of the stage of anaesthesia, as this is common on induction.

If only one of the above occurs, the result should be double-checked (e.g., by feeling for the pulse at a separate point, checking the piece of machinery is functioning correctly, checking depth of anaesthesia, etc) whilst intensively monitoring the horse and deciding on the need for CPR.

The triggers for immediate CPR are given in Box 1.3. A low venous oxygen concentration may indicate that an imminent arrest is likely.¹

Procedure

Firstly, it should be decided whether resuscitation is appropriate for this patient. This depends on the reason for the surgery. Horses that arrest during elective surgery appear to have a good chance of survival based on the two horses I have seen in this circumstance and two further ones I have had reported to me. I was also involved with one horse that arrested during stitching at the end of colic surgery, in which successful CPR was performed. An outline for CPR of the anaesthetised horse is given in Box 1.4. Placing the horse in lateral recumbency can obviously be problematic when the horse is in dorsal recumbency with an open abdomen. Depending on the circumstances, packing the abdomen quickly and securing with two or three sutures through all layers of the abdominal wall, or simply trying to keep the abdominal contents sterile and on the table, is an option. It is not possible to successfully resuscitate a horse in dorsal recumbency.

There is no effective way to perform thoracic compressions in the adult horse. Most people try to use their body weight to squeeze the heart and lungs. The most effective way to do this is to jump from the ventral side of the thorax onto the midpoint of the thorax just behind the triceps muscle mass, landing on the knee and shin.² This can result in injury to the person doing the thoracic compressions either by damaging the leg they land on or possibly from the legs of the horse if it moves. The technique also may cause rib fractures in the horse, especially if done by a heavier person. An alternative is to thump the middle of the thorax, just behind the triceps muscle mass, which

Box 1.4. CPR during anaesthesia

1. Turn the vapouriser for inhaled anaesthetic agent to zero. If on any gases other than oxygen, turn these off to give 100% oxygen.
2. Open the pressure-relief valve and press the emergency oxygen flush to try and flush out as much anaesthetic agent as possible. Squeeze the rebreathing bag.
3. If using an inflatable mattress or support, let all the air out.
4. Position the horse in lateral recumbency on the hardest surface available quickly.
5. Intubate the horse, if not already intubated (see Chapter 1.1).
6. Connect the horse to anaesthetic machine, if not already done so.
7. Turn the oxygen flowmeter to high flow (10–15 L/min).
8. Half close the pressure-relief valve on the anaesthetic machine.
9. Squeeze the rebreathing bag to give the horse a breath.
10. Check the pulse and ECG.
11. If there is no pulse, start thoracic compressions.
12. Jump onto horse, landing with knee and shin on the high point of the thorax just behind the triceps muscle mass*.
13. Aim for 80 compressions per minute.
14. Continue squeezing the rebreathing bag to give 10–20 breaths per minute.
15. Adjust oxygen flowmeter and valve to refill the rebreathing bag between breaths.
16. Check for pulse and ECG waveform after 30 seconds of thoracic compressions.
17. If no return of circulation, give 1–2 ml/100 kg body weight of 1 mg/ml epinephrine (adrenaline) intravenously (NOT direct cardiac injection).
18. Continue thoracic compressions and squeezing the rebreathing bag.
19. Check for pulse every 60 seconds.
20. Repeat epinephrine (adrenaline) at 3-minute intervals.
21. Stop if no return of spontaneous circulation after 15 minutes.
22. If there is a return of spontaneous circulation, maintain the horse on mechanical ventilation or continued manual squeezing of the rebreathing bag for the rest of the procedure.
23. Make a plan to finish the surgery as rapidly as possible, under the minimum anaesthetic agent possible. Consider regional or systemic analgesia to reduce anaesthetic agent requirements.

*This risks injury to the person doing the thoracic compressions.

might be effective in small horses and ponies. Thumping the thorax risks bruising and possible breakage of the hand of the person doing the thumping.

The ideal rate for thoracic compressions in the adult horse is 80 compressions per minute.² This is obviously

hard to maintain for any length of time and will require several people to take turns to try and maintain this rate.

CPR for the nonanaesthetised adult horse

A nonanaesthetised horse that undergoes a cardiopulmonary arrest is likely to rapidly lose consciousness, fall to the ground and have no palpable pulse or auscultable heart-beat. It is most important to decide whether CPR is appropriate in this circumstance. Most of the horses I have seen arrest are horses with severe colic lesions shortly after arrival at the hospital. I have attempted CPR on a couple of these horses, mostly to satisfy owner demand. None have been successful.

If CPR is attempted on a nonanaesthetised horse, the same general scheme applies as for the anaesthetised horse. The plan in Box 1.4 can be followed, starting at point 4.

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1.3 Physical examination

Anna Hammond

The clinical examination is a vital, and often partially neglected, component of the diagnostic puzzle presented by patients. This is especially true in the hospitalised patient where there is a danger of overreliance on the use of sophisticated diagnostic technology. The following description should serve only as a basic guide to the process of clinical examination and may not apply to every case. In the emergent case, such as the collapsed foal or violently colicking horse, the principles of triage must apply and a shortened version should be used to gather vital information quickly. A full examination can then follow resuscitation or instigation of pain relief. The ability to recognise an abnormality is built upon a sound knowledge of what is normal; thorough clinical examination of normal horses is never time wasted.

Equipment needed

Little equipment is required for the physical examination (Box 1.5). Generally, money invested in a stethoscope is well spent. More subtle abnormalities, particularly of the heart, are hard to appreciate with inferior stethoscopes.

Physical examination

Knowledge of the patient's history, including previous and concurrent disease, management, other animal contact and transportation, provides a useful background to the examination. It is important to try and avoid leading questions,

Box 1.5. Equipment for physical examination of the horse

Required

Stethoscope, with a large (adult, not paediatric) bell
Thermometer
Small flashlight or pen-torch
Physical examination form or notebook
Pen

as some owners may bias their answers in an attempt to help.

There is a great deal of information that can be obtained from standing back and observing the animal's behaviour: Is it aware of its surroundings? Is it interested in what's going on? Does it appear painful? Subtle changes in the animal's behaviour may only be apparent to the owner, so it is worth asking (and listening) whether there has been any recent change. From a distance, one can also observe any nasal/ocular discharge or asymmetry, the respiratory pattern and rate (normal: 8 to 12 breaths per minute), any asymmetry in the musculature, unwillingness to bear weight on a particular limb, reluctance to move and the stance of the animal. Palpation of the animal follows observation. Many clinicians adopt a "head-to-toe" approach; others work through each body system in turn. It matters less which approach is adopted than it does to have a routine so that no parts are overlooked.

Using a head-to-toe approach: Starting at the head, movement of air through each of the external nares is observed and any nostril flaring or discharge is noted and characterised. Parting the lips then allows assessment of the gingival mucous membranes for colour and, by pressing on the gum, the capillary refill time (this is, however, very subjective). Mucous membrane colour can also be assessed in the conjunctiva and vulva. Moving to the eyes, presence of symmetry, discharge and ptosis are again noted. Ptosis is most easily observed by assessing the angle of the eyelashes. Ears should display symmetry in position and movement in response to the presence of the observer. Assessing the inside of the ear often requires sedation. Percussion of the frontal and maxillary sinuses should then be performed. The areas medial, dorsal and ventral to eye level are tapped with one knuckle. A "dullness" or reduced resonance may indicate the presence of fluid or soft tissue within the sinus cavity. Palpation of the submandibular lymph nodes is achieved within the V-shaped groove between the mandibular rami. The pharynx should also be pinched in an attempt to elicit a cough reaction, which may suggest airway inflammation. Such a response is, however, highly variable. The muscles of the head and neck should be palpated for symmetry, presence of masses, wasting and a painful response to touch. Running the hands down the fore limbs will enable localisation of any areas of heat, pain

or swelling. Particular attention should be paid to each joint. This process should end at the feet, where the pulsation in the palmar digital vessels is palpated as they course over the lateral, proximal sesamoid bone. The feet are also palpated for general warmth.

Moving to the thorax, the left and right lung fields are carefully auscultated for any abnormal noises (e.g., crackles and wheezes) superimposed on the normal quiet bronchovesicular sounds. The normal sounds should be audible in all areas of the lungs. These sounds can be very difficult to hear in an overweight individual. To exaggerate any abnormalities, an airtight bag is placed over the nostrils, which is kept in place until the respiratory rate and effort is increased. The thorax is auscultated during the period of increased rate, and on recovery. This procedure is known as a rebreathing examination and is not performed in horses that have obvious respiratory symptoms. If pleuritis is suspected, it can be helpful to place both hands on the sternum and give a sudden push upwards, often eliciting a marked pain response in such cases. Auscultation of the heart should cover the entire cardiac area, underneath the triceps muscles on the left and right sides, in the third to fifth intercostal spaces. The heart rate should be counted (normal: 28 to 36 beats per minute), allowing for increases if the horse is nervous or excited. In a nervous animal, it is often a good idea to auscultate the heart over a more prolonged period. The heart rate will gradually decrease more towards its true resting rate as the horse gets used to the auscultation procedure. If there is any abnormal rhythm, the heart rate should be counted over several minutes. Any murmurs should be auscultated whilst simultaneously palpating the pulse (usually using the facial artery) to confirm their presence in systole or diastole. Accurate description of any murmur heard requires its localisation physically and within the cardiac cycle.

The abdomen is normally auscultated in separate quadrants: upper and lower, left and right. Each quadrant is auscultated for a minute to assess borborygmi and any “tinkling” associated with gas accumulation. The rectal temperature should be taken (normal: 37.5° to 38.5° C or 99.5° to 101.5° F) and at the same time the rectal and tail tone can be appreciated. Palpation and observation then continues over the hindquarters and hind limbs noting any swelling or muscle wastage, often best done by careful observation from behind the animal. Once this examination is completed, abnormal findings are recorded and, in association with the history, form the basis of a diagnostic plan.

1.4 Examination per rectum

Emma Rowe

It is only possible to palpate the caudal 30% to 40% of the horse's abdomen, as the peritoneal cavity is so large.¹ Because of this, not all structures and areas within the abdomen can be palpated, and therefore it may not always

be possible to arrive at a definitive diagnosis following rectal examination. However, it is rare that useful information is not gained. Usually, the findings of the rectal examination are evaluated in conjunction with the results of other diagnostic procedures. For example, a horse hospitalised for colic with worsening pain may have a rectal examination performed in addition to a physical examination, nasogastric intubation, abdominocentesis and blood work in order to decide the appropriate course of action. The severity of the problem and necessity of surgery are often made judged mainly on the findings of the rectal examination, even if the specific lesion cannot be identified. In certain cases, the rectal examination will allow diagnosis of certain conditions such as nephrosplenic entrapment, ileal impaction, uterine torsion or inguinal ring herniation of the small intestine.^{1,2}

Equipment needed

Little equipment is required for examination per rectum (Box 1.6). It is extremely important to have very good control of the horse when performing the technique and a competent handler is required to hold the horse.

Preparation for the examination

To perform a rectal examination, it is vitally important that the horse is properly restrained. Ideally, the horse should be restrained in stocks to increase the safety of the veterinarian. In most purpose-built equine hospitals, stocks are available for restraint. Sedation, an experienced handler and application of a nose twitch can also be very effective. In some cases the horse will be in the stall, connected to intravenous fluids and possibly continuous rate drug infusion. For these horses, it will be easier to perform the rectal examination in the stall rather than disconnecting all the infusions and moving the horse to the stocks.

The handler should stand the same side as the veterinarian performing the rectal. The horse should have a nose

Box 1.6. Equipment for examination per rectum

Required

Rectal sleeve
Obstetrical lubricant
Competent horse holder

Optional

Sedation
Twitch
Stocks to restrain the horse
Mepivacaine* or lidocaine to instil in the rectum
75-cm (30-inch) fluid extension set†
50–60-ml syringe

*Intra-epicaine, Arnolds Veterinary Products, Shrewsbury, UK; Carbocaine-V, Pfizer Animal Health, New York, NY, USA.

†2C5645; Baxter Healthcare, Deerfield, IL, USA.

twitch applied and should be sedated, if necessary. A nose twitch helps restrain the horse and promotes relaxation of the rectum.¹ The horse can be sedated with an α_2 -agonist such as xylazine or detomidine, which improves control of the patient and also relaxes the rectum. If the horse is very young or fractious or has a suspected rectal tear, it may be necessary to perform epidural anaesthesia with 2% lidocaine (lignocaine) (0.22 mg/kg) or xylazine (0.17 mg/kg expanded to the appropriate volume with sterile saline)³ (see Chapter 1.41).

Long rectal sleeves should be worn for the examination. It is preferable to turn the sleeve inside out if there are prominent seams in the sleeve. Some examiners prefer to use a surgical glove over the rectal sleeve, which can increase the sensitivity of palpation. This is often preferable if palpating a rectal tear, or the examiner may choose to wear no protection so the tear can be felt with the gentlest palpation. It is extremely important for the examiner to use a large amount of lubrication over the sleeve on the hand and arm to ensure there is minimal irritation to the rectal mucosa, minimal discomfort to the horse and minimal chance of a rectal tear. The most common lubricant is hydrated methylcellulose.³ When the veterinarian initially places the hand into the rectum, if the horse is not standing in stocks, he or she should stand to one side of the hind end, adjacent to the hind limb, facing caudally. There is a certain amount of force required to manipulate the hand through the anus into the rectum, which should be done in a slow, controlled manner. The thumb and fingers should be together in the extended position, and once the hand has moved passed the anus, the examiner can move directly behind the horse and remove the faeces from the rectum.

Examination per rectum

After the faeces have been removed, the examiner can replace the hand in the rectum very slowly, after applying more lubricating gel to the sleeve, using the same technique. Once inside the rectum, the examiner should relax and leave the arm in place for 20 to 30 seconds (allows the rectum to relax around the arm), and then the arm can be advanced cranially. Initial examination of the caudal abdomen with the arm only inserted halfway into the rectum is not recommended as the horse may start straining, which can result in excessive peristaltic contractions of the rectum.¹ It is extremely important that advancement of the examiner's arm is slow, and if any resistance is felt, the examiner should cease cranial movement immediately. If a peristaltic contraction is felt, the arm should be retracted and the contraction allowed to pass. The most serious complication of the rectal examination is iatrogenic perforation of the rectum: Withdrawing the hand at the appropriate times will avoid rectal injury in most cases. If the horse is straining or tense, intrarectal administration of local anaesthetic (lidocaine [lignocaine] or mepivacaine) can be useful to provide analgesia and relax the rectum. It

is rare that a broodmare would require this, but a tense Arabian horse or young gelding unaccustomed to the rectal examination may require this in addition to sedation. Local anaesthetic can be administered into the rectum with a fluid extension set attached to a 50- to 60-ml syringe filled with 2% lidocaine (lignocaine) or mepivacaine.

Once the arm is in as far comfortably as possible, the examiner should relax again for 15 to 30 seconds and allow the anal sphincter, rectum and small colon to relax. If the bladder is very full, it may prevent palpation of the rest of the abdomen, and in that case the horse should be encouraged to urinate by terminating the examination and placing the horse in a stall. If voluntary urination does not occur, then a urinary catheter should be placed (Chapter 1.42). The rectal examination should be performed in a systematic manner to ensure that problems are not missed. The particular order of the structures that are palpated may vary between examiners, but a common approach is to start in the left dorsal quadrant of the abdomen and systematically move around in a clockwise direction (Figure 1.6). Starting in the left dorsal quadrant, the spleen is located with the caudal edge against the left body wall. The examiner can follow the caudal edge of the spleen up to the nephrosplenic ligament and caudal pole of the left kidney and into the nephrosplenic space. No intestine or other material is present in the nephrosplenic space in the normal horse, and three or four fingers can be placed into it.³ However, in larger breeds of horses, the nephrosplenic space may not be able to be reached. From this location, the examiner moves the hand to the right side across midline and the aorta can be palpated. The root of the mesentery may also be palpated, but in large horses the mesentery may be out of reach or may just be reached with the tips of the fingers.⁴ The aortic pulse is easily palpable, whereas the pulse within the mesenteric stalk is only occasionally palpable.³ The right upper quadrant of the abdomen is then palpated. The duodenum is located dorsal to the base of the caecum and can sometimes be palpated if it is distended or distends during a peristaltic wave⁴ but is not often felt during rectal examination. The examiner's hand can then move down to the base of the caecum and palpate the ventral and medial caecal bands (taenia). These bands run in a dorsocaudal-to-ventrocranial direction and are usually relaxed and can be moved with gentle manipulation by the examiner's fingers. The examiner then moves caudally and to the left ventral quadrant, where pelvic flexure and the dorsal colon may be felt, if there are enough ingesta and that part of the large colon is sitting caudally. The pelvic flexure may occasionally be out of reach, even in the normal horse. The left dorsal colon is identified by the fact that there are no palpable haustra or taenia, compared to the left ventral colon, which has two palpable taenia and haustrations.³ The small colon can also often be palpated in the left ventral quadrant but may be palpable in various regions. The small colon usually contains formed faecal balls, which make it easily identified. In the normal

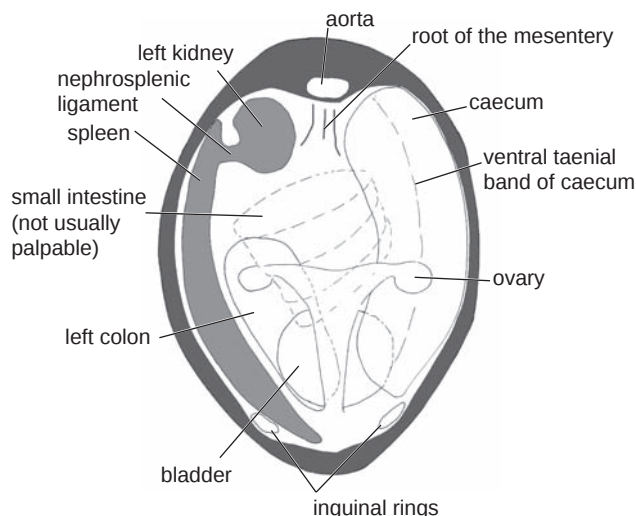


Figure 1.6 Schematic diagram illustrating structures palpable on examination per rectum.

horse, it is rare to palpate the small intestine, which is usually only felt when it is distended. The examiner should then move caudally at the end of the examination to palpate the reproductive structures including uterus, ovaries and cervix for the mare and internal inguinal rings for the stallion or gelding. The inguinal rings can be located by moving the hand across the pelvic rim and then feeling cranial and just ventral and lateral to the cranial edge of the pelvis.⁴ In some stallions, a finger can be inserted into the inguinal ring and the ductus deferens is then palpable in the caudo-medial aspect of the vaginal ring. However, the inguinal ring is much smaller in geldings and decreases in size with age, making the vas deferens nonpalpable.⁵ The bladder should also be palpated for thickening or the presence of uroliths.

Abnormal findings on examination per rectum are described in Chapter 11.1.

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Box 1.7. Equipment for collection of blood samples and intravenous injection

Vacutainer blood collection

18–20-gauge vacutainer needle
 Vacutainer sleeve
 Appropriate vacutainer* (see Box 19.3)

Syringe and needle blood collection

Appropriate sized syringe (usually 10–30 ml)
 18–20-gauge 2.5–3.75-cm (1–1½-inch) needle
 Appropriate vacutainer or blood sample bottle (see Box 19.3)

Blood collection for packed cell volume measurement only

23–25-gauge 1.6-cm ($\frac{5}{8}$ -inch) needle
 Microhaematocrit tube containing EDTA
 Microhaematocrit tube sealant

Intravenous injection

Appropriate-sized syringe filled with drug
 18–20-gauge 2.5–3.75-cm (1–1½-inch) needle

Required for all techniques

Competent horse handler

Optional for all techniques

Alcohol- or antiseptic-soaked cotton wool or gauze swab (4 × 4)
 Twitch

*Becton Dickinson (<http://catalog.bd.com>).

1.5 Collection of blood samples and intravenous injection

Kevin Corley

Blood sampling and intravenous injections are fairly straightforward in the horse. The main vein used is the jugular vein, which is usually the safest and most practical from which to collect. Venipuncture can result in sudden, sometimes violent, movements by the horse. Appropriate restraint techniques by a competent handler are required to reduce the risk to the person attempting venipuncture.

Equipment needed

The equipment needed is listed in Box 1.7.

Procedure

Disinfection prior to venipuncture

It is debated whether disinfection prior to venipuncture is necessary or effective. Proponents argue that not disinfecting the skin prior to venipuncture increases the chance of thrombophlebitis or local cellulitis. Opponents suggest that a single wipe with disinfectant is ineffective. Alcohol-based disinfection works primarily by drying and desicca-

tion. Most people who use disinfection do not allow any time for the alcohol to dry. It is argued that a quick wipe simply puts resident bacteria into suspension, making it easier to introduce them into the subcutaneous tissues and vein. If the area over the vein is grossly contaminated, it should certainly be cleaned and disinfected prior to venipuncture.

Collection of blood and injection from the jugular vein

It is easiest to collect blood from and inject into the jugular vein in the upper half of the neck. The carotid artery lies in closer proximity to the jugular vein in the lower half of the neck, making inadvertent carotid puncture less likely in the upper neck.

The vein should be raised below the site of venipuncture (Figure 1.7), using the nondominant hand. The needle is held with the bevel facing outwards (with the tip closest to the skin), and at a narrow angle to the vein (Figure 1.7). The aim should be to push the needle through the skin over the middle of the vein. It is important to observe how the vein runs above the venipuncture site, and to make sure that the needle is on the same line as it. Otherwise, it is easy to push the needle through the vein and into the tissue on the other side. If using a vacutainer system, it is important not to push the vacutainer completely onto the piercing needle until the needle is securely into the vein (Figure 1.7).

The needle should be pushed firmly through the skin and into the vein, whilst keeping the vein raised. Donkeys and ponies have tougher skin than do Thoroughbred horses, necessitating more force to get the needle through the skin. Once through the skin, the angle should be flattened, and the needle advanced to the hub (Figure 1.8).

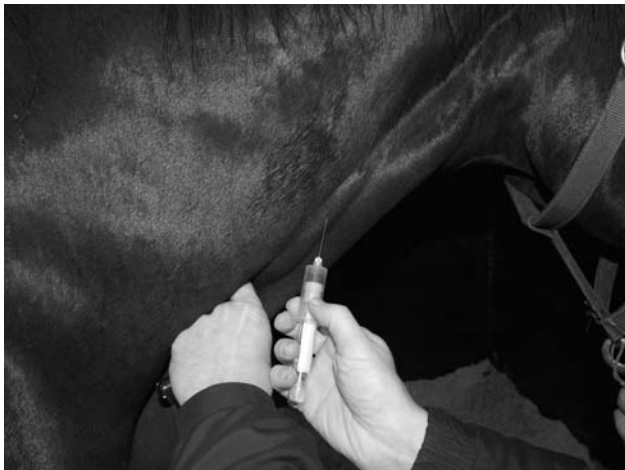


Figure 1.7 The vein is raised with one hand, whilst the needle is pushed into the centre of the vein at a narrow angle. The bevel of the needle should be pointing out (i.e., the tip is closest to the skin of the horse). The vacutainer is held in light contact with the piercing part of the needle, without puncturing the top of the vacutainer. ©Kevin Corley 2007.

With a vacutainer system, the vacutainer should be pushed firmly onto the piercing needle, taking care not to move the needle in the vein. It may be easiest to place one or two fingers of the hand holding the vacutainer sleeve onto the skin of the horse to make sure that the sleeve, and therefore the needle in the vein, does not move relative to the horse and the vein (Figure 1.8). The vacutainer can be pushed onto the piercing needle with the heel of the hand raising the vein (Figure 1.8), or the little finger of the hand holding the vacutainer sleeve. The vein should be raised until the vacutainer is full. If no blood flows into the vacutainer, it should be pulled off the piercing needle. The sleeve and needle are then redirected, and the vacutainer is again pushed onto the piercing needle. If the vacutainer is fully on the piercing needle, and the needle inadvertently comes out of the skin of the horse, the vacuum in the vacutainer will be lost. The vacutainer should be replaced before reattempting venipuncture.

When using a syringe and needle for collection of blood or injection, it is generally easier to take the needle off the syringe and introduce it fully into the vein before connecting the syringe. This is particularly the case in fractious horses. If the horse moves suddenly in response to the needle placement, there is a good chance that a needle will stay in place, allowing connection of syringe once the reaction is over. A second advantage of disconnecting the needle is that, if it is inadvertently placed in the carotid, pulsatile flow of bright red blood can be seen, avoiding accidental intra-arterial injection of potentially very harmful drugs. The disadvantage of disconnecting the needle is that it increases the chance of dropping the needle, which may become hidden in the horse's bedding material and could potentially penetrate part of the horse or the person cleaning out the stable. Once



Figure 1.8 After the needle has been slid into the vein, the vacutainer is pushed onto the piercing needle, which allows the blood to flow. It is important not to accidentally push the needle out of the vein when pushing up the vacutainer. ©Kevin Corley 2007.

the needle is through the skin, it should be redirected into the middle of the raised vein. The syringe should be connected whilst holding the hub of the needle, taking care not to inadvertently push the needle through the vein. If collecting blood, once the syringe is connected, the plunger should be slowly drawn back, whilst keeping the vein raised. If the blood stops flowing, the needle should be carefully redirected to allow blood to flow again. Often, just slightly pulling the needle back is sufficient to restore blood flow.

When injecting a drug, once the syringe has been reconnected, the plunger should be slightly withdrawn to allow a small amount of blood into the syringe. This confirms that the needle is still in the vein and should be repeated two or three times during injection of the drug. Once it is confirmed that the needle is still in the vein, the plunger should be slowly depressed. Some drugs, such as potassium penicillin and oxytetracycline, require very slow injection over several minutes (see Chapter 6.3). The vein should not be continuously raised during injection of a drug, unless it is the intention to give the drug as a bolus.

The jugular veins are the most accessible and easy veins from which to collect blood and in which to inject drugs. However, bilateral jugular thrombophlebitis can have serious consequences for the horse, including profound swelling of the head due to impaired venous drainage, potentially causing respiratory distress and necessitating placement of a tracheotomy (see Chapter 7.2). Therefore, in high-risk patients (such as those with fulminant colitis, see Chapter 8.1) and those with a preexisting jugular thrombophlebitis (see Chapter 7.2), jugular venipuncture should be limited as much as possible, and alternative sites such as the facial sinus should be used.

Collection of blood from the facial sinus

The facial sinus is a good site for collection of blood for a number of reasons. Firstly, noninfectious thrombophlebitis in this area seems to be of little consequence. Secondly, placing a needle in the facial sinus is surprisingly well tolerated by a majority of horses. It is possible to collect quite large volumes of blood (20 to 30 ml) easily from this site. Blood may be collected either by needle and syringe or vacutainer from this site. People unfamiliar with blood collection from this site are advised to use a needle and syringe for the first few horses on which they attempt this technique. The author usually leaves the syringe attached to the needle for this collection site, although it is also possible to place the needle and then connect the syringe.

The facial sinus is just below the facial crest on the side of the face. It is directly below the centre of the eye (Figure 1.9). The needle should be placed at 90° to the skin, approximately 1 to 1.5 cm ($\frac{2}{5}$ to $\frac{3}{5}$ inch) below the facial crest. The needle should be pushed until it just touches the bone, and then very slightly withdrawn. The plunger of the syringe is gently withdrawn, and the syringe is filled with



Figure 1.9 The facial sinus (white semicircle) is located just below the facial crest, at the level of the middle of the eye (arrow). ©Kevin Corley 2007.

blood. If no blood is obtained, the needle should be slightly redirected. Initial redirection should be to angle the needle slightly towards the muzzle of the horse.

Collection of blood and injection into other veins

Blood can be collected, and drugs injected into other veins in the horse. The cephalic vein can be used but is potentially dangerous for the operator, as it involves crouching next to the front leg of the horse. The cephalic vein is described in Chapter 1.15 and Figure 1.38. Collection is similar to that from the jugular vein, except that it should be raised above the site of venipuncture. The lateral thoracic vein (see Chapter 1.15 and Figure 1.45) is very difficult to collect blood from or inject, without first placing a catheter.

Collection of blood for packed cell volume and total solids only

If collecting blood for packed cell volume (PCV) and total solids only, a needle hub technique may be used. A small-gauge (23- to 25-gauge) needle is placed in the jugular vein, facial sinus or other site. When the hub of the needle has filled with blood, the end of a microhaematocrit tube is placed directly into the hub of the needle to collect the blood. The blood should flow along the microhaematocrit tube via capillary action, although it may be necessary to slightly point it downwards to allow the blood to fill it. The microhaematocrit tube is immediately pushed into tube sealant clay or putty at the side of the horse and then carried to the laboratory for centrifugation.

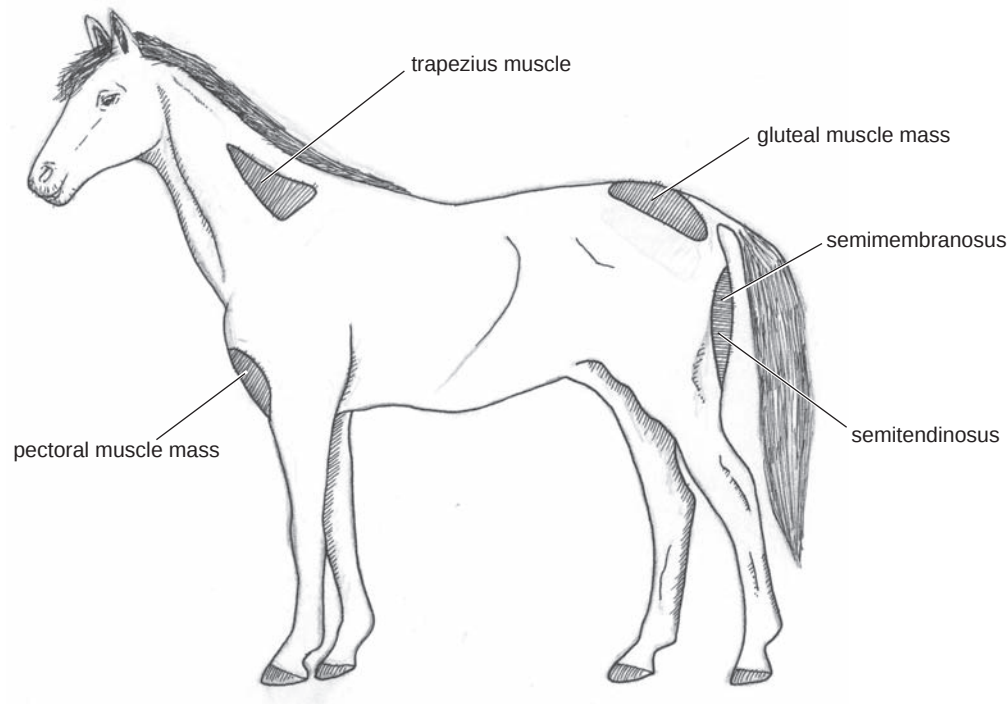


Figure 1.10 Sites for intramuscular injection in the horse.

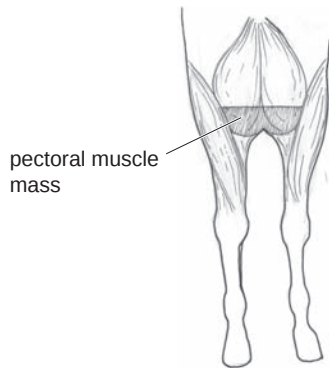


Figure 1.11 Schematic of the cranial aspect of the front legs, showing the site of intramuscular injection into the pectoral muscles.

Box 1.8. Equipment for intramuscular injection

Required

Syringe
1½-inch, 22–18-gauge needle (depends on viscosity of medicine to be delivered)

Optional

Alcohol- or antiseptic-soaked cotton wool or gauze swab (4 × 4)

1.6 Intramuscular injections

Jennifer O. Stephen

Potential sites for intramuscular injection in the horse

1. Neck: above the cervical vertebrae, below the nuchal ligament and in front of the scapula (Figure 1.10)
2. Lower half of semitendinosus and semimembranosus muscles (Figure 1.10)
3. Pectoral muscles (Figure 1.11)
4. Gluteal muscles (Figure 1.10)

Equipment needed

The equipment needed is listed in Box 1.8. Some authors recommend cleaning the skin with alcohol prior to injection.¹ However, it is important to check the manufacturer's data sheet, as this is contraindicated with some products, particularly vaccinations. If alcohol is used, sufficient time must be left for the alcohol to dry for it to be effective.

Technique

The horse must be properly restrained by an assistant. The needle should be inserted through the skin as quickly as possible. The initial insertion is likely to cause a reaction;