Dehydration and fluid therapy

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6.1 Anuresis, heat stress and dehydration

Anuria or 'lack of urine production'

> Anuria = absence of urination
>
> Oliguria = reduction in urination

Both of these describe symptoms and are not a diagnosis.

The pathophysiological mechanisms causing anuria/oliguria can be put into three different categories:

1. PRE-RENAL In response to hypoperfusion (decreased renal blood flow) of the kidney

   This can result from the following:

   a. Dehydration – which can be caused by an imbalance of fluid inputs versus outputs:

      i. A lack of water input: drinking water
      ii. Increased fluids outputs/loss: diarrhoea, sweating, respiration

   b. Cardiogenic shock, or sepsis (endotoxaemic shock) which affects blood distribution around the vascular system

2. RENAL In response to direct kidney damage (intrinsic renal failure), e.g. via damage caused by nephrotoxic drugs (NSAIDs/aminogylcosides)

3. POST-RENAL Caused by an obstruction to urinary output (e.g. urinary bladder rupture in foals, obstructing urinary calculi)

Anuria or 'failure to urinate' is a commonly encountered presentaion. Although it is important to consider obstruction any time an animal does not pass urine, often this is not the case; a primary blockage is rare in equids.

> In the majority of cases a good history will be able to identify the causes of anuria and allow the correct treatment.

This is really important because the wrong treatment may result in serious and permanent damage.

If an animal presents with anuria, the first thing to ascertain is whether it is pre-renal, renal or post-renal.

Pre-renal is the easiest to diagnose and is the most common cause of anuria. Post-renal is the next most common cause. Renal is the last and most unlikely cause.

- Pre-renal causes This can be very easy to assess – through offering water. Refer to the dehydration section below and 7.2 (Pritchard et al. 2008). Additionally a thorough clinical examination and history will help decide the underlying cause. Colic and other systemic factors are a common cause of anuria/dehydration as the animal is reluctant to drink. Observe the circulatory system for signs of shock, common in endotoxaemia, which may be the underlying cause.

- Renal causes Although not discussed at length in this manual, renal causes for anuria include acute renal failure or infection. Refer to diseases of the urinary tract in Section 13.2, and other equine texts.
- Post-renal causes Ascertain whether the animal has an obstruction or infection. This is relatively uncommon and will be diagnosed by history (straining to urinate or straining when urinating, passing small volumes of urine, blood in urine) and urinary catheterisation (unable to pass a urinary catheter past the blocked urethra). It is important to get a good understanding of the amount of water given/drunk, diet (increased mineral content of local water) and other possible causes, e.g. foaling. Refer to diseases of the urinary tract in Section 13.2 for more information.

Diuretics – Inappropriate use is a common contribution to poor welfare in many countries.

> The use Frusemide (Lasix) and other diuretics is strictly contra-indicated as a treatment for anuria.

This is very serious; owners may think that giving a Lasix injection will 'solve' the problem, and that making an animal urinate has fixed the problem. However, by understanding how the kidney works it is clear that lack of urination is the clinical sign, not the problem itself. A diuretic produces urine (thus fixing the 'sign') but does not solve the underlying cause.

> N.B. Administration of a diuretic is potentially lethal if there is an obstruction of any sort. If the animal is suffering from dehydration it can cause the animal to go into acute renal failure.

How diuretics work

Generally, all diuretics work to increase excretion of sodium and water leading to an increased urine output. There are many types with differing mechanisms of action; however, the most common in equine practice are the loop diuretics, e.g. frusemide. These have been comprehensively studied in equids due to widespread use in racehorses, and are the most likely diuretic available to veterinarians.

Diuretics have a dose-dependent increase in urine output, therefore the bigger the dose, the greater the urination.

Frusemide works by affecting the ion transport systems of the kidney's Loop of Henle, resulting in increased expulsion of sodium, potassium and chloride ions which causes the signs of urination.

> Although not indicated for anuria, diuretics can be very useful to decrease oedema associated with pulmonary or cardiac disorders, or consequences of trauma.

The historical practice of administering loop diuretics to bring about urination is no longer recommended; these drugs will worsen dehydration status.

Long-term diuretic use will have other effects. See clinical pharmacology texts for more information on the indications and correct usage of diuretic drugs in equine medicine. In general,

work to encourage owners and paraprofessionals to understand what causes urinary flow, i.e. the balance between the input (drinking) and outputs (urination, sweating, faecal loss, etc.), and help to decrease the inappropriate usage of diuretics to 'treat' anuria.

Heat stress in equids

Heat stress occurs when the body absorbs or produces more heat that it can lose. It will ultimately result in hyperthermia when the body temperature actually increases and this is a medical emergency that warrants immediate veterinary treatment. Simple cooling interventions can avoid hyperthermia altogether, and ensure that the welfare of working equids is not compromised. Although it is important to have reliable veterinary services available to treat sick equids with hyperthermia, it is even more important to educate owners how to stop their animals suffering from this entirely preventable condition.

> Every equid treated should be offered water. Hot animals should be cooled while waiting to be examined. Aim to conduct examinations in the shade and provide shade to avoid further discomfort while animals are waiting.

Heat stress is a common condition in working equids, especially in the hot, humid months. It is serious and may be fatal, but should be recognised as an abnormal physiological state, not a 'disease'. Treatment should be as simple as possible, focusing on measures which an owner can take at any time to prevent or reduce the severity of the condition.

> The aim of management of heat stress is to show owners that it is both preventable and treatable without veterinary intervention. Education is critical to ensure that, in the future, owners are aware about how heat stress can be avoided. Also explain how to recognise the early stages of heat stress so treatment can be simple and intervention can be implemented before the animal develops more severe clinical signs.

Clinical signs (may be unrelated to the presenting problem)

- Increased respiratory rate and effort
- Flaring nostrils
- Tripping when moving
- Lowered head, increased head movement
- Dullness, lack of response to environment (e.g. other animals nearby)
- Increased pulse and congested mucous membranes
- Raised rectal temperature

N.B. The behavioural signs indicating heat stress in this list are a valid diagnostic alternative to taking the rectal temperature. Therefore, although a clinician may need to take a temperature as part of a clinical examination, an owner does not need to do this to identify heat stress. Furthermore, the treatment for heat stress should not be delayed just to get the rectal temperature and an animal should not be overly stressed trying to obtain this reading as it is not essential for diagnosis.

In both horses and donkeys heat stress behaviour (as described above) is associated with an increased rectal temperature (Pritchard et al. 2006).

If owners can recognise behavioural heat stress symptoms (Figure 6.1.1), they can use them to make judgements regarding rest and cooling.

Owner recognition of heat stress has a number of advantages:

- It will reduce the time it takes to improve the animal's condition – reducing the animal's suffering and avoiding progression. (If untreated, heat stress can progress to endotoxaemia, disseminated intravascular coagulation, renal failure, central nervous system disturbance, organ dysfunction and death.)
- It will prevent further heat load and fatigue while travelling to and waiting for veterinary attention.
- It will reduce the cost in both time and money for the owner and reduce dependency on external sources to improve animal welfare and management.

All veterinary and animal health field staff, including community development workers, drivers and farriers, should be able to recognise the signs of heat stress and instruct owners on the necessary intervention if this is seen at any time.

Treatment of heat stress

Encourage owners and paraprofessionals to be able to recognise these signs and give the following first aid measures to the animal immediately:

- Pour two or three buckets of cool water over the animal's back, neck and belly. Rub the water into the hair so the skin is thoroughly wetted.
- Offer a bucket of water to drink. Leave it with the animal for 10 minutes, as it may be initially too overheated to drink. Allow the animal to drink in a quiet area if possible, as stress can deter drinking.
- Stand the animal in the shade.

Figure 6.1.1 Clinical presentation of heat stress in a donkey.

Giving intravenous fluids/injections is not recommended for the majority of heat stress cases. They are not only unnecessary – as most animals can rehydrate themselves naturally through drinking – but involve needless veterinary intervention. Most importantly, aggressive veterinary treatment for heat stress may lead the owner to think that it can only be treated by a veterinarian, thus making them more likely to bring heat-stressed animals long distances to mobile or field veterinary clinics, instead of resting, watering and cooling the animal themselves.

Prevention through extension and capacity building of paraprofessionals is better than cure.

If fluid therapy is required, for example the animal is unable or unwilling to drink, refer to the fluid therapy in Section 6.2 of this chapter. For more information refer to the paper by Pritchard et al. (2006) on behavioural measures of heat stress for dehydration in working equids.

Caution – Do not inject adrenaline. Adrenaline injected into a heat-stressed animal risks killing it by increasing the heart rate and metabolic oxygen demand in an already compromised circulation.

- Historically, intradermal (not IV) adrenaline has been used for the treatment of suspected cases of anhidrosis (the inability to sweat in response to normal stimuli). True anhidrosis (non-sweating) is an extremely rare condition and almost all animals that are not seen sweating are simply too dehydrated to produce sweat and do not have pathophysiology of the sweat gland requiring adrenaline as treatment. It is therefore recommended never to inject adrenaline in such cases.

6.2 Fluid therapy

Dehydration

Approach to an animal which is not drinking or urinating

Dehydration is a serious welfare concern in working equids and is known to be a contributing factor to exhaustion, heat stroke, reduced work capacity and work-related skin injuries.

Recognising dehydration

- The volume of water consumed and the number/duration of drinking bouts have been shown to be the most reliable guide to the hydration status in mature working horses (Pritchard et al. 2008).
  - In the first instance give water. Never assume a working equid is not dehydrated. Many owners say their animal is not drinking – but this is often because of stress or lack of time taken, an unsuitable or new environment, unfamiliar water container/trough, dirty water or bullying from other animals. All of these can be factors that prevent an animal from drinking.

    Offering water is a recognised diagnostic test.

  - Whether or not an animal drinks when offered water is a reliable test of dehydration in the majority of cases, provided that there are no internal factors compromising their ability to drink, or external factors preventing them from drinking (e.g. fear of the environment, owner behaviour or water availability/quality).

Clinical signs of dehydration can be difficult to interpret as they can be affected by many other factors and do not become apparent in horses until they are at least 3–5% dehydrated.

Signs to look out for include:

- reduced or absent urination
- cool extremities – cool nose, ears (may not be see in heat stress)
- increased capillary refill time: CRT > 2 seconds
- heart rate increases as dehydration becomes more severe.

Caution

- Historically, skin tent time and mucous membrane dryness have been used as indicators of dehydration. However, these have been shown to be unreliable in working equids and therefore should not be used.
- Similarly, because of the confounding effects of sub-clinical disease, excessive sweat losses and poor nutrition on standard laboratory variables, the packed cell volume (PCV) and total protein (TP) are also unreliable measures of dehydration in working equids. (Pritchard et al. 2008).

'Offering palatable water to drink ad libitum (freely) provides both a simple diagnosis and a remedy for dehydration that can be implemented by any person in the field.' (Pritchard et al. 2008).

Refer to the full article by Pritchard et al. (2008) and ensure that daily clinical practices and future training reflect the conclusions of this work.

Treating dehydration

Offer fresh clean water and give the animal time and space to drink in a quiet environment, as stress can deter from drinking.

Figure 6.2.1 Offer fresh clean drinking water at each interaction with a working equid.

- As part of a clinical examination, offer a bucket of clean water to drink (Figure 6.2.1). Allow the animal to drink in a quiet area if possible and leave water with the animal for 10 minutes to allow sufficient time for adequate water intake.
- Once the animal has drunk, monitor for urination. The best indication of adequate fluid therapy is an improved clinical status and, most notably, urine output. This is particularly important if the owner is concerned about anuria. It provides a good example to demonstrate to paraprofessionals/owners that an injection is not required to get the animal to urinate.

- Clinical examination after urination has occurred As previously stated, the evidence of urination has not necessarily solved the underlying cause of dehydration so it is important to ensure that the animal is showing no other signs of disease. However, if the anuria was caused by dehydration, the animal will be much improved following hydration and no further treatment is required. Then advise the owner about management to correct and maintain fluid input to prevent fluid deficits and dehydration in the future.

If the animal is unable or unwilling to drink, e.g. stressed by environment, very busy area, or recumbent, think about the following:

- Ensure there is no physical reason why the animal will not drink (e.g. choke, oral foreign body).
- If it is a behavioural response, and the animal has been left quietly and is still not drinking, then consider fluid therapy.

Fluid therapy

Estimate the volume of fluid that the animal requires to treat the fluid deficit.

Table 6.2.1 shows an estimation of the percentage dehydration of an equid related to clinical signs; these can be used to assess fluid balance.

(CRT = capillary refill time, PCV = packed cell volume)

Clinical signs	Percentage dehydration
▪ Strong desire to drink	0–4% – Subclinical
▪ Strong desire to drink ▪ Cool nose, ears and extremities (useful to feel around fetlock regions) ▪ Poor distensibility of the jugular vein ▪ CRT 1–2 seconds	4–6% – Mild
▪ Strong desire to drink (may be subdued if very weak) ▪ Thready, weak pulse ▪ CRT 3–4 seconds	7–9% – Moderate
▪ Strong desire to drink (may be subdued if very weak) ▪ Weak or no detectable pulse ▪ CRT > 4 seconds ▪ PCV may be increased (but if anaemic this will not be evident)	9–12% – Severe (over 15%; animal dies)

Table 6.2.1 Clinical signs related to percentage dehydration in equids.

The following calculation can be used to give the volume in litres of fluid needed to correct the hydration status of equids.

> Fluid deficit (litres) = % dehydration x bodyweight (kg)

Therefore, if a 300 kg horse is 8% dehydrated it will require 24 litres (L) of fluid to correct, i.e.
300 kg x 0.08 (8%) dehydration (Collatos 1999).

There is no point in giving a moderately dehydrated horse, donkey or mule 1–2 L of fluid. This is inadequate for rehydration and the animal will remain dehydrated after such treatment.

> Giving inadequate small volumes to dehydrated equids will not only compromise their welfare, by leaving them in a state of dehydration, but it is a waste of resources.

Route of administration

Enteral fluid therapy

> Oral fluid therapy is the most physiological and least invasive way to restore hydration.

The gastrointestinal mucosa acts as a natural selective barrier for absorption.

- Plain water for drinking should always be offered first. If this fails, fluids can be administered via a nasogastric tube. (Forced oral administration of large volumes is not recommended due to the risk of aspiration.)
- The stomach capacity of a 500-kg horse is approximately 18 L – remember working equids may be significantly lighter/smaller than this.
- Horses can tolerate oral fluids at a rate of 40 ml/kg bwt/hour. Caution: This is fine for continuous delivery, but take extreme care with bolus delivery of such an amount.
  - e.g. a 300-kg horse can receive a maximum of 12 L (40 ml x 300 kg) of fluids via nasogastric tube per hour if given continuously or in small boluses. Do not give such a large volume in one go. It can be split up into smaller doses at set intervals, e.g. 4 L every 20 minutes.

> Always ensure that there is no gastric reflux before enteral therapy is given.

- If gastric reflux is not checked for, the stomach can become distended and may rupture. Do not perform nasogastric intubation if in lateral recumbency as there is a risk of inhalation. If an animal can support itself in sternal recumbency then it is acceptable for fluid administration by stomach tube.

Fluid composition

- Equids with normal kidney function and adequate diet can tolerate even large volumes of oral fluids that are not of ideal composition. The diet provides a source of electrolytes and the kidney prevents severe imbalances developing.
  - Water is hypotonic. However, there is a risk of hyponatraemia (low sodium) and possible hypokalaemia (low potassium) if large volumes are given enterally.

- It is safe to use as a one-off in the dehydrated animal. However, it is better to make up isotonic fluid.

- ISOTONIC FLUID

> An isotonic solution is a better alternative to water and can be easily made in the field situation.

- Make up an isotonic solution by adding 4.5 g NaCl (table salt) and 4.5 g KCl (lite salt) per litre of water. This provides sodium, which is important for water absorption in the gut, and potassium which can be low if a horse is anorexic or has an inadequate diet.
- Pre-weighed packs of salt can be prepared in advance (e.g. enough for 6 L of water) so that in a field situation these can be added directly to water without the need for weighing, etc.
- If repeated doses of enteral fluids are needed to restore hydration, the fluid should be as close to isotonic as possible.

Intravenous fluid therapy

- This should always be the last resort for fluid therapy – and only used if the other methods described above have failed or are not appropriate (e.g. very severe dehydration, hypovolaemia). See Figure 6.2.2.
- A jugular catheter and giving set should be placed aseptically (see Section 4.6).
- The volume of fluid required to correct the dehydration should be calculated – see above.

> It is important to estimate the volume required, and to monitor the animal's response carefully, whilst delivering the first 75% of the total amount.

- Once the volume has been calculated – start by giving 75% of this total volume, e.g. if 12 L is calculated as the volume needed to restore hydration, administer 8–9 L initially.
- Sterile isotonic fluid should be administered, e.g. lactated ringers solution, 0.9% NaCl.
- Monitor carefully the clinical effect this has on the animal and check for urination.
- Once hydration has been restored (e.g. animal urinates) stop the fluids.
- If after this initial therapy, the animal has improved but is still showing signs of dehydration, then deliver the last 25% slowly, monitoring carefully.

Glucose saline is not the most effective method of providing for an animal's energy requirements.

Figure 6.2.2 Intravenous fluids being administered to a working equid. Ensure the calculated volume required is given.

Historically, glucose saline has been administered in small volumes to heat-stressed or dehydrated animals in the belief that it provides energy. However, it should be remembered that giving 500 ml of 5% dextrose solution only contains 25 g (1 tablespoon) of dextrose which is not sufficient to replenish an animal's energy requirements.

> It is far more effective to supply energy by offering molasses/jaggery/green fodder or other energy sources after or while the animal is offered water. This will provide more energy for a more sustained period of time.

Monitoring fluid therapy

- Monitor for urination Many animals will pass dilute urine within 2 hours of fluids, although some may be slower. If an animal urinates this is a good indication that hydration has been restored and fluids should be stopped.
  - If an owner or paraprofessional is concerned about anuria it can be very useful to show them that an animal will urinate after just giving it water alone to drink and that it does not require aggressive veterinary intervention or drug therapy to resolve this problem. This is crucial to the education about this subject and will hopefully avoid incorrect diagnosis and unnecessary treatment in the future.
- Monitor the animal's attitude and clinical parameters
  - The animal should become brighter, more alert and responsive.
  - The extremities will feel warmer, and pulse quality will improve.
- Monitor for signs of over-hydration
  - Increased respiratory rate and effort. (Note: In adult horses this will only occur with very aggressive over-hydration.)
  - Abnormal, increased lung sounds on auscultation are suggestive of pulmonary oedema.
  - Provided an animal has normal kidney function, frequent and large volumes of dilute urine will accompany over-hydration.

Donkeys

Physiological differences exist between donkeys and horses. Donkeys are able to maintain their plasma volume even when 20% of their normal body water is lost compared with horses that are much less resistant to dehydration (Mathews et al. 1994).

6.3 References

Collatos, C (1999) Fluid therapy: when and where? Proceedings of the annual convention of the AAEP (45) 271–2.

Pritchard, J.C., Barr, A.R.S., Whay, H.R. (2006) Validity of a behavioural measure of heat stress and a skin tent test for dehydration in working horses and donkeys. Equine Vet. J. 38 (5), 433–438.

Pritchard, J.C., Burn, C.C., Barr, A.R.S., Whay, H.R. (2008) Validity of indicators of dehydration in working horses: A longitudinal study of changes in skin tent duration, mucous membrane dryness and drinking behaviour. Equine Vet. J. 40 (6), 558–564.

Mathews, N.S., Taylor, T.S., Hartsfield, S.M., Hayton, W.L., Jones, D.H. (1994) Pharmacokinetics of ketamine in mules and mammouth asses premedicated with xylazine. Equine Vet. J. 26 (3), 241–243.

Further reading

Lopes, M. (2002) Physiological aspects, indications and contraindications of enteral fluid therapy plan. Equine vet. Educ. 14 (5), 257–262.

Lopes, M. (2003) Administration of enteral fluid therapy: methods, composition of fluids and complications. Equine vet. Educ. 15 (2), 107–112.

Seahorn, J., Seahorn, T. (2003) Fluid therapy in horses with gastrointestinal disease. Vet. Clin. N. Am. – Equine. 19, 665–679.

Schott, H. (2006) Fluid therapy: A primer for students, Technicians, and veterinarians in equine practice. Vet. Clin. N. Am. – Equine. 22 (1), 1–14.