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Equine Emergencies Online 'Mini Series'

Session 3: Mare and Foals: Difficult Foaling's, Retained Placentas and Management of Sick Foals

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Dystocia
Dystocias are true equine emergencies, where the life of the mare and/or foal can depend on prompt attention. They are fairly uncommon however (between 1 and 10% of foalings) and veterinary attention is often not required, especially if the client is experienced in foaling mares. In comparison to some other species, fetomaternal disproportion is an uncommon cause of dystocia in mares, with maldisposition (abnormal presentation/position/posture) being far more likely.

On the telephone:

Inexperienced client: Careful questioning is often required in order to determine whether you need to attend (see below). For many, reassurance of what is normal and advice on monitoring parturition is all that is required.

Experienced stud groom: Immediate attendance is normally required with minimal advice.
Advise the client to:

- Check for 'Red bag' (velvety red chorioallantois) delivery indicating premature placental separation - rupture with fingertip or scissors immediately and provide traction to the foal.
- Clear foal's nose/mouth foal of any membranes as it is delivered.
- If you need to attend: ask that the mare is in large stable with clean bedding, 2 buckets of clean warm water, clean towels, tail bandage applied and a clean perineum.
- Ensure transport is available if required.

Normal Parturition

Normal gestation: 320-360 days. Average: 341 days

Stage 1:
- Variable duration (<1-4 hours).
- Cervix relaxes and uterine contractions start.
- Signs similar to colic: Getting up/down, sweating, tail swishing, up and down, pacing and pawing.
- Ends with rupture of chorioallantois and expulsion of several litres of yellow allantoic fluid.

Stage 2:
- Lasts 20-30 minutes. Generally less in multiparous mares.
- Mares usually in lateral recumbency, might stand a few times.
- Appearance of translucent fluid filled amnion at vulva should be within 5 minutes.
- 1 hoof appears first, followed by other a few cms behind. Soles should face ventrally.
- Foal's head should be between carpii.
- Contractions get more forceful as foal's chest exits, amnion should rupture at this point.

- When hips are out foal often stays with hind legs in birth canal for several minutes. Assuming foal's mouth is clear and breathing don't interfere. This allows blood from placenta/umbilicus to transfer to foal. A normal foal will extract its hind limbs as it struggles to get into sternal.

Stage 3:

- Normal: 30 minutes – 3hrs post foaling.
- Expulsion of placenta

When to attend:

Stage 1:

- Very Prolonged
- Uterine contraction stop after having been present

Stage 2:

- Red bag delivery
- Failure of foal or amnion to appear at vulva
- Maldisposition visible (e.g. head without legs, hind limbs, one foot and a head, soles facing dorsally etc)
- Lasts longer than 20-30 mins
- Delivery of foal stops progressing

Stage 3:

- Failure to expel membranes after 4 hrs

Arrival and initial assessment:

Quick history while starting examination:

- Gestational age of foal
- Timing of stages
- Problems in pregnancy
- Any manipulations already

Quick assessment of mare:

- mm colour, CRT, pulse pressure
- Is there a caslicks – open if present.
- Vulval discharge – excessive bleeding / malodourous
- Which parts of foal/membranes are external

- Any other prolapses etc – bladder/rectum/intestines

Restraint of mare:

- If possible use only twitch as sedatives cross placenta.
- Some mares are violent – if sedation required give ACP (2-3mg/100kg bodyweight iv) +/- xylazine +/- butorphanol.
- Easiest to examine standing but many will lie down.

Examination of mare:

- Quick rectal examination (not essential), can be used to rule out uterine torsion if no foetus is visible.
- Vaginal examination: Tail bandage and scrub perineum and hands/arms. Sterile sleeves optional. Copious lube.
- Feel vagina for any tears etc., cervix for dilation, pelvic abnormalities, uterine torsion.
- Is foal alive? Feel for spontaneous movement, response to coronary band pinch / gentle pressure on eye /pulling tongue. Presence/absence of heart beat definitive test if thorax can be palpated. If posterior presentation anal reflexes/hind limb coronary band can be used.
- Assess posture, presentation and position. Any gross deformities/twins?
- If vaginal delivery won't be possible (common with transverse and posterior hip/hock flexion presentations) go straight for caesarean/foetotomy.

Delivering the foal: 4 methods

1st: Assisted vaginal delivery (AVD)

- Check time when starting. If foal is alive and caesarean is an option spend a maximum 15 minutes attempting this before transporting for controlled vaginal delivery/caesarean.

- Correct maldisposition by manipulation, usually into normal anterior longitudinal birthing position with front legs and head fully extended. For caudal presentations try to extend hind limbs. Usually need to repulse foal.

- Use ropes/chains, lots of lube.

- Care feet/joints don't traumatise uterus during manipulation. Don't use calving jacks.

- **Clenbuterol** (0.8 micrograms/kg IV = 13ml of injectable Ventipulmin/500kg BW) reduces uterine tone/contractions, giving you more room for manipulation, however delivery of foal when in correct position more difficult.

- **Epidural** can be given to reduce straining (0.5ml of 100mg/ml xylazine and 2-3ml of 2% lignocaine/mepivicaine made up to 10ml with sterile saline for 500kg horse), However if CVD/caesarean is an option this uses up valuable time.

2nd: Controlled vaginal delivery (CVD)

- Only perform at yard if referral for caesarean definitely isn't an option.

- Facilities to lift mare's hindquarters (e.g. front loader/forklift) for all but miniatures will help considerably.

- Give mare a short general anaesthetic, and if available elevate hindlimbs until pelvis is 2-3 feet off the ground (for Thoroughbred) using hobbles.

- This stops mare straining and moves foetus cranially to allow more space for manipulation.

- If available, intubate mare and provide supplementary oxygen. Elevate hindlimbs for max. 20 mins due to respiratory and cardiovascular compromise and potential neuropathy.

3rd/4th: Live Foal: Caesarean section
Dead Foal: Caesarean or Foetotomy

Caesarean section has to be performed under GA at a referral centre. Frequently best course of action even if foal is dead as foetotomy is commonly associated with damage to mare's reproductive tract. Foetotomy should involve a maximum of 3 cuts to minimise damage.

Terminal caesarean section can be considered if the foal is valuable, or mare has sustained catastrophic medical condition (e.g. fracture/prepubic tendon rupture). Mare is given a GA, foetus is removed quickly via midline incision and mare is euthanized under GA. Discuss commitment of rearing of orphan foal with owner first.

Euthanasia of mare and foal by injection can be considered in unresolvable dystocia cases where caesarean section/foetotomy is not possible.

How to place obstetrical rope/chain on a foal's distal limb using a double loop around teh fetlock/pastern. From Blanchard et. al. *Manual of Equine reproduction*. 2nd Ed. 2003

Retained Foetal Membranes (RFM)

On the telephone:

- Normally expelled within 3 hours post parturition.
- Veterinary attention required if retained >3-4hrs.
- If membranes not hanging from vulva advise owner to carefully check stable/field where foaling occurred.
- In a field the placenta is often not found/scavenged by wild animal.
- Advise owner to tie membranes up from ground to stop mare treading on them.
- If membranes expelled ask owner to keep in bag/bucket for checking, or if experienced check it themselves.

At the yard:

History:

- Time since parturition
- Dystocia or placentitis? RFM is more likely to occur after either of these
- Tetanus status

Examination:

- General physical examination of mare: TPR, any signs of endotoxaemia.
- Diagnosis: Easy to determine if membranes hanging from vulva or if mare foaled in stable and membranes are not in bedding.
- If membranes all in uterus (unusual) diagnosis requires palpation

Examine any membranes expelled

- Wet concrete surface and hosepipe are useful. Maintain good hygiene and disinfect area afterwards.
- When expelled, the placenta is 'inside out' - white shiny allantoic surface is outermost with white amnion at the end of the umbilical cord .
- Rinse off with water, and spread out (can help to fill with water). Forms an F shape. 2 large arms are gravid horn and body of uterus, narrow arm is non gravid horn.
- There should be one torn hole, at or near the cervical star within the body of the uterus.
- Check for any missing parts (tip of non gravid horn most common).
- Turn the placenta the other way out, so the red velvety chorionic surface is outmost. Again, filling with water can help.
- Check the colour and thickness of membrane at and around the cervical star (whiter area without red velvet on), and elsewhere for any indication of placentitis.

- Check again that the membrane is complete, especially at the tips of the uterine horns.

Treatment for RFM

If membranes are hanging from vulva:

- Tie hanging placenta up above level of hocks.
- Give 10-20IU oxytocin im. Warn can cause mild colic.
- Repeat every 2 hours for 3 injections.
- Tetanus antitoxin if unvaccinated.
- Can use very gentle traction and twisting of vaginal portion of RFMs:
- After cleaning of perineum very gently slide hand in sterile sleeve between chorion and endometirum.
- Additionally, assuming the chorioallantois is intact, infuse 10L of warm sterile solution or dilute betadine via a giving set/sterile stomach tube into the chorioallantoic cavity, and then tie closed the external opening of the foetal membranes for 30 minutes. This helps stimulate myometrium to expel membranes.

If a small part is retained (e.g. tip of non gravid horn):

- After cleaning perineum use rectal sleeve to examine the uterus.
- If retained portion is completely separate then can be removed.
- If still attached you risk causing involution of tip of uterine horn by pulling. In this case use oxytocin and lavage uterus with sterile saline/dilute betadine in 3L boluses until fluid is clear.
- Repeat q 2hrs until retained portion is expelled/easily removed.

If any part of foetal membranes retained > 6 hours:

- Administer systemic NSAID (e.g. flunixin) and broad spectrum antimicrobials.
- Monitor for secondary toxaemia/laminitis. Consider foot supports etc.

If membranes are retained for >12 hrs:

- Lavage uterus with sterile saline solution/betadine in 2-3 L boluses.
- Use sterile stomach tube inserted with end in cupped hand
- Repeat boluses until fluid clear

Approach to the Sick Foal
Sick foals can be a significant challenge to the attending vet. When compared to adult horses they tend to deteriorate more rapidly and are at much higher risk of developing secondary complications such as sepsis. However, when the first signs of ill health are detected in good time by the owner, many foals can be successfully treated at the yard rather than referred.

<u>On the telephone:</u>

Often owners are asking for advice or reassurance, and so knowing what is normal is essential (see below). Going off the suck or being dull and unaware of their surroundings is often the earliest sign of ill health.

Before you arrive the owner should try and get the mare and foal to a warm dry place with a clean bed laid down. Ideally they have information such as gestational age etc to hand. Some extra help to hold mare/foal is also useful.

Normal values for foals

- Full term gestation: 320 – 360 days (TB av. 341 , ponies av. 333 days)
- Aware and responsive: 1-5 minutes after birth
- Suck reflex: 1-15 minutes
- Time to stand: Within 1 hour
- Time to nurse: Within 2-3 hours
- Frequency of nursing: 4-7 times per hour
- Voluntary intake of milk: 20-25 % body weight/day
- Meconium passed: Within 24 hours
- Mean time to first urination: Colts: 6 hrs
  Fillies: 10.7 hrs
- Weight of neonatal foal: 10% of Dam's weight (TB ~ 50Kg)
- Weight gain: 50 kg TB foal ~ 1.5 Kg/day
- Weight of placenta: 11% foal's weight
- Time to pass placenta: ~ 3 hrs

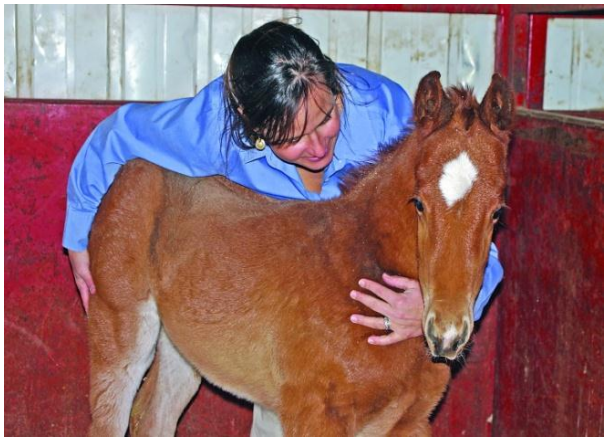
<u>At the Yard:</u>

History – depends on age of foal but useful questions include:

- Gestational age of foal at birth?
- Were the pregnancy and birth normal?
- Mare healthy – udder normal?
- Time to stand/suck etc?
- Colostrum / Foal's IgG measured?
- Has meconium passed?

Examination

- Heart Rate: 70-100 bpm (60-80 @ birth, 120-150 0-2hrs old). commonly a gr. I-IV, L-sided systolic murmur for first 4 days
- Temperature: 37.2 – 39 °C
- Respiration: 20-40 brpm (75brpm at birth, 50brpm at 1 hr old)
- Menace reflex absent until 2 weeks old
- Normal urine specific gravity: 1.001 – 1.027



How to restrain a foal standing and recumbent

Assessment of foals immediately *post partum*

Modified APGAR scoring system, 2-5 minutes post foaling

This is a simple test that clients can perform on new born foals to evaluate the degree of neonatal stress and birth asphyxia. It has been adapted from human neonatology.

	Score		
Parameter	**0**	**1**	**2**
Attitude / Muscle tone	Lateral recumbent, limp	Flexed extremities	Able to maintain sternal position
Pulse Rate	Undetectable	<60	>60
Grimace response to nasal mucosal stimulation	No response	Grimace/movement	Cough/sneeze
Appearence of mucous membranes	Grey/Blue	Pale Pink	Pink
Respiratory Rate	Undetectable	Slow, irregular	Regular, 40-60

Interpretation of the APGAR score

Score	Interpretation	Action required
9-10	Normal foal	Avoid interference
6-8	Mild – moderate asphyxia	Rubbing and stimulate limbs
3-5	Moderate – severe asphyxia	Intranasal oxygen/Ambu Bag, keep in sternal, conservative fluid therapy, clear airway (suction/gravity)
0-2	Severe Asphyxia – (Nearly dead)	Attempt cardiopulmonary resuscitation, but only for a limited time. Adrenaline, Atropine

Resuscitation of the newborn foal – 'ABCD'

1. Note time

2. Put Foal in lateral recumbency on clean firm surface. If broken ribs put affected side downwards.

3. **AIRWAY** – Intubate if possible via nose or mouth. If no tube use face mask.

4. **BREATHING**: Connect Ambu Bag, ventilate at 10-20 breaths/min.
   If no equipment use mouth to nose resuscitation:
   Use one hand to cup chin and cover opposite nostril.
   Use the other to occlude oesophagus on L jug groove.
   Blow into upper nostril 10-20 breaths/min.

5. **CIRCULATION:** If heart rate <40 bpm give thoracic compressions 100 beats/minute.
   Kneel next to spine of foal, use one hand on top of the other on highest part of chest just behind triceps. Use straight arms and aim to compress the chest ~5cm. Check for spontaneous heart beat every 30-60 seconds. If two people available do compressions and breaths simultaneously. If only 1 person, do 15 compressions then 2 breaths, repeated.

6. **DRUGS**: After 2 minutes if HR <40 bpm administer 0.02mg/kg adrenaline IV (1ml of 1:1000 or 1mg/ml solution for a 50kg foal). If no venous access it can be given intratracheal, (not intracardiac). Can be repeated every 3-5 minutes.

7. Stop resuscitation if heart rate >60 bpm and spontaneous breathing >16 breaths/min. Keep tube in place and offer supplementary oxygen if available.

8. If no response to resuscitation stop after 15 minutes.

Recognition of Prematurity/Dysmaturity

These foals are at particularly high risk and should be monitored and supported carefully.

- Rarely viable: <300 days
- Premature: <320 days (70-75 % survival rate)
- Dysmature: >320 days but with premature features.

Clinical Signs:	Domed head	Silky coat	Tendon laxity
	Floppy ears	Slipper feet	Slow to stand/suck
	Dull	Low body temperature	
	Low birth weight	Poorly ossified cuboidal bones (radiograph)	

Bloods: Leucopenia – Neutrophils < 1.0 X 10^9/L
Neutrophil:lymphocyte ratio narrow or < 1 (normal ratio > 2)
Glucose low (< 2.5 mmol/l), and decreasing

Assessment of foals after immediate *post partum* period

Assessment of Immunoglobulin Status and failure of passive transfer

Colostrum quality:

- Physical appearance: Sticky, thick yellow => Good quality
  Watery, white/translucent => Poor IgG conc.
  Was the mare running milk before foaling?

- Specific gravity: Colostrometer: > 1.065 indicates > 70 g/L of IgG
  Sugar refractometer

- Stable-side commercial kits: Several available

Foal:

- Observe nursing behaviour

- Blood IgG measurement

  Optimum time after birth?:

  - < 12 hours: Allows easy/cheap treatment of FPT by stomach tubing colostrum, unless malabsorption. *But* IgGs usually haven't reached maximum levels.

  - 16 – 24 hours: IgG levels will have reached maximum. Supplementation will require plasma transfusion

  Methods available for measuring IgG

  a. Concentration Immunoassay Technology Test (CITE test) e.g. SNAP test, IDEXX
     8-10 minutes to perform, accurate, stable side
     Serum or whole blood
     Semi quantitative – gives 3 brackets: <4, 4 - 8, and >8 g/L

  b. Glutaraldehyde Coagulation
     Inexpensive and stable side
     Takes 10-60 minutes
     Commercial kits available

  c. Single Radial immunodiffusion test (SRID)
     Test takes 15 – 24 hours
     Very accurate quantitative test but requires lab and expensive

  d. Zinc sulphate turbidity test
     Quick and cheap, stable side. Qualitative.
     Obvious turbidity after 10 minutes means sufficient IgG

Interpretation of results:

When measured	IgG concentration	Action
At <12 hours post birth	<4 g/l	Tube 2l good colostrum, recheck 18–24h
	4 – 8 g/l	Tube colostrum or just recheck at 18-24 hrs
	>8 g/l	Fine
At 18-24 hrs post birth	<4 g/l	Plasma transfusion required
	4 – 8 g/l	Ideally plasma transfusion depending on owner finances /health of foal
	> 8 g/l	Fine

Therapy for Failure of passive Transfer (FPT)

1. Colostrum:
   - Only suitable if < 12 hours old.
   - Give ideally 1-2L, by stomach tube (Max 500ml at a time)
   - Best to worst opinions: Mare's colostrums>frozen colostrums>powdered colostrums replacer>bovine colostrum

2. Plasma:
   - 1 litre of plasma will increase IgG concentration by approximately 2 g/L
   - Administer via giving set with an in-line filter and jugular catheter.
   - Sedate with diazepam if required (5mg iv to 50kg foal)
   - Foals should be monitored for adverse reactions (incr. heart/respiratory rate, coughing, urticarial wheals, muzzle oedema), and the transfusion slowed or stopped if they occur. Adrenaline should be available in case of severe anaphylaxis.
   - If administered as prophylaxis to healthy foals – give 1 litre over 20-30 mins.
   - Ideally reassess IgG status after administration

Commercial hyperimmune plasma:

Available in frozen 1 litre bags.

Easier to use and safer. Expensive.

Thaw in warm water, not the microwave

Plasma from donor:

Dam convenient donor. If unavailable/ill then use a healthy, well vaccinated gelding which has received no previous transfusions. Normally ~50% of blood volume can be harvested as plasma.

1. Ideally check PCV / TP of donor are normal.
2. Aseptically collect 3 or 6 litres of blood into commercially available 4% sodium citrate bag using a catheter and gravity. (Plasma collection sets, Dechra). Mix the blood and anticoagulant frequently.
3. When blood collected place bag with drainage tubes upwards in plasma separator (2 pieces of wood with a hinge or large book) and allow the cells to sediment (2-3hrs).
4. Squeeze the bag to remove the plasma from the top into another bag.
5. Administer to foal as described through filtered giving set.
6. Plasma can be stored for 14 days at 4°C or 12 – 24 months at < -30°C

Sepsis Scoring system

This is another scoring system, which can be useful in a clinical setting to differentiate between mildly ill foals and those with early sepsis which will require aggressive therapy or referral. Traditionally a score of 11 or higher indicates sepsis, however this should only be taken as a guide.

Section	Factor	Score				
		4	3	2	1	0
Historical	High risk foaling*		Yes			No
	Gestational age at birth (days)		<300	301 – 310	311-330	>331
Clinical	Petechiation/scleral injection		+++	++	+	normal
	Pyrexia		>39	<37.5		37.5 - 39
	Hypotonia/coma/depression			Marked	Mild	Nil
	Uveitis/diarrhoea/joint swelling/wounds	Yes				No
Haematology	Neutrophils ($x10^9$/L)	<2	2-4	4-6		Normal
	Band neutrophils ($x10^9$/L)		>2	0.05-0.2		<0.05
	Toxic Neutrophils present	++++	+++	++	+	Nil
Biochemistry	Fibrinogen (g/L)		>6	4-6	3-4	<3
	Glucose (mmol/L)			<3	3–4.5	>4.5
	IgG (g/L)	<2	2-4	4-6	6-8	>8

* Placentitis, vulvar discharge prior to delivery, dystocia, mare sick, foal induced or gest. age > 360 days

Ultrasound examination of the umbilical structures

Simple to perform with a higher frequency linear or curvilinear probe (rectal probe fine)
Perform on any foals with thickened external umbilical remnants, and sick foals, esp. septic ones.

Normal structures:

Caudally:	Paired umbilical arteries:	Normal diameter < 10mm
	Combined urachus and umb. arteries:	Normal diameter < 25mm
Cranially:	Single umbilical vein in midline:	Normal diameter < 8mm

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Therapeutics for sick foals

As a guide

Conditions to generally treat on the yard	Conditions to generally refer
Mild neonatal maladjustment Mild Neonatal isoerythrolysis Meconium impaction Early/mild sepsis Mild prematurity Diarrhoea without secondary complications	Foal which remain recumbent Seizures Moderate-severe Sepsis No improvement seen after resuscitation fluids. Can't tolerate enteral feeding Joint/umbilical infections

Aims of treatment:

1. Maintain perfusion / tissue oxygenation

2. Nutritional support

3. Prevent sepsis

4. Treat primary disease

5. Nursing care

6. Keep bond between mare/foal and keep mare healthy

1. Maintaining perfusion: Resuscitation intravenous fluid therapy for sick foals

Recommended for all but mildly sick foals.

Indications:

- Hypovolaemia: More difficult to recognise in foals compared to adults. A history of poor nursing, poor mentation, increased heart rate, weak peripheral pulses, pale mm, increased CRT, cold extremities and anuria/oliguria .

- Dehydration: Increased CRT, skin tent and dry mucous membranes. Sunken eye. An/oliguria. PCV/Total protein is useful but shouldn't be used alone.

What to give:

- Hartmann's (Lactated ringer's) Solution (LRS): Good replacement fluid. If in doubt use this for replacement treatment.

- 0.9% Sodium chloride: Only in cases of hypochloraemia +/- hyponatraemia, or hyperkalaemia (e.g ruptured bladder).

- Glucose: Sick foals often hypoglycaemic. If not possible to measure glucose, supplement fluids by adding 20ml of 40 or 50% i/v glucose solution to each 1 litre bag of fluids. If milk intake improves halve or stop glucose concentration. If possible monitor with blood glucometer (or urine glucose with dipstick).

- Plasma: Most commonly used in FPT, clotting disorders and hypoalbuminaemia e.g. after diarrhoea. Can be commercial or donor (e.g. from Dam)

- Bicarbonate therapy is very rarely indicated, and should never be used unless there is definite indication of good respiratory function using blood gas analysis.

How much to give:

1st Objective: Correct Hypovolaemia:

1. Give 20ml/kg (1 litre to 50kg foal) as a bolus (full flow over 20 minutes – use pressure bag if available).

2. Assess clinical response: Improved mentation, urine production, decrease in heart rate, improved mucous membrane colour/CRT, warming of distal extremities all indicators no further boluses required. Repeat 1 litre bolus if no clinical response.

3. Repeat boluses up to 3 times.

4. If referring a collapsed foal in to a hospital squeeze 1 litre of LRS in and then send.

2nd Objective: Correct dehydration:

Calculate fluid deficit from table below (body water content 60-70% of body weight)
Clinically dehydrated animals are 5-15% dehydrated (<5% you can't tell, >15% - dead)

	Mild (5% dehydration)	Moderate (5-10%)	Severe (10-15%)
Capillary Refill	< 2 secs	2-3 secs	>4 secs
Mucous Membrane	Slightly Tacky	Tacky	Dry
Skin Tent	1-3 secs	3-5 secs	>5 secs

Aim to replace fluid deficit over 12 hours and provide maintenance (4-6ml/kg/hr)

e.g. 50kg foal (Body water content ~30 litres), with moderate (10%) dehydration requires: 3 litres of electrolyte solution replacement for dehydration.

Fluids required in first 12 hours: 3 litres (replacement)+ 12hrs x 4ml x 50kg (maintenance)
= 5400ml in 12 hours
= 450ml/hour

3rd Objective: Provide maintenance and replace ongoing losses (e.g. diarrhoea)

Maintenance rate = 4-6ml/kg/hr (plus ongoing losses).

Maintenance fluid type: Care must be taken not to overload foals with sodium. Vetivex 18 (0.18%NaCl + 4% glucose) (Dechra), 0.45%NaCl and 2.5% glucose, Normosol M or plasmalyte M are good maintenance fluids. If ongoing losses such as diarrhoea ideally monitor electrolyte levels and use appropriate fluid accordingly. LRS is often better if ongoing losses, and potassium levels need monitoring with supplementation if required.

How to give fluids to foals

- For intravenous fluids a catheter is required.
- Strict asepsis is required for i/v catheters in foals.
- For indwelling >24hrs polyurethane ('Milacath') is better and less thrombogenic than Teflon ('Angiocath').
- Sterile heparin/saline should flushed through the catheter a minimum of 4 times daily and after every medication.
- A wrap ('vetwrap'/elastoplast) around the catheter helps maintain sterility and stop the foal kicking the catheter out.

- Fluids should ideally be warmed to body temperature (1L 1 minute in the microwave), esp. if hypothermic. But don't delay administering to hypovolaemic foal.

- Often it isn't practical to give continuous fluids – so the fluid therapy regimen can be divided into 1-2 hourly boluses – e.g. 1L every 2 hours. Do not bolus fluids with supplementary electrolytes (e.g. KCl / Ca).

If available intranasal oxygen supplementation should be given to sick recumbent foals. 5-10L/hr.

2. Provide nutritional support

Indications:

- Inability of a foal to consume adequate fluid/nutrients, e.g. Recumbent foal.

- Insufficient colostrum/milk from mare

Contraindications for enteral feeding:

- Reflux / Intestinal obstruction / ileus / lactose intolerance

- Enteral fluids often need to be given in combination with i/v fluids, esp. in cases when malabsorption is present (e.g. diarrhoea)

Milk (mare or replacer) feeding:

- The dam's milk is ideal. Replacer can be used.

- Healthy foals: Give ~250 – 500ml every hour for 50 Kg foal. Increase to 500ml/hr when > 2 days old.

- Sick foals: Aim for 10% body weight/day.

- Very sick foals often have reduced gut function and should receive less (e.g. 100ml/hr).

- Enteral feeding is important for enterocyte function, so whenever tolerated some should be given.

Administering enteral fluids/milk

- Always in sternal recumbency or standing.

- Bottle feeding should be avoided in very sick foals as aspiration is common.

- Stomach tubing is the ideal way to administer fluids.

- For regular feeding small gauge (e.g. 12 Fr, 108cm long MILA int.) indwelling tubes can be sutured using butterfly tape to the nostril. A sterile adult urinary catheter also works well.

- Confirm the tube in the oesophagus by:
    - Visualisation/palpation in the oesophagus in the left jugular groove
    - Blow down the tube and see the oesophagus inflate
    - Aspiration of milk from the stomach
    - If available by radiography or endoscopy.

- Always draw back on the tube before administering milk to ensure no reflux is present.

- Only use gravity to administer milk.

- Block the end of the tube (e.g. plunger from a 2ml syringe) when not in use.

- If the foal will tolerate it, bucket feeding is the easiest way to give longer term milk or without stomach tube.

Indications to reduce/stop feeding:

- no appetite/suck reflex
- colic
- abdominal distension
- absent gut sounds
- no faeces passed.

Keep milking the mare as frequently as possible, and preferentially use the mare's milk instead of replacer. Domperidone (1.1mg/kg PO SID) can be used to maintain lactation in the mare.

3. Prevent Sepsis

Check for failure of passive transfer (IgG concentration) – see above
Maintain hygiene – see supportive care below

Commonly used antimicrobials for sepsis treatment/prevention:

1. Ceftiofur (5-10mg/kg i/v,i/m BID)

2. Penicillin (22,000IU/kg i/v QID) with either gentamicin (8-15mg/kg IV SID) or amikacin (25mg/kg i/v SID)

3. Cefquinome (2-4 mg/kg i/v or i/m BID)

If PO administration is required in milder cases:

4. Trimethoprim Sulphur 30mg/kg combined po/iv/im.

5. Doxycycline (10mg/kg PO BID)

4. Treat primary disease

e.g. seizures / pneumonia / sepsis / diarrhoea / meconium impaction

5. General Supportive care

Recumbent foals require intensive nursing and should ideally be hospitalised.
Important supportive care issues to consider include:

- Position: sternal is ideal but hard to maintain. Straw bales etc can help. Encourage to stand if possible. When in lateral recumbency turn regularly
- Warmth: Frequently hypothermic. Provide insulation above and below – e.g. vet bed, blanket etc. Wrap lower limbs. Provide wrapped hot water bottles but care not to overheat.
- Perineum: Clean off faeces and apply Vaseline/zinc oxide cream.
- Ophthalmic: Apply lubricant every 3-4 hours and check for entropion
- Umbilicus: Topical antiseptic (0.5% chlorhexidine) 4 times in the first 24 hours then twice daily

- Padded bed: Avoid pressure sores – e.g. mattress/blankets rather than just straw.

- Gastric ulceration: Risk in sick foals – prevention with Sucralfate 20mg/kg PO QID and 1-2 mg/kg omeprazole PO sid once >2 days. The use of ulcer prophylaxis in younger foals is controversial.

6. Keep bond between mare and foal

Ideally the mare and foal should be able to see and communicate with each other during treatment. If possible regular suckling helps maintain the foal-mare bond and milk production by the mare.

Colic in Foals

Examination
Foals have a lower pain threshold than adults, and mild abdominal lesions can cause signs such as rolling and kicking. This makes pain behaviour, and response to analgesia less useful surgical indicators. Otherwise the diagnostic approach is very similar, although some ancillary techniques such as ultrasonography and radiology are more useful than in adults. Obviously only digital rectal palpation is possible, and abdominocentesis should only be performed under ultrasound guidance, as the serosa of foal's intestine is very delicate and liable to tear.

Diagnosis
Similar diagnoses should be considered as in adults. Often a specific diagnosis remains elusive.
Some more foal specific causes of colic include:

- Meconium impaction
- Enteritis due to septicaemia/E. coli/rotavirus
- Ascarid impaction
- Gastro-oesophageal reflux/ulceration
- Pyloric stenosis
- Ruptured bladder
- Atresia coli/recti/ani
- Umbilical/inguinal hernias

Treatment for meconium impaction:

- If dehydrated consider fluid therapy
- Monitor nutrition
- Analgesics: butorphanol 0.01mg/kg and/or NSAID – care if dehydration.
- Can give hyoscine butylbromide (Buscopan) (0.2mg/kg iv)
- Administer laxative: liquid paraffin (100ml) by stomach tube with fluids.
- Care of rectal trauma
- Use well lubricated finger to palpate and remove any distal meconium

- Enema: ~150ml of warm soapy water with some lube via a soft thin tube using gravity only. Or ~150ml of 4% acetylcysteine. If possible use Foley catheter to retain in rectum for 20-30mins.

- Can use a loop of plastic wire inserted into the rectum (such as used on a strimmer).

Diarrhoea in foals

Common, often self limiting but can lead to dehydration and secondary sepsis.
Perform full clinical exam, and assess hydration status, joints, umbilicus any signs of sepsis.
Diarrhoea can occur as part of neonatal maladjustment syndrome.

Common causes of diarrhoea in different ages of foal.

< 2 weeks	2-8 weeks	>8 weeks	Any age
• Foal heat diarrhoea • Necrotising enterocolitis • Neonatal maladjustment • Rotavirus • Cl. difficile • Cl perfringens • Cl. parvum	• Rotavirus • Cryptosporidium • Strongyloides Westeri	• Strongyloides westeri • Cyathostomes • Lawsonia	• Salmonella • Nutritional (e.g. lactose / indiscretion) • Luminal irritants

Adapted from Hepburn (2007) Management of diarrhoea in foals up to weanling. *In Practice* 29, 334-341

Further tests:

- Blood sample

- Faecal samples: culture, worm egg count, rotavirus, crytosporidium and clostridial toxin assays

- Test IgG status

- Ultrasound

Management:

- Fluid therapy if dull / signs of dehydration.

- Antimicrobials if pyrexic

- NSAIDs – low dose of e.g. ketoprofen

- Bismuth Subsalicylate (Peptobismol) 1ml/kg q 6 hrs

- Gastric protectants:
    - Sucralfate: 20mg/kg q 6 hrs
    - Omerprazole 4mg/kg PO SID

- Live yoghurt/probiotics if >7 days old

- Keep perineal area clean + apply Vaseline

- Biosecurity

Dose rates of some drugs commonly used in foals

Drug	**Route**	**Dose rate** (mg/kg unless stated)	**Notes**
Acetylcysteine	rectal enema	150ml of 4% solution	Administer under gravity only and maintain in rectum for 15-20minutes
Adrenaline	i/v low dose i/v high dose Intratracheal:	0.01 – 0.03 0.1 – 0.2 2.5 times i/v dose	Primary drug for resuscitation
Amikacin Sulphate	iv/im	25 sid	Aminoglycoside. Good Gr -ve activity.
Bismuth Subsalicylate	po	1-2 ml/kg peptobismol q. 4-6 hours	'Peptobismol'
Butorphanol	i/v	0.01 – 0.04	Analgesia/sedation
Cefotaxime sodium	iv	40 qid	3rd gen. cephalosporin
Cefquinome	i/v	2 – 4 mg/kg BID	4th gen cephalosporin
Ceftiofur	iv / im	5 – 10 mg/kg bid	3rd gen. cephalosporin
Clarithromycin	po	7.5 BID	For Rhodococcus with rifampin
Detomidine	iv	0.005 – 0.02 mg	Care in sick foals >4 weeks
Diazepam	iv	0.1 – 0.2 Max 0.4	Anticonvulsant, excellent sedative for neonates. Can repeat after 30 minutes if req.
Doxycycline	po	10 PO BID	
Erythromycin	po	15-25 tid	Care hyperthermia/ respiratory distress and diarrhoea in mare
Flunixin Meglumine	iv	0.5 – 1 sid – bid	Care of nephrotoxicity and gastric ulceration
Gentamicin	iv	8-15 sid	Gram negative activity. Higher doses in younger foals
Ketoprofen	iv	0.5 tid – qid	? less ulcerogenic than other NSAIDs
Metronidazole	po	10 – 25 bid - tid	Anaerobic infections
Omeprazole	po	1-4 mg/kg sid	Anti-ulcer treatment of choice
Oxygen	intranasal	5-10 litres/hr	Warm/Humidified if possible.
Oxytetracycline	slow i/v	antimicrobial: 5-10 bid Contracted tendons: 40 mg/kg sid	
Penicillin, Sodium	i/v	22,000 IU/kg qid	Gr +ves / anaerobes
Procaine penicillin G	im	22 bid	Gr +ve / anaerobes
Pentobarbitone	slow iv	2-10	Long acting anticonvulsant
Phenytoin sodium	po	1-5 bid	Anticonvulsant
Ranitidine	po	6.6 tid	Histamine H_2 antagonist
Rifampin	po	5-10 bid	Rhodococcus infections. Synergistic with erythromycin. Stains urin/faeces/tears etc red
Sucralfate	po	20-40 tid - qid	Binds to ulcers
Trimethoprim/ sulphonamide	po im	30 bid 30bid	Combined product dosage. Broad spectrum
Xylazine	iv/im	0.25	Sedative/analgesic