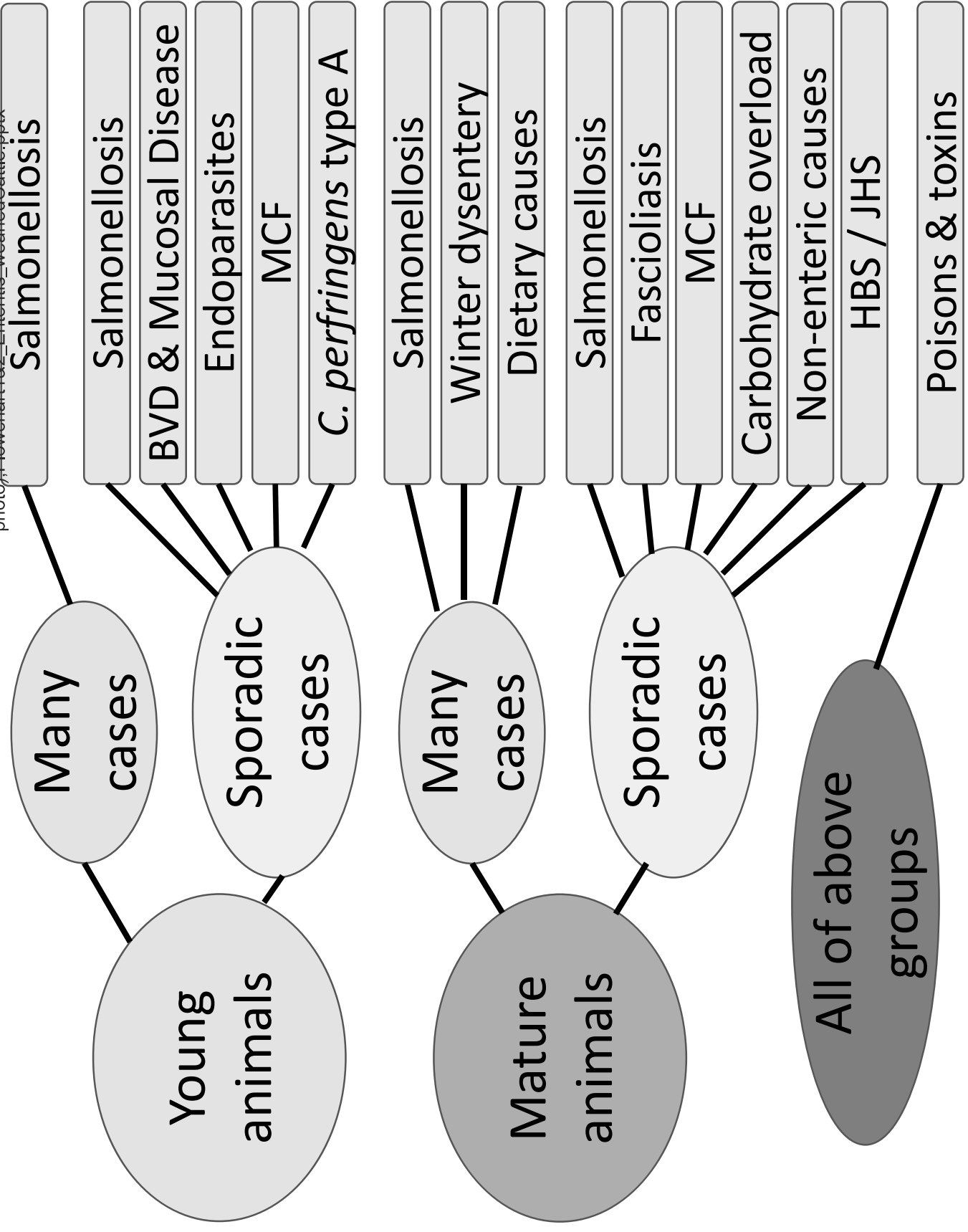


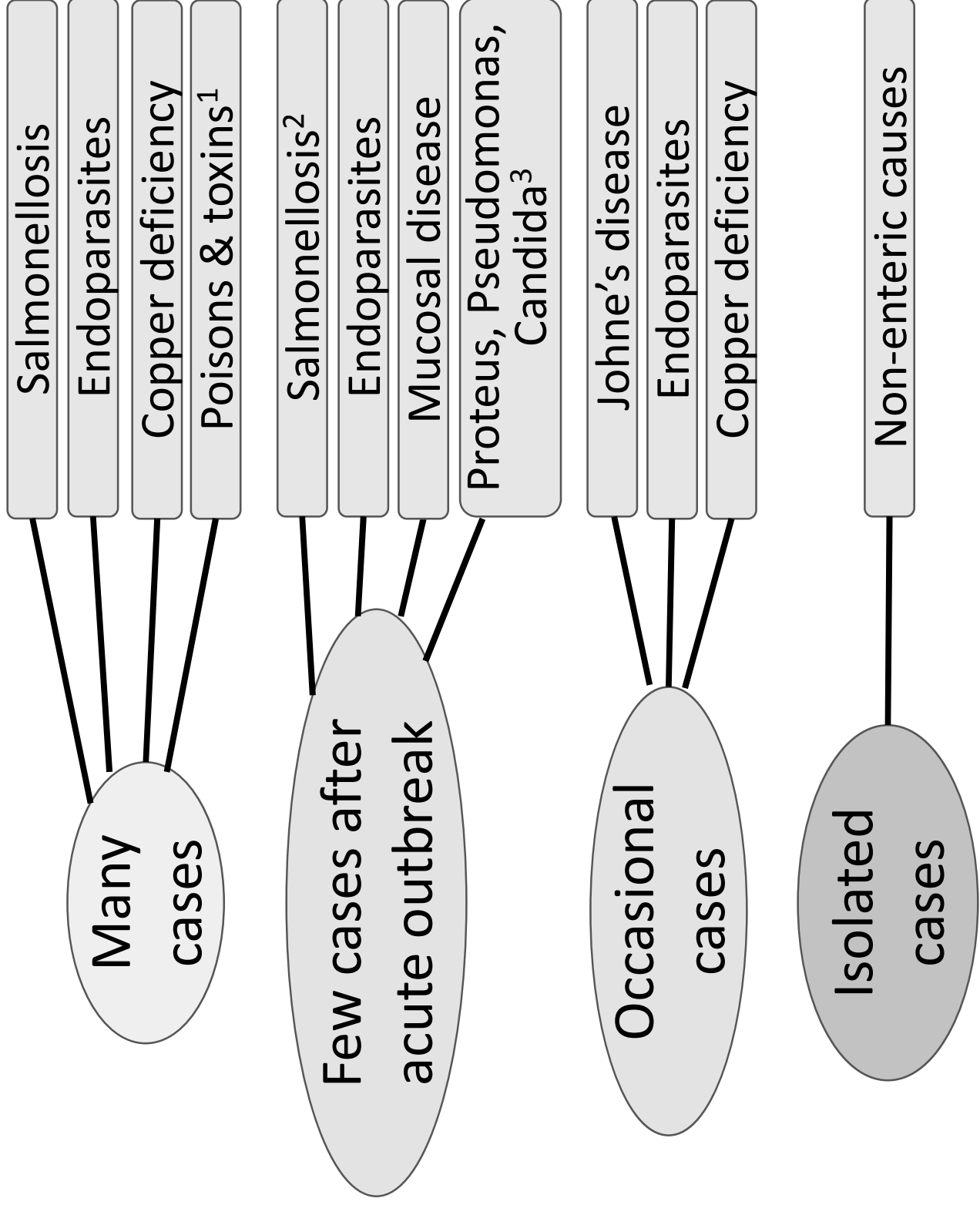
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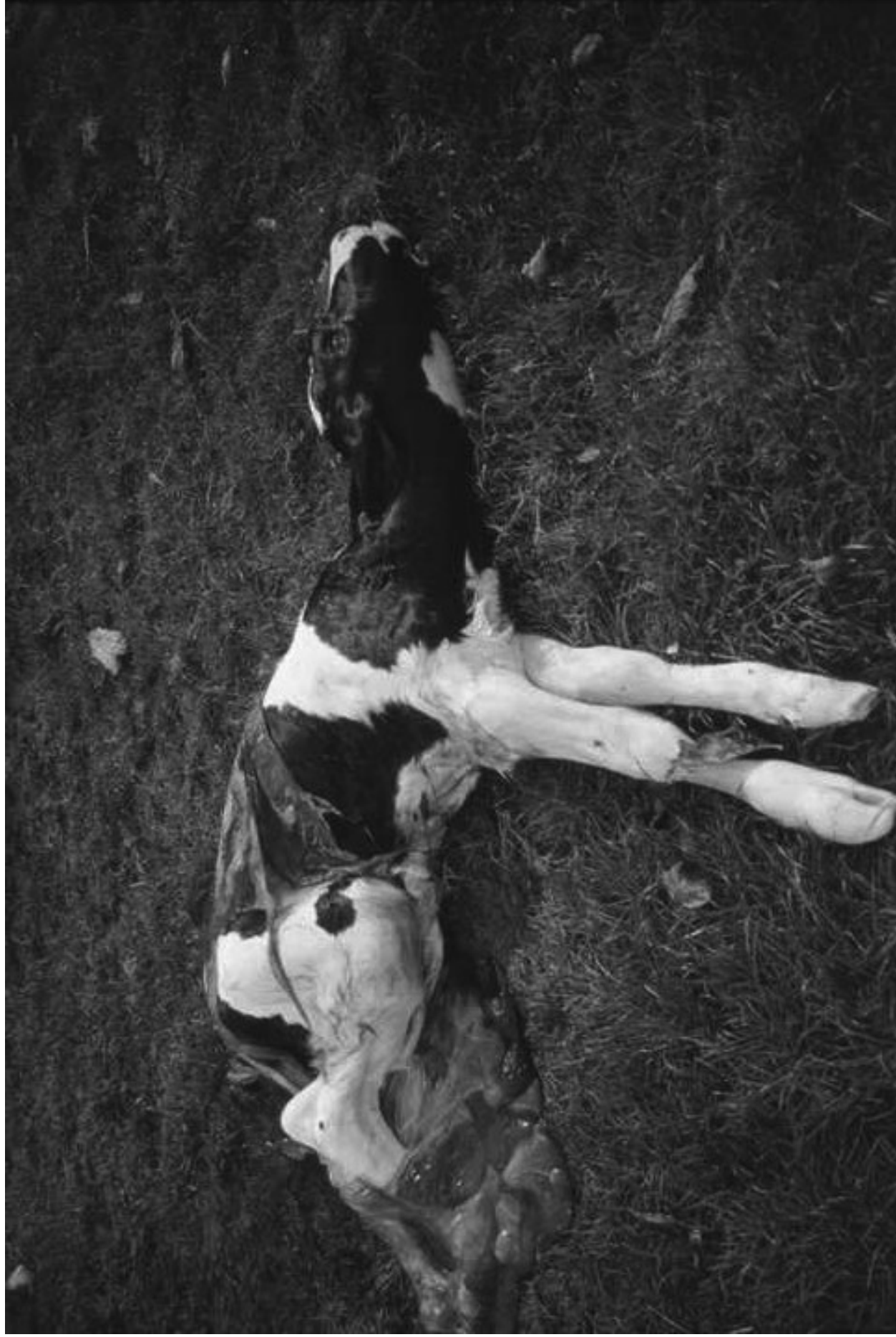
Enteritis in weaned cattle: an overview of causes

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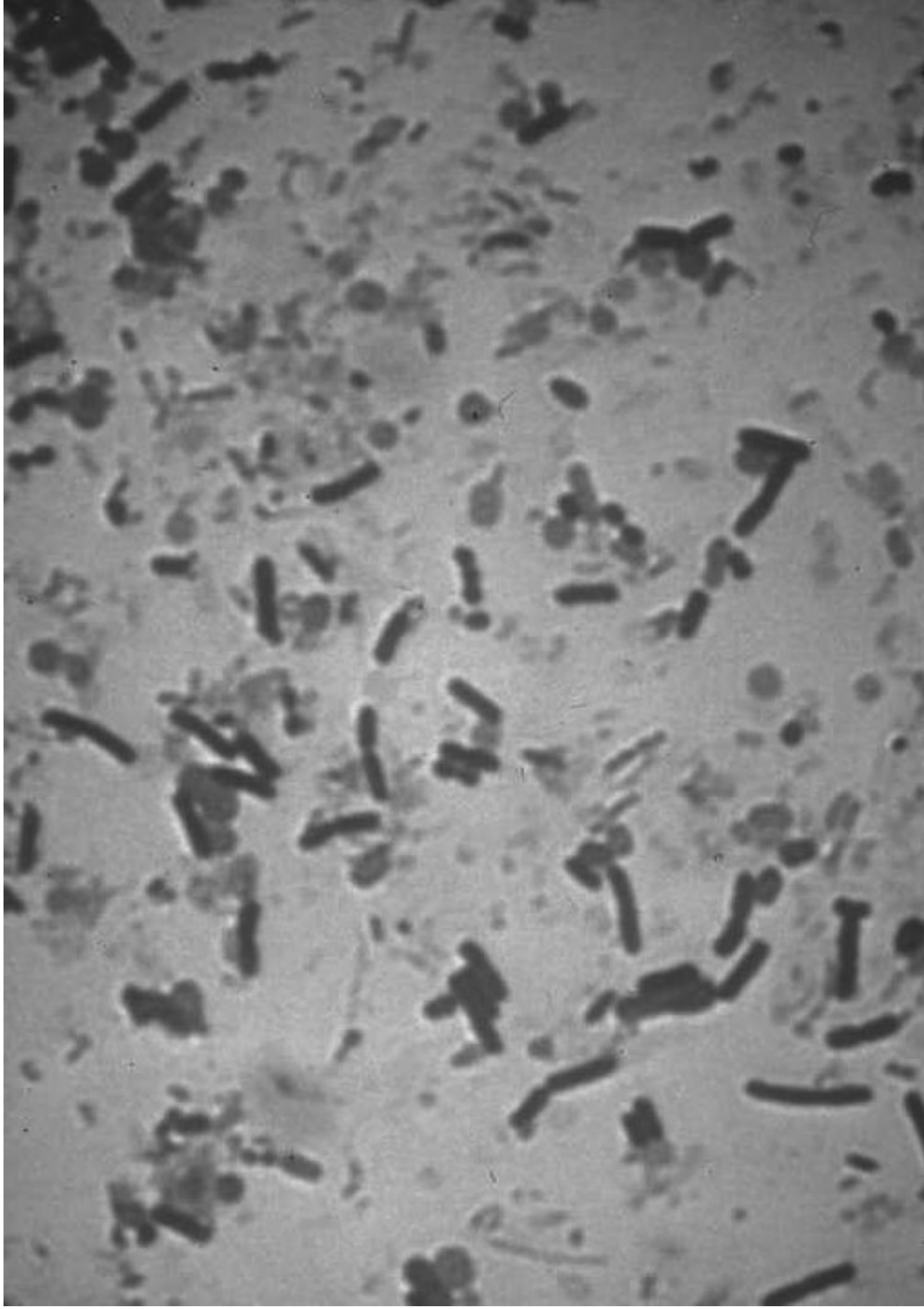
















Enteritis in weaned cattle: an overview of causes

Short title: Enteritis in cattle

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Abstract:

While calf diarrhoea may receive more attention, enteritis in young adult and mature cattle is common and has a variety of causes. This review provides an overview of such causes and an outline how to approach diagnosis in the weaned animal with diarrhoea.

Enteritis is defined as inflammation of the intestinal mucosa, in particular of the small intestine. This paper will focus on primary enteritis in post-weaning cattle, specifically rising-two-year olds and adults. Enteritis and gastro-intestinal tract infection typically (although not always) result in diarrhoea, but in contrast causes of diarrhoea are not restricted to disorders of the intestines. To aid the working up of a diarrhoeic patient, all important causes of diarrhoea (i.e. all enteropathies) are mentioned to provide a comprehensive list of differential diagnoses.

The main purpose of this article is to provide an overview of causes that should be considered in young adult or mature cattle with enteritis, with salient and clinically important points regarding history, presenting signs, and further diagnostics summarised (see Table 1). It is suggested to use flowcharts 1 and 2 in the first instance, as an aid to derive at a more focused differential diagnosis list when working up a diarrhoeic animal by distinguishing:

- Acute (flowchart 1) from chronic (flowchart 2) presentation,
- then youngstock from mature cattle,
- and whether an individual or a number in the group are affected.

Thereafter, the information provided in Table 1 will help in deciding which of the differential diagnoses remain relevant to the case. Extensive details on the various causes of enteritis are beyond the scope of this article, however resources offering further information on aetio-pathogenesis, diagnosis, management and control are provided.

Table 1: Important causes of enteritis and diarrhoea in UK cattle post-weaning, grouped by type of causative agent.

Agent group	Disease [Causative agent]	Suggestive history and / or clinical signs	Occurrence in UK	Diagnosis	Further information
Viral	Bovine viral diarrhoea (BVD) [BVD virus type I & II]	Type I: mild, transient diarrhoea (often unnoticed), possibly with reduced appetite and pyrexia, with animals typically recovering quickly. Possibly abortion (Fig. 1). Across herd, may see weak calves, congenital abnormalities, increased occurrence of respiratory disease. Type II: often severe, with haemorrhagic diarrhoea, pyrexia, respiratory signs, scleral haemorrhage and hyphaema, severe milk drop, pyrexia, dehydration and rumen stasis.	Type I: Large proportion of cattle and herds exposed, but eradication schemes in place. 1-2% of cattle persistently infected. Type II: rare	Individual animal: paired serology with rising antibody titre Herd (to establish exposure, endemic infection, presence of persistently infected animal): bulk milk screen, cohort comparison (e.g. first lactation heifers vs. older cows), 'tag & test' of calves	[1, 2]
	Mucosal disease (MD) [BVD virus type I]	Vaccination & biosecurity history. Acute cases: typically less than 24 months-old. Stomatitis, profuse watery diarrhoea which may contain blood or mucus, tachycardia, pyrexia is often intermittent. Rapid deterioration, high mortality (90%). Chronic cases: usually 2-3 years-old animals. Intermittent diarrhoea, emaciation (Fig. 2), chronic rumen tympany, often non-healing skin lesions on limbs and feet (Fig. 3); other signs of BVDV in herd (abortions etc.)	In affected herds, up to 5% of under 2-year-old animals develop MD	Serology: antibody negative and antigen or PCR positive (repeatedly at 3-4 weeks interval). Virus isolation from nasopharyngeal swabs, viscera, blood.	[3]
	Malignant catarrhal fever (MCF)	'Head & eye form': Stomatitis, ocular lesions with corneal opacity, persistent fever, enlarged	Sporadic, typically	Histopathology, PCR on blood or tissue (ideally lymphnode or spleen)	[4]

	[typically Ovine Herpesvirus 2]	lymphnodes, copious mucopurulent nasal discharge (Fig. 4), dyspnoea. Can be diarrhoeic or constipated. Peracute form: severe gastro-enteritis, dyspnoea, pyrexia. Highly fatal.	individual animals only	Negative serology for BVD virus	
	Winter dysentery [likely Coronavirus]	Explosive outbreak, large proportion of herd affected. Animals remain bright, show good appetite, have profuse watery diarrhoea usually without blood (Fig. 5). Concurrent or preceding respiratory signs may be seen. Recover quickly and entire outbreak rarely lasts longer than 2-3 weeks.	Sporadic in individual herds	Paired serology for coronavirus (with rising titre).	[5]
	Schmallenberg virus	Acute, short-lived (<5 days in individuals, <3 weeks across herd) episode in adult cattle with pyrexia, reduced milk yield, diarrhoea. When early-pregnant females are infected, abortion and stillbirths with fetal deformities of limb and skull.	Disease in adult cattle rare. Foetal abnormalities reported sporadically across UK.	Paired serology (with rising titres) or PCR (also on aborted foetuses).	[6]
	Enzootic bovine leucosis (EBL) [Bovine leukemia virus]	Range of signs and opportunistic infections depending on organs involved, with lymphnode enlargement commonly present. Diarrhoea may result if intestinal lymph tissue is involved.	Currently disease free status	Persistent lymphocytosis is present in 30-50% of cattle. Serology.	[7]
Bacterial	Salmonellosis [Common isolates are: <i>S. dublin</i> , <i>S. mbandaka</i> , <i>S. typhimurium</i> , <i>S. Montevideo</i> , <i>S. agama</i>]	History of stress (eg. transport) or recent parturition. Also flood, or rodent / bird infestation or dead ones found in foodstuffs or water. Severe illness characterised by profuse haemorrhagic diarrhoea (Fig. 6) often containing mucus or	Sporadic outbreaks common	Faecal culture. Shedding may be intermittent, i.e. take several samples over 24-72 hours. To establish source and extent of problem, culture drinking water, building (faeces, bedding, parlour; Fig. 8), feed, milk filter sock.	[8, 9]

		fibrin casts (Fig. 7), pyrexia, depression, dehydration, abdominal pain, tenesmus. Recurrent diarrhoea possible with <i>S. dublin</i> . Occasionally chronic cases with persistent diarrhoea, intermittent fever and body condition loss.			Pooled samples from at least 20% of cattle in each management group are useful to gauge extent of herd infection.	
	Johne's disease [<i>Mycobacterium avium</i> subsp. <i>paratuberculosis</i> (MAP)]	Animal remains bright with good appetite until terminal stage characterised by intermittent or persistent diarrhoea. Often progressive weightloss (Fig. 9) and unsatisfactory milk yield.	Present in high proportion of herds.		Acid-fast bacteria in faecal smear; serology or PCR positive. Only culture or histopathology is fully conclusive. For establishing herd status, please see suggested resources.	[10, 11]
	Campylobacteriosis [<i>Campylobacter fetus</i> subsp. <i>jejuni</i>]	Role as primary cause of enteritis unclear. May be involved in secondary infection in cases with winter dysentery.	unknown		Faecal culture, however can be part of normal gut flora, therefore culture results need to be interpreted with caution.	
	Yersiniosis [<i>Yersinia pseudotuberculosis</i> and <i>enterocolitica</i>]	Most common in rising 1-year old animals. Role as primary cause of enteritis unclear. Diarrhoea may have foam-like appearance.	unknown		Faecal culture, however <i>Y. pseudotuberculosis</i> can be part of normal gut flora, therefore culture results need to be interpreted with caution.	
	Clostridial disease [<i>Clostridium perfringens</i> Type A in calves and adult cattle; rarely Type D in adults]	Vaccination history. Severe haemorrhagic enteritis, colic, sometimes nervous signs, rapid death; no buccal lesions (like in MD or MCF); in youngstock, often best growing animals affected	sporadic		Post-mortem examination – need to confirm presence of toxin	[12]
	Actinomycosis (alimentary form) [<i>Actinomyces bovis</i>]	Lesions in oesophageal groove, lower oesophagus and reticulum causing impaired digestion. Periodic diarrhoea with passage of undigested food, chronic bloat and allotriphagia.	rare		'Sulphur granules' on post-mortem examination, with gram-positive non-acid fast bacteria. Histopathology and culture.	

	<p>Haemorrhagic bowel syndrome (syn. Jejunal haemorrhage syndrome) [cause unestablished]</p>	<p>Predominantly affects high yielding dairy cattle, parity 2 and older, usually in first half of lactation. Often history of ration high in carbohydrates and low in fibre, recent stress. May present as sudden death. Otherwise, signs of intestinal obstruction with or without apparent anaemia. Severe haemorrhagic enteritis, rapid progression and high mortality rate.</p>	<p>Sporadic.</p>	<p>Post-mortem examination.</p>	<p>[13]</p>
<p>Parasitic</p>	<p>Nematodes: Ostertagiosis (type I in youngstock or first grazing season; type II in adults), other Trichostrongyloidea</p>	<p>Grazing and anthelmintic treatment history (Fig. 10). Early summer if not previously grazed, but also other seasons for Ostertagia (type I and II). Often only part of a group affected. Type II ostertagiosis may affect first-calving heifers in particular. If low number of chronic cases after an outbreak, poor anthelmintic protocol (e.g. incorrect timing, weight or route, animals missed, poor efficacy of product used) or immune-suppression in such individuals. Marked weightloss and profuse diarrhoea.</p>	<p>Common, especially in yearlings and young adults (Fig. 11).</p>	<p>Faecal egg count. Beware pre-patent period, and sometimes poor correlation between egg count and actual worm burden or pathology caused. Pepsinogen levels for ostertagiosis.</p>	<p>[14, 15]</p>
	<p>Coccidiosis [Common isolates are: <i>Eimeria zuernii</i>, <i>E. bovis</i> and <i>E. alabamensis</i></p>	<p>Coccidiosis is rare in animals over 12 months old (unless immune-compromised), but consider where tenesmus and blood or mucus in faeces is present. History of recent weaning, mixing of groups and overstocking is common.</p>	<p>Usually sporadic cases, but outbreaks may occur after stress.</p>	<p>Faecal oocyte count, including speciation. Beware pre-patent period.</p>	

	Fascioliasis [<i>Fasciola hepatica</i>]	Grazing and anthelmintic treatment history and herd location (Fig. 12). Persistent diarrhoea, chronic weightloss. Reduced milk yield (in suckler cows reflected in poor growth of nursing calf). Anaemia during migratory phase (with possible dyspnoea).	Widespread, with large proportion of herds showing exposure.	During prepatent period: grazing history and land type, raised liver enzymes. In cull cattle, abattoir report. Antibodies in milk or serum. Faecal egg count, with any eggs found indicating pathogen present on farm (note: min. 40 g of faeces required).	[16]
	Rumen fluke [<i>Calicophoron daubneyi</i>]	Clinical signs of diarrhoea (may be profuse, fetid), weightloss and death associated with immature fluke during pre-patent and migratory phase. Adult fluke in rumen typically asymptomatic.	Becoming common.	Faecal egg count. Beware pre-patent period. Also post-mortem examination and abattoir reports.	[17]
Nutritional	Copper deficiency ('Peat scours') [primary or secondary]	May be seen in particular after flush of grass growth. Youngstock typically more severely affected. Watery diarrhoea, often with small bubbles, and which can continue for weeks. Sometimes anaemia, reduced fertility and body condition loss evident in group. Usually skin depigmentation obvious before onset of diarrhoea.	Regionally common.	Blood and / or liver copper concentrations (from affected individuals and 5 to 7 random animals). Check soil and feed for excess molybdenum or sulphate.	[18]
	Copper toxicity (acute)	History of copper oxide needles or injection. Severe gastro-enteritis, abdominal pain and severe shock, followed by ascites, hydrothorax, hydropericardium and internal haemorrhage.	Sporadic.	History and post-mortem findings. Ingesta may show blue-green discolouration.	[18]
	Cobalt deficiency	Mainly growing youngstock. Loss of appetite and body condition, some diarrhoea and possibly anaemia.	In certain, well-defined areas of country.	Liver concentrations, or cobalamin blood levels. Sampling co-grazing sheep as sentinel cases is useful.	[18]

	Selenium deficiency	Lack of soil supplementation or top dressing. Affects all ages. Progressive loss of condition, profuse diarrhoea especially in autumn and winter. May see increased incidence of retained foetal membranes and low fertility in herd.	Most UK soils are deficient, therefore common where animals not supplemented or pastures not fertilised.	Blood concentrations (affected individuals and 3 to 5 random animals). Note that GPx reflects selenium status of about 6 weeks previously. Pasture / soil samples.	[18]
Toxicosis	Mycotoxins (Fusarium and others), nitrates, salt (sodium chloride), heavy metals (mercury, arsenic etc.), ragwort.	History of access (incl. supplementation or treatment), change of pasture, feed or water source. Most toxins require prolonged access (weeks to months). Aside from diarrhoea, may see colic or nervous signs.	Sporadic.	Rule out other causes. Check feed and water sources, toxic plant burden of pastures, source of conserved forages. Laboratory examination of hair, urine, blood to confirm. For mycotoxicosis, trial administration of binding agents.	[19]
Non-enteric	Toxaemia	History of metritis, mastitis or other severe systemic infection. Clinical signs of toxaemia.	Individual animals.	Usually obvious on clinical examination. Haematology to confirm, if necessary.	[19]
	Peritonitis	History of dystocia, recent surgery, or penetrating abdominal wound. Clinical signs include abdominal discomfort (Fig. 13), changed vital signs including reduced GI-tract activity, and possibly distension, pyrexia, septicaemia or toxæmia.	Individual animals.	Usually obvious on clinical examination. Abdominocentesis, ultrasonography and haematology to confirm, if necessary.	[19]
	Carbohydrate engorgement and SARA (subacute rumen acidosis)	Feeding history: mixing error, sudden introduction of new feed, accidental access to feeds, low forage component of TMR (<40% on DM basis), concentrate feeding in parlour. CH overload: rumen stasis and distension, severe depression, dehydration, dyspnoea. SARA: low faecal score, undigested material present in	Individual animals for CH overload. SARA common in dairy cattle.	Rumen fluid pH < 5.5, and rumen fluid smear shows large numbers of Gram-positive bacteria (including Lactobacilli = gram-positive rods; Fig. 14).	[19]

		faeces, low butterfat and variable milk yields, reduced cudding rates.				
	Excessive acid ingestion [for example: Soured Brewer's grains, silage]	Recent change in ration. Several animals affected. Often reduced milk yield and rumen activity.	Sporadic herds problem.	Examination of feeds and ration. Rumen fluid pH.	[19]	
	Congestive heart failure	Older animals. History of exercise intolerance. Clinical signs of cardio-vascular abnormality or compromise (Fig. 15).	Individual animals.	Clinical examination and imaging.	[19]	
	Caudal vena cava thrombosis	History or suspicion of rumenitis, animals on high cereal diets. Often found dead, or not detected until end stage when haemoptysis is seen.	Individual animals.	Clinical examination, haematology, imaging.	[19]	
	Renal insufficiency (acute stage)	Depression with reduced rumen activity and inappetence, abdominal pain, watery or haemorrhagic diarrhoea. Muscle tremors, may be recumbent (Fig. 16). Polyuria or oliguria.	Individual animals.	Clinical examination, blood and urine analysis, imaging	[19]	

Case Example

A 5-year-old Friesian cow presents 12 hours after calving with signs of illness and profuse diarrhoea. The cow is the fifth animal to calve from the autumn-calving block of a 270 Friesian cow herd, with cattle still at grass at time of presentation. She calved unassisted during the previous night about two weeks prematurely - her premature calf also requires veterinary attention. The herd routinely vaccinates against Leptospirosis.

Salient clinical findings in the cow are vital signs within normal range but reduced and weak rumen contractions, septicaemia, dehydration of about 7%, retained fetal membranes, signs of respiratory tract involvement, and profuse, watery, foul-smelling diarrhoea.

Her calf was found moribund in the field early in the morning, and is showing signs of severe depression, hypothermia and septicaemia.

Three scenarios are considered:

- 1) Abortion or premature calving as the main disease entity with systemic involvement of dam and calf
- 2) Diarrhoea as the main disease entity with premature calving caused by a septicaemia or bacteraemia.
- 3) The illness in the dam and the calf not being associated with each other

Scenario 1:

Infectious Bovine Rhinotracheitis (IBR), Leptospirosis, Listeriosis and Salmonellosis are the main causes to consider for premature calving or abortion with systemic signs. With the first three listed causes, there is usually a delay of one to eight weeks between signs of illness in the dam and termination of pregnancy. The foetus is unlikely to be alive, with foetal autolysis common with IBR and a necrotising placentitis present with Listeriosis. Abortion due to Listeriosis is more common in mid-stage gestation rather than late gestation. Leptospirosis can result in weak calves being born, but is unlikely in this herd given the vaccination history.

Scenario 2:

Differential diagnoses for enteritis with signs of systemic illness include Salmonellosis, Yersiniosis, Malignant Catarrhal Fever (MCF), ingestion of toxins (e.g. nitrates, acute copper toxicity, salt). The main non-enteric causes to consider in a freshly calved cow include toxemia (secondary to mastitis or metritis) and peritonitis. Udder examination is normal in this animal, and as she calved unassisted peritonitis is unlikely. Toxaemia secondary to retained fetal membranes is a possibility.

Toxicity is possible, however there is no history of access to a poison or toxin, and no additional signs commonly observed with toxicities are present, like abdominal pain or colic, bruxism, or neurological dysfunction. MCF is ruled out because it typically infects individual cattle under 2-years-old, and pyrexia and ulceration of the oral and nasal mucosa are very common.

The role of *Yersinia* spp. as primary cause of enteritis in farm animals remains unclear. Case reports suggest that it mainly affects cattle under 3-years-old and is more prevalent in winter and spring. It is a potential zoonosis.

Salmonellosis in cattle causes three types of disease: septicaemia, which is common in calves, acute enteritis, which is common in adult cattle especially after stress (transport, calving), and chronic enteritis, which is usually a sequel to acute disease. The clinical signs observed in this cow and her calf are consistent with salmonellosis. Not least because of the zoonotic risk, any freshly calved cow showing diarrhoea with systemic involvement should be considered a potential salmonella case until faecal culture proves otherwise.

Follow-up

Three days later, another cow is presented with haemorrhagic diarrhoea 36 hours after calving, making it more likely that there is a common cause across all three animals.

Faecal culture from both cows and the calf are confirmed positive for *S. typhimurium* type I.

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Captions:

Table 1: Important causes of enteritis and diarrhoea in UK cattle post-weaning, grouped by type of causative agent.

Flowchart 1: Common causes of acute diarrhoea, grouped by age and number of animals affected.

Flowchart 2: Common causes of chronic diarrhoea, grouped by number of cases affected.

¹ for example, ragwort; ² especially *S. Dublin*; ³ overgrowth after prolonged antimicrobial therapy

Figure 1: Where BVD (bovine viral diarrhoea) is present in a herd, signs other than diarrhoea like abortion may be seen.

Figure 2: Emaciation and poor growth in a BVD persistently infected animal. This may also be seen in cattle with chronic mucosal disease.

Figure 3: Non-healing skin lesions on the distal limb of an animal with chronic mucosal disease.

Figure 4: Mucopurulent nasal discharge in an animal with the 'head & eye form' of malignant catarrhal fever. Affected cattle may show diarrhoea or constipation.

Figure 5: Winter dysentery in a Jersey cow. Animals typically remain bright and recover quickly.

Figure 6: Differential diagnoses for haemorrhagic diarrhoea include Salmonellosis, BVD Type II, coccidiosis, *Clostridium perfringens* Type A, haemorrhagic bowel syndrome, and renal insufficiency.

Figure 7: Fibrin cast and haemorrhagic faeces in the bedding of an animal with Salmonellosis.

Figure 8: Environmental sampling – here in the parlour – to establish the extent and success of control measures in a herd outbreak of Salmonellosis.

Figure 9: Emaciation in a beef suckler cow with Johne's disease. Resulting immune-suppression facilitated lice infestation in this animal (lick marks over body).

Figure 10: Anthelmintic treatment history is important to assess the likelihood of endo-parasitism as cause of diarrhoea, both acute and chronic.

Figure 11: Clinical endo-parasitism is much more commonly seen in young animals than adults.

Figure 12: The presence of standing water on this pasture should prompt consideration of fascioliasis as a differential diagnosis.

Figure 13: Peritonitis causing abdominal pain and the animal adopting a stance with an arched back.

Figure 14: Gram-stained smear of rumen fluid showing overgrowth of gram-positive Lactobacilli in a case of acute carbohydrate overload.

Figure 15: Distended jugular veins in a cow with right-sided heart failure.

Figure 16: Simmental stock bull in end-stage renal failure, showing recumbency, weightloss and diarrhoea.



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