Case-Based Challenges

GI Disorders, A Systematic Approach to Vomiting and Diarrhoea

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Vomiting and Diarrhoea

DIAGNOSTIC APPROACH to gastrointestinal cases

As in all internal medicine, history and physical examination are far more important than any diagnostic tests.

HISTORY

KEY POINTS:
1) a GI history must include detailed information about the following
   -vaccination status
   -worming prophylaxis, what used, how frequently
   -travel history and travel history of in contact animals
   -time spent in kennels / rescue centres
   -health status of in-contact animals (and people!)
   -dietary history
     -type of food, amount
     -what time fed
     -titbits / human table scraps
     -scavenging behaviour especially if there are changes in the environment
     -access to carrion
   -detailed questioning about the status of other body systems
   -response to medications and diets given (be open minded about this – there is always a natural tendency to believe that medication should work – the owner will soon disabuse you of this!)
   -leave specific questioning about the GI system until last

2) let owners tell you about the GI history in their own words first before questioning them specifically. This is very important – make a note of what the owner perceives to be the main problem. They may be erroneous in this (in which case a lot of counselling / communication will be needed to correct this impression) but unless you address their specific concern, they will be dissatisfied with any response.

3) GI cases require more communication than any other medical cases. This is because:
- in acute cases a definitive diagnosis is often not possible or needed – symptomatic management may be all that is needed.

- in most chronic cases a cure is not possible (except with surgical diseases eg stricture). Owners should be counselled about this – most chronic GI disease is ‘manageable’ at best rather than curable. In many owners minds this requires a significant shift in expectation from the mindset of their being a simple problem with a simple solution. Many owners will know people with Crohn’s disease, peptic ulcer disease, IBS or other chronic GI disease and, though medically inaccurate, there is nothing wrong with drawing comparisons with human chronic GI medical problems to help owners come to terms with this.

- in many cases a definitive diagnosis is not possible

- therapeutic trials are often needed but require strict discipline, regular client communication and re-evaluation and a healthy degree of self-criticism and acceptance of unexpected results.

4) when questioning about the GI disease, concentrate on

- frequency
- volume, texture, colour, shape
- relationship to eating but do not place undue emphasis on this
- changes in appetite
- changes in body weight
- presence / absence of pain and timing of pain responses
- relationship / response to food types. Be sensitive to the fact that many owners have very firmly held convictions of what does and does not constitute a sensible diet for a dog and this may be fuelled by internet articles, natural health fads and many other sources of opinion.

5) Try to ask open questions and always try to quantify / qualify answers by asking How often? How much? What appearance? etc

**Specific GI questioning**

You should seek to identify what primary signs of GI dysfunction are present, attempt to anatomically localise the problem (if enough information is available) and also note signs which may be secondary GI signs or that may be due to concurrent disease. Primary GI signs may include dysphagia, odynophagia, regurgitation, vomition, bloating, borborygmus, diarrhoea, dyshezia, melaena,
haematochezia, tenesmus, abdominal pain, belching, excessive flatus, icterus and ascites. Secondary signs may include anorexia, fever, depression, dehydration, hypersalivation and polyphagia.

**Dysphagia**

Question owners carefully about feeding behaviour from approach to food to prehension character, and try to ascertain at what stage of normal coordinated eating / swallowing dysfunction occurs. Ask if pain is seen and question whether improvements are seen with varying food type. Question about differences between solid food and liquids. Especially helpful is asking about coughing / spluttering during swallowing of food / water which frequently occurs with pharyngeal dysfunction. Changes in bark pitch (laryngeal dysfunction) and abnormalities of tongue movement, facial muscle tone, the vestibular system and proprioception should all be closely questioned if multiple cranial neuropathies are suspected. Pain after swallowing may indicate oesophageal disease.

**Vomiting / regurgitation**

The differentiation between these two is not always as straightforward as some texts would have you believe. Relationship to eating can be especially misleading. Dogs can regurgitate many hours after eating (particularly if it is a mixture of pooled saliva / food that they are bringing up) and vomiting may occur instantly after eating if marked gastritis is present.

Useful signs include

- presence / absence of abdominal heaving (vomiting Vs regurgitation)
- ‘projectile’ vomiting (care – many owners will exaggerate this!) which may indicate gastric outflow obstruction
- presence of fresh blood (care – small amounts will often be seen with prolonged retching and do not necessarily mean gastric ulceration) or ‘coffee grounds’ which suggest gastric disease
- Vomiting of undigested / partially digested food more than 5-6 hours after eating (suggesting delayed gastric emptying).
- vomiting of bile (which suggests that gastric pyloric obstruction is unlikely). The presence of bile in vomited fluid does not imply ‘gastric reflux’ (bile is a normal finding in the stomach of many dogs) and does not rule out regurgitation.
- Faecal odour / appearance to vomit – this is usually unmistakable when it occurs and implies complete lower GI obstruction – rapid diagnosis and correction (usually surgically is needed if such signs are seen)
- vomiting bile first thing in the morning, especially if accompanied by a desire to eat grass and accompanied by discomfort which is relieved by the act of vomiting, is a hallmark of the so
called ‘bilious vomiting syndrome’ a frustrating but benign clinical entity usually of terrier breeds

-odour, pH and colour of vomits are seldom otherwise helpful. Frequently gastric pH measurement is advocated to differentiate between vomit and regurgitation but I would not advise relying on it!

-‘praying posture’ – may indicate pancreatic pain but beware over-reliance on this. Postural changes merely indicate abdominal pain (or sometimes meningeal / spinal / renal!!!) and are not pathognomonic for pancreatitis contrary to veterinary folklore!

**Diarrhoea**

-try to characterise as small intestinal / large intestinal or both. In many cases the GI tract is diffusely affected but localising the problem will help marshal diagnostic tests and plan procedure such as upper GI endoscopy Vs upper+lower GI endoscopy. Specifically ask about volume, frequency, urgency, appearance, colour, tenesmus and presence absence of blood / mucus / melaena / parasites / vegetable matter. Be careful when asking about melaena – many vets over interpret what owners tell them. Melaena is black / tarry not ‘dark’ not ‘dark chocolate’ but ‘black’ ‘like tar’, ‘like black treacle’, ‘like molasses’. If the owner does not volunteer this information don’t put words into their mouth! In general

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Small Intestinal Diarrhoea</th>
<th>Large Intestinal Diarrhoea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Normal to increased</td>
<td>Usually very increased</td>
</tr>
<tr>
<td>Volume</td>
<td>Usually increased</td>
<td>Usually normal to decreased</td>
</tr>
<tr>
<td>Nature of blood if present</td>
<td>Melaena</td>
<td>Fresh blood</td>
</tr>
<tr>
<td>Presence of mucus</td>
<td>Absent</td>
<td>Often present</td>
</tr>
<tr>
<td>Presence of urgency</td>
<td>Normal to mild increase in urgency</td>
<td>Usually increase in urgency</td>
</tr>
<tr>
<td>Presence of tenesmus</td>
<td>Absent</td>
<td>Often present</td>
</tr>
<tr>
<td>Presence of weight loss</td>
<td>Often</td>
<td>Usually not</td>
</tr>
</tbody>
</table>

If large bowel signs predominate but there is weight loss – assume there is concurrent SI disease
PHYSICAL EXAMINATION

KEY POINTS

- do this in the same order each time to avoid errors of omission
- the order you do it in is not important, just adopt a routine which suits you best
- THINK what you are doing, every time you do a physical examination – most findings which are missed on physical examination are not due to lack of skill, patience or technique but due to the examiner not concentrating / not thinking about what they are feeling.
- Be careful not to over interpret your findings and if you can’t feel anything abnormal then record it.

- Be aware of the limitations of physical examination and avoid dogma / folklore of which there is plenty in the veterinary profession! Examples of veterinary ‘urban myths’ include:
  - the feeling of ‘thickened’ guts / diagnosis of infiltrative bowel disease by palpation – do you really think you can tell the difference between a pathologically thickened area and an area undergoing prolonged peristalsis due to spasm?
  - plentiful borborygmi indicate ‘lots of gut contractions’ – no they don’t. The sound of borborygmi is made by fluid rushing unopposed through gut segments – this occurs when segmental contractions are abolished so it is more likely that the opposite is true.
  - listening to a dog’s abdomen with a stethoscope is useful. Complete absence of gut sounds for a prolonged period of time may indicate ileus. An enlarged cranial abdominal viscus which sounds like a cow's displaced abomasums on flicking it may indicate gastric dilation. Borborygmi over the thorax is never normal and usually indicated diaphragmatic hernia or rupture. Other than these limited circumstances, abdominal auscultation is unhelpful and you should not waste time reading any more into it.
  - the liver of normal dogs is palpable – it isn’t usually except maybe a very narrow part at the right costal arch if you really dig your fingers in
  - splenomegaly and hepatomegaly are easy to palpate. Not always! If in doubt stick to cranioventral organomegaly – keep an open mind!

Examination tips / frequently neglected area of the physical examination:

- always examine oral cavity thoroughly including sublingual area (not only cats which have sublingual foreign bodies!), dentition, gums and palatal tissue
- always palpate the retropharyngeal area carefully
-palpate the length of the cervical oesophagus and in regurgitating dogs palpate and observe the thoracic inlet – frequently this will pouch out with accumulated fluid / gas and will often be seen to ‘balloon’ with inspiration

-when examining an abdomen:

  • -examine everything else first!
    o -stand behind the patient and stand above it. Palpate in a cranial to caudal directions alternating pressure and release with finger tips.
    o -use finger tips to explore for focal discomfort / alterations in expected anatomy, use flat of hand for determining diffuse painful regions and sensations of local organomegaly
    o -compensate for the inaccessible nature of organs within the costal arch and wideness of the abdomen at this point by palpatnig more firmly and for a more prolonged time in this region. Having an assistant hold the front end up can help tip cranial organs backwards
    o -palpation for liver / biliary tract abnormalities can be facilitate by shifting abdominal contents to one side and pushing in a caudal to cranial direction with the flat of the hand orientated parallel to the visceral surface of the liver. You can also stand cranial to the dog and hook your fingers around the costal arch bilaterally and palpate by ‘digging’ your fingers in towards you
    o -if discomfort is displayed by the patient try to determine if it is localisable and especially if it is reproducible – come back to it at a later stage or get an unbiased colleague to examine the dog without telling them what you found. Always consider referred pain from spine, meninges, perirenal area, muscle, abdominal wall
    o -try to palpate as much of the small intestine between your fingers. Bearing in mind comments about ‘gut thickening’ focal thickenings s/ mass lesions may be detected. Beware the caeco-colic junction in cats which may feel like a mass lesion and also beware palpating the superimpose rectus abdominis muscles of the abdominal wall which can feel like abnormal structures.
    o -differentiate colonic faeces from mass lesions by fingertip indentation-always do a rectal examination in entire male dogs and in any dog with large intestinal signs. Feel lumen, feel prostate if applicable (size, symmetry, hardness, pain), feel for subiliac lymph node enlargement, feel down either medial aspect of the ilium.
    o -don’t forget that the abdominal contents are bounded by the abdominal wall and integument – palpate the wall for abnormalities / defects and observe the integument of the abdomen especially the ventrum. The umbilicus is a useful area to observe due
to its connection with the falciform fat. Intra-abdominal bleeding frequently results in bruising / discoloration in this area as blood ‘tracks down’ the falciform ligament.

-when a dog or cat is anaesthetised / sedated do not miss the opportunity to repalpate the abdomen. Be aware that this may cause artefactual gas bubble formation prior to radiography especially if contrast studies are being performed.

GENERAL APPROACH TO INVESTIGATION OF GI DISORDERS

These are merely suggested lines of approach / differential diagnoses which should be ruled out when investigating chronic GI disease. Note that in acute cases a different approach is needed which may include merely watchful waiting

As a general rule try and answer the following clinical questions (in this order)

1) is the dog or cat showing signs of systemic disease or consequences of its GI illness that are life-threatening / require immediate therapy? [ eg shock, dehydration, hypovolaemia, hypokalaemia, encephalopathy]

2) can I localise the areas of the GI tract that are affected? If not what can I do to help me do this?

3) Are the signs of GI disease caused by a primary GI problem, disease that is local to a portion of GI tract which is affecting it as an ‘innocent bystander’ (eg abscess / adhesions) or is there a systemic disease present with predominantly GI signs?

4) If there is a GI disease is it likely to be surgical (good prognosis for resolution) or medical (poor prognosis for resolution)?

There is a natural tendency with any patient that presents with primarily GI signs to ‘focus on the gut’. Whilst it is true to say that probably the majority of these problems are primarily to do with the gut, such tunnel vision leads to errors of clinical omission. It is conceptually useful to therefore consider problems other than primary GI disease first (like when you stick up a radiograph with an obvious mass, it is sensible to look at the rest first then concentrate on the mass last). I therefore like to discuss with vets and clients that the order of concern should be:

-consider systemic diseases with predominant GI signs first

-then consider disease local to the GI tract next

-lastly consider primary GI tract disease
This approach not only makes medical sense (can you imagine the resultant problems if a dog with GI haemorrhage due to hypoadrenocorticism has an ex-lap before any investigation for an endocrine cause? This sounds dramatic but it is something that we see vets do more often than you might think!) but also uses resources appropriately.

If you think about it, investigating systemic problems usually requires blood tests (cheap, do not require hospitalisation, minimum intrusiveness for patient). Investigating problem local to the GI tract usually requires diagnostic imaging (combination of radiography and ultrasonography) which are more expensive, require hospitalisation and are more of an issue for the patient. Examining primarily for the GI tract causes usually requires anaesthesia, endoscopy or exploratory celiotomy which are expensive, require hospitalisation and are medically intrusive). By ‘logical staging’ of investigation we can a) make sure that important disease states that may not initially spring to mind are not overlooked to the detriment of the patient b) clients and animals are not exposed respectively to unnecessary expense or unnecessarily intrusive diagnostic tests and c) in the case of overanxious clients whose animals have self-limiting / resolving GI disease we do not become participants in ‘health tourism’ by giving the process time to resolve on its own before we medically investigate (this is likely more a problem in referral practice).

As an example of why this logical approach is needed:

Some time ago I was referred a 2-year old dog with a history of vomiting and failure to maintain weight. The referring veterinarian was insistent that the dog be seen ‘just for an endoscopy’. I explained that this was not the way that GI investigation is performed and that an isolated procedure would be likely to fail as a diagnostic tool if not integrated into a logical diagnostic approach. Finally we agreed that the course of investigation would be determined, logically, by my assessment of history and physical examination and description of the presenting complaint. This was borne out almost immediately when upon presentation I could ascertain 4 things – i) the dog was very skinny and had never maintained weight since being a pup ii) the dogs chronic vomiting had been a lifelong feature iii) I could not palpate the normal volume of abdominal viscera that I would expect iv) on thoracic auscultation borborygmi could clearly be heard coming from the wrong side of the diaphragm! A thoracic radiograph confirmed the diagnosis of congenital pericardio-peritoneal diaphragmatic hernia and the dog’s problem was relieved by surgery. Now can you imagine how stupid (not to mention medically negligent) both myself and the referring vet would have appeared to the owner if I had just endoscoped this dog? I consider myself a good endoscopist but I suspect that I would not have made a diagnosis of PPDH from inside the duodenum!

Examples of primary / local/systemic causes of GI signs may include:
Systemic diseases with GI signs
- hypoadrenocorticism
- hyperthyroidism in cats
- hypothyroidism
- vasculopathies
- behavioural problems
- severe congestive heart failure
- uraemia
- sepsis
- CNS disease
- vestibular nausea
- ‘visceral epilepsy’

Local disease affecting GI tract
- pancreatitis
- exocrine pancreatic insufficiency
- peritonitis
- pansteatitis
- adhesion disease
- focal abscessation
- sclerosing / encapsulating peritonitis
- migrating foreign bodies
- thromboembolic disease
- portal hypertension
- portosystemic shunt

Primary GI disease
- physical / obstructive problems (usually surgical)
  - foreign body
  - intussusception (do not forget that these can be intermittent / relapsing)
  - neoplasia
  - torsion
- entrapment
- stricture / stenosis
- diverticulae
- herniation / rupture of diaphragm or abdominal wall
- short-bowel syndrome
- congenital anatomical defects
- infectious
  - viral (eg Parvovirus)
  - bacterial (eg Salmonella, Campylobacter, Enteropathogenic E.Coli, Clostridium, ‘SIBO’ / antibiotic responsive diarrhoea, bacterial cholangitis)
  - protozoal (eg giardia)
  - fungal / algal (rare in UK)
  - parasitic (eg heavy Trichuris infestation)
- inflammatory / immune mediated / neoplastic
  - IBD
  - lymphangiectasia
  - dietary intolerance
  - neoplasia esp. lymphoma
  - ulcerative disease
  - cholangiohepatitis
- simple dietary indiscretion / upset
- enzyme deficiencies
- ‘motility’ disorders – very poorly characterised and mostly impossible to definitively diagnose. Usually diagnosed on response to therapy but very frustrating
Assessment of routine laboratory findings in the presence of gastrointestinal disease

**HAEMATOLOGY**

A complete blood count is often normal in the presence of gastrointestinal disease but should nevertheless always be performed during the initial assessment these patients. Sometimes important diagnostic evidence may be afforded by the blood count and specific examples are listed in table 1

<table>
<thead>
<tr>
<th>Red blood cell indices</th>
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<tbody>
<tr>
<td>Normocytic, normochromic, non-regenerative anaemia</td>
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<tr>
<td>-may be seen due to anaemia of chronic disease</td>
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<tr>
<td>in patients with many illnesses or in the first</td>
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<tr>
<td>48-72 hours after acute GI haemorrhage</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Macrocytic, hypochromic, regenerative anaemia</td>
</tr>
<tr>
<td>-may be seen with GI haemorrhage</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Microcytic, hypochromic anaemia</td>
</tr>
<tr>
<td>-may be seen with iron deficiency due to</td>
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<tr>
<td>chronic GI blood loss (eg due to parasitism)</td>
</tr>
<tr>
<td>in some hepatic disease especially portosystemic shunting. May be</td>
</tr>
<tr>
<td>regenerative or non-regenerative</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Relative polycythaemia</td>
</tr>
<tr>
<td>-may be seen due to haemoconcentration in</td>
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<tr>
<td>Cases of dramatic or prolonged GI fluid loss.</td>
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<tr>
<td>Most dramatic examples seen with canine haemorrhagic gastroenteritis</td>
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<tr>
<td></td>
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<tr>
<td>White cell indices</td>
</tr>
<tr>
<td>Neutrophilia</td>
</tr>
<tr>
<td>-an increased white cell count, usually composed principally of</td>
</tr>
<tr>
<td>neutrophils, may indicate ongoing GI tract inflammation, though</td>
</tr>
<tr>
<td>more usually this is within normal limits.</td>
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<tr>
<td></td>
</tr>
<tr>
<td>-a band shift represents severe ongoing inflammation and is</td>
</tr>
<tr>
<td>most typically seen in infectious GI disease such as parvovirus. In</td>
</tr>
<tr>
<td>severe cases the band shift may exceed the mature neutrophil count</td>
</tr>
<tr>
<td>(degenerative left shift) and is a poor prognostic sign. Toxic</td>
</tr>
<tr>
<td>neutrophils may be seen with gram -ve sepsis accompanying bacterial</td>
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<tr>
<td>translocation in severe GI disease</td>
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</table>
**BIOCHEMISTRY**

**Total protein, Albumin and Globulin**
Whilst a mild hypoalbuminaemia and compensatory hyperglobulinaemia is frequently seen in many debilitated animals, severe hypoproteinemia from starvation alone is rarely seen. More significant hypoalbuminaemia should prompt a search for sources of decreased protein production (namely hepatic disease) or increased loss (protein-losing enteropathies and protein-losing nephropathies).

Urinary protein loss can easily be quantified and the use of urine-protein:creatinine ratios can be invaluable as a screening test; in cases of protein-losing nephropathy a hypoalbuminaemia / normoglobulinaemia is usually seen. Protein-losing enteropathies are characterised by loss of albumin and globulin (panhypoproteinaemia) whilst the magnitude of globulin in hepatic disorders may be normal, increased or decreased. Liver function testing is ultimately required in most cases.

**Urea and Creatinine**
Urea may be elevated due to recent feeding, GI bleeding or dehydration and renal azotaemia should be distinguished by assessment of urea and creatinine with simultaneous urine SG determination in a fasted sample. Low urea may reflect hepatic insufficiency.

**Other biochemical analytes**
While ALT and ALKP are often considered markers of hepatocellular damage and cholestasis respectively, both may become non-specifically raised with a number of extra-hepatic GI disorders with no evidence of hepatic pathology.

Calcium may be decreased in pancreatitis but the most usual reason for hypocalcaemia is concurrent hypoalbuminaemia. Raises are seldom seen in primary GI disease. Cholesterol may be found to be decreased in hepatic insufficiency or increased in cases of severe cholestatic disease.

**Electrolytes and blood gas analysis**
These tests, if available, are extremely useful in the assessment of the acid-base balance and electrolyte levels of anorexic, vomiting and diarrhoeic animals as well as monitoring for iatrogenic electrolyte depletion through inappropriate fluid therapy. Potassium loss is frequently dramatic in anorexic, vomiting animals receiving potassium-poor fluids and acid-base disturbances may become life-threatening in protractedly and severely vomiting / diarrhoeic animals. Hypochloridaemia is frequently encountered in dogs with true gastric vomiting (and should ring an alarm if you see it!) and is often accompanied by profound metabolic alkalosis.

**FAECAL ANALYSIS:**

*Gross examination*
Gross examination gives information as to the consistency, colour and shape which may aid further diagnostic endeavours (see table.)
Microscopic faecal analysis is performed to assess the presence of micro-organisms, intestinal parasites, cytological evaluation of inflammatory cells and potentially may aid the diagnosis of malabsorption.

**Faecal parasitology**

Ova, oocysts, trophozoites and larvae of many nematodes and protozoa can be identified by direct smear examination. However, many nematode ova and protozoal cysts and oocysts are best identified by faecal flotation using a faecal flotation test. For many intestinal parasites, immediate examination of faeces is preferred and due to the intermittent nature of the shedding of some (in particular *Giardia* sp) a minimum of 2-3 faecal examinations is recommended.

Protozoa of relevance to feline diarrhoea include *Cryptosporidium* spp and *Isospora* (*Cystoisospora*) spp and probably of greater significance *Giardia* spp and *Tritrichomonas foetus*. *Cryptosporidium felis* infection is usually asymptomatic in cats though may be implicated in some cases of small intestinal diarrhoea in young cats in which no other pathogenic cause is found. Cysts are very small (4 x 6 um) and are best seen with Ziehl-Neelsen staining. Similarly most cats are thought to at some times be infected with *Isospora felis* and rivolta and though very large numbers may cause very watery small-intestinal diarrhoea in young kittens, most infections are asymptomatic. *Giardia* and *Tritrichomonas* are thought to be clinically more important and their presence is usually associated with clinical signs. Organism identification is best made on assessment of fresh faecal mucus, especially from samples taken by gentle swab insertion then rolling on a clean microscope slide. *Giardia* have a rolling / ‘falling leaf’ motion whilst *Tritrichomonas* has a jerky / progressive motion on light microscopy. Faecal flotation increases chances of detection of *Giardia* but not *Tritrichomonas*. Samples taken for ELISA for *Giardia* and quantitative PCR for *Tritrichomonas* should similarly be as fresh as possible and of a reasonable volume in order to prevent false negative results.
Faecal flotation or concentration by the Baermann method is indicated to detect parasitic ova and some protozoa. Faecal flotation with centrifuged zinc sulphate has been shown to maximise diagnostic yield. Identified roundworm ova are usually large (80um) with a thick wall and are generally *Toxacara cati* and *Toxascaris leonina*. Hookworm infections appear relatively uncommon in the UK with *Uncinaria stenocephala* being more common that the more voracious *Ancylostoma spp* (the same is true in UK dogs). These worms produce large amounts of eggs which have characteristically thin walls, and large numbers of eggs contained within a ‘packet’. Whipworm infections are uncommon in cats and are usually *Trichuris vulpis* which has a predilection for the caecum and colon, and is therefore usually associated with large intestinal diarrhoea.

**Faecal microbiology / virology**

Assessment of faecal bacterial pathogens is often time, labour and cost-intensive and often yields dubious results. However, historical findings of onset of GI signs after kennelling, mixing with other affected dogs, ingestion of spoiled foods or bloody diarrhoea accompanied by signs of systemic illness should prompt consideration of infectious causes. Many potential pathogens can be isolated from the intestines of normal asymptomatic dogs and cats and interpretation of positive findings must always be very cautious. The findings of large numbers of neutrophils, bacterial spores (especially *Clostridium spp*) or intracellular bacteria on microscopic examination of fresh faeces or cytology of rectal scrapes may suggest pathogenic bacterial involvement. *Salmonella*, *Clostridium perfringens*, *Campylobacter jejuni* and *Enteropathogenic E.Coli* are the most commonly isolated bacterial enteric pathogens in the UK. Diagnosis is often hampered by the need for exacting microbiological technique and the need for very fresh samples.

The most common viral intestinal pathogens isolated in the UK are canine and feline parvovirus and enteric coronaviruses. Laboratories claiming ‘quantitative’ faecal cultures, routinely reporting *E.coli* as a pathological findings without examination of pathological determinants or seeking to overinterpret normal flora or indeed to derive information regarding bacterial ‘overgrowth’ from faecal sample results, should be viewed with a healthy degree of ‘diagnostic scepticism’!

**Faecal occult blood**

Testing for occult blood may be performed where occult GI bleeding is suspected. Animals must be fed on a diet free of red meat for at least 3 days prior to testing and certain drug, iron supplements and vegetable haem-proteins will cause false positives. Faecal occult blood tests suffer from the simple fact that they are non-quantitative and the amount of faecal blood may be clinically irrelevant or may be due to catastrophic haemorrhage.
Faeces as an indicator of malabsorption

The findings of large amounts of undigested starch, fat and muscle fibres in faces may be supportive, but is not diagnostic of malabsorption. Faecal proteolytic activity, measured by the ability of faecal trypsin to digest gelatin on x-ray film, is an extremely unreliable test for exocrine pancreatic insufficiency and is not recommended.

**DIAGNOSTIC TESTS FOR EXOCRINE PANCREATIC DISEASE**

**DIAGNOSIS OF PANCREATITIS**

**Imaging**

**Radiography**

Very few studies examine diagnostic sensitivity in the diagnosis of pancreatitis though there are many review articles / case series of radiographic abnormalities. In one study of abnormalities in 70 cases of fatal acute pancreatitis radiographic abnormalities were detected in only 10 of 41 dogs (24%) of which 8 (19.5%) had increased radio-opacity / loss of detail in the right cranial quadrant, 2 (4.8%) had a gas-filled displaced duodenum. 6 of these 10 dogs also had suggestive signs on ultrasound examination. In 31 of these 41 dogs thoracic radiographs were also available and 12/31 (38.7%) were abnormal. 5/31 (16%) had evidence of pneumonia, 5/31 (16%) had pleural effusion and 2/31 (6%) had signs of pulmonary oedema. Radiography appears generally insensitive for diagnosing pancreatitis in the cat.

**Ultrasound**

Again whilst there exist many reviews of pancreatic ultrasound, and ultrasonographic features of experimentally-induced pancreatitis there are few studies documenting ultrasonographic features and sensitivity / specificity of ultrasonography in the diagnosis of naturally occurring pancreatitis in dogs and cats. Diagnostic ultrasound of the pancreas is highly operator dependent, and even imaging specialists who ultrasound many pancreases every day of their working week, are frustrated by lack of specificity. In one retrospective study of acute, severe and fatal pancreatitis ultrasonographic abnormalities were found in 23/34 dogs (68%). 20/34 (58.8%) had enlarged irregular pancreases, 16/34 (47%) had peritoneal effusion, 12/34 (35%) had abnormal duodenal corrugation or thickening and 6/34 (17.6%) had evidence of extrahepatic bile duct obstruction. Other reported features include an enlarged hypoechoic pancreas, cavitary lesions such as abscess or pseudocyst, dilated pancreatic duct, swollen hypomotile duodenum, evidence of EHBDO and local accumulation of peritoneal fluid. In a series of 20 cats with pancreatitis, pancreatic ultrasound was abnormal in only 7 /20 – mainly showing features of a hypoechoic irregular pancreas with hyperechoic peripancreatic fat.

**CT/MRI**
CT anatomy of the normal canine pancreas has been reviewed. Contrast-enhanced CT examination of two dogs with naturally occurring necrotising pancreatitis has been reported but the relative sensitivity and specificity of the technique has not been evaluated. The use of ERCP-enhanced CT in experimental pancreatitis in dogs has been reported to be a potentially useful diagnostic tool. CT of the feline pancreas has yielded variable results MRI has not been evaluated for the investigation of pancreatitis in dogs to date but anecdotally we have not found MRI resolution of the normal canine pancreas to be that impressive.

**ERCP**

Endoscopic-retrograde cholangiopancreatography (ERCP) is the diagnostic imaging method of choice in determining sphincter and pancreatic duct abnormalities associated with pancreatitis in people. Essentially contrast medium is injected through a cannula placed endoscopically through the ampulla of Vater in the small intestine to highlight the pancreatic duct and common bile duct. Stricture of the sphincter of Oddi can also be dilated by balloon catheter, stents placed and stones removed by this method. A risk of inducing pancreatitis of 2% is reported though some reports put the risk as much higher than this. However it is likely that these reports are based on rises in amylase and lipase after ERCP which commonly occurs. ERCP has been reported in normal dogs and in dogs with experimentally-induced pancreatitis. A potential difficulty in interpretation arises from variation in regional anatomy. In most dogs the pancreatic duct enters the duodenum from the right lobe at the major duodenal papilla as does the common bile duct. The larger accessory pancreatic duct enters from the left lobe in most dogs at the minor duodenal papilla but in some dogs all pancreatic secretion enters duodenum by this route and the pancreatic duct does not exist. Additionally the degree and position of fusion of the pancreatic duct and common bile duct is highly variable.

**Laboratory tests**

In 70 dogs with severe pancreatitis (all these dogs died and had necropsies performed): neutrophilia with left shift 55%, neutropenia 3%, thrombocytopenia 59%, anaemia 29%. Azotaemia frequently occurred (increased urea 53%, creatinine 59%). Other frequent analyte alterations were raised glucose (29.7%), raised phosphorus (68.3%), raised calcium (15%), raised ALT (61%), raised ALKP (79%), raised TBil (53%) and raised cholesterol (48%). Pancreatitis is cited in one retrospective study as the most common cause of obstructive jaundice in the dog accounting for 42% of cases. In cats the most commonly altered routine laboratory tests are hypokalaemia (seen in around 50%) and mild to moderate but non-specific raises in ALT, ALKP and TBil seen in 50-60%.

**Amylase / lipase**

Amylase – sensitivity of 62.1%, specificity 57.1% in study by Mansfield, 69% sensitivity in study by Hess. Amylase also raised by non-pancreatic conditions notably renal failure, salivary gland and GI perforation. Corticosteroids appear to decrease serum amylase.
Lipase – sensitivity of 73.3%, specificity 55.2% in study by Mansfield 52% in study by Hess. Also elevated by renal failure, dexamethasone administration, glomerulonephritis, most hepatic lesions, lymphoma, adenocarcinoma of small intestine, amyloidosis, gastritis and heat stress. Empirical recommendations that levels of amylase and lipase >3 x the upper limit of the reference range appear to be based on a study by Polzin in 1983. Amylase and lipase seem to be of little diagnostic value in the cat.

**TLI**

Trypsin like immunoreactivity is a sensitive and specific marker of pancreatic function but few studies assess sensitivity and specificity in pancreatitis. In one study, using a cut-off value of 120umol/l a specificity of 65.4% and sensitivity of 33.3% was reported in dogs. In experimental pancreatic duct ligation TLI peaked at 100ug/l earlier than raises in amylase and lipase (within 24 hours) and returned to baseline by 14 days after ligation. TLI frequently returns to baseline soon after initial peaks in the setting of pancreatitis and will sometimes become subnormal soon after. The diagnostic utility of fTLI in cats is controversial. Using an upper limit of 82ug/ml as a cut off the test has a sensitivity and specificity of around 55%. Using a cutoff of 100ug/ml the sensitivity drops to 33% but a high value has a 90% specificity. Unfortunately many UK labs use a rather confusing reported range involving a large 'no-mans land’ and using reference values that have not been published in a way that they can be well evaluated. As a general rule though, very high fTLI values are convincingly representative of pancreatic inflammation.

**cPLI/ fPLI**

Recently an ELISA has been developed and validated for the measurement of Canine Pancreatic Lipase Immunoreactivity (cPLI) Lipases are a group of water-soluble enzymes that hydrolyse lipids to more polar lipolysis products so that a bipolar biological membrane can be crossed by the lipid. Lipases include digestive lipases (which facilitate polarisation of lipid for transport from intestinal lumen to intestinal epithelial cells), intestinal acidic lipase (intestinal epithelial cells to vascular space) lipoprotein lipase and hepatic lipase (vascular space to tissue cells) and hormone sensitive lipase and lysosomal acidic lipase (adipocyte and tissue cells to vascular space). Essentially the digestive lipases comprise classical pancreatic lipase and gastric lipase. Canine cPLI is a 2-step ELISA using anti-cPL antibody raised against cPL isolated by preparation of a pancreatic extract, protein extraction and anion-/cation-exchange chromatography. The assay is specific for pancreatic lipase. Sensitivity is 1.8ng/L, working range is 0.1-999.2ug/L. Normal range in 74 clinically healthy dogs (2.5th to 97.5th percentile) was 2.2-102.1ug/L. Median cPLI in 11 dogs with histologically confirmed pancreatitis was significantly higher (p<0.0001) at 676.8ug/L than in clinically healthy dogs (16.3ug/L). All had values above reference range established for normal dogs and with an empirical cut off value of 250ug/L 9/11 confirmed cases of pancreatitis had values above this range (sensitivity 81.8%, specificity 100%). The principals of fPLI are similar and the test seems similar to cPLI in being reasonably sensitive compared with some other laboratory tests – the difficulty in evaluating it comes from the fact that studies to date compare the fPLI results in cats with aggressive pancreatitis versus
completely normal cats. The test performs well in this situation but what you and I would like to know is how does this test perform in determining whether a cat with vague GI signs, vague abdominal discomfort or with anorexia has pancreatitis or something else. Unfortunately in this situation the test appears to work less well. Again, as a general rule, very high fPLI levels are convincing evidence for pancreatic inflammation but a normal value should not be used to rule it out.

**Other assays**

**Trypsinogen activation peptide (TAP)**

Cleavage of trypsinogen to active trypsin is the initiating event of all pancreatic enzyme activation. Normally the zymogen trypsinogen is cleaved by enterokinase in the intestinal lumen to trypsin and the N-terminus segment (which has aa sequence Asp-Asp-Asp-Asp-Lys which is conserved in most species) which is known as TAP. Since TAP should normally only be found within the intestinal lumen cleavage of trypsinogen within the pancreas results in TAP accumulation in plasma and clearance through the kidneys. TAP therefore not only has the possibility of being a marker for pancreatitis but may also be a means of grading severity. However studies in dogs with naturally occurring pancreatitis, normal dogs and dogs with spontaneously occurring non-pancreatic disease such as renal failure (which may raise traditional markers of pancreatic inflammation) have failed to demonstrate diagnostic utility in the diagnosis of mild and moderately sever pancreatitis. Plasma TAP is raised in dogs with severe necrotising pancreatitis but also in dogs with renal failure and some normal dogs. Dogs with pancreatitis that had higher plasma TAP concentrations tended to have more severe disease though 53.4% did not have raised plasma TAP. Plasma Tap was significantly higher in dogs with pancreatitis versus other non-renal disease and healthy dogs but not between pancreatitis and renal disease groups. Urinary TAP appears to be highly variable even in normal dogs and there was such overlap that no normal reference range or limit of abnormality could be set. There was a tendency for dogs with fatal necrotising pancreatitis to have higher urine TAP. A recent study has also shown that urinary TAP:creatinine ratio to be of prognostic value.

**alpha-1-proteinase inhibitor:trypsin complex**

During pancreatitis alpha-1-proteinase inhibitor binds reversibly to trypsin. An ELISA has been developed and validated for the quantification of α-1 PI – trypsin complex. 16 healthy dogs had either had mild, moderate and severe pancreatitis induced by 3 experimental methods (IV cholecystokinin n=3, pancreatic duct ligation n=4, and intraductal injection of enterokinase and autologous bile into pancreas n=5), were sham operated (n=2) or were non-surgical controls (n=2). Sera from 10 dogs with spontaneous pancreatitis were also examined. Concentrations of the complex were significantly raise in all experimental models compared with baseline and sham / non-operated. In CK –induced levels increased to 150% baseline in 1 hour but decreased thereafter, in DL and EK induced pancreatitis complex increased steadily over 5 hours to 425% and 1918% baseline. However in spontaneous pancreatitis levels increased but were not statistically different from normal dogs.

**Canine Pancreatic Elastase and C-reactive protein**
A small preliminary study looked at 16 healthy dogs, 6 dogs with renal failure, 14 dogs with acute pancreatitis (but not all histologically confirmed!). Serum pancreatic elastase was significantly raised in dogs with acute pancreatic compared with healthy dogs and those with renal failure. CrP was significantly higher in dogs with confirmed pancreatic necrosis versus those with mild disease.

**Abdominal fluid analysis**

Often small amounts of abdominal fluid are present in pancreatitis cases. It is sometimes useful to analyse the fluid in order to attempt to a) differentiate pancreatitis from other causes of localised loss of serosal detail (principle DDx would be pancreatitis, pansteatitis, peritonitis, carcinomatosis, free abdominal fluid eg blood / bile / chyle / urine) and b) to establish whether intra-abdominal sepsis is occurring. Fluid can be sampled initially using a 5/8” – 1” 18-21G needle inserted just caudal to the umbilicus and to the right of midline with the dog in LL recumbency in order to let the spleen ‘fall away’ from the puncture site. A severe limitation to abdominal paraacentesis is plugging of the needle with falciform fat which can be extensive in some dogs. Inadvertent puncture of the spleen or bladder, whilst seldom of clinical significance if one is careful, may lead to erroneous results. Further attempts to analyse fluid if this is unsuccessful may include doing a ‘4 quadrant tap’ ie puncturing in each of the 4 abdominal quadrants (personally I find this seldom increases yield) or performing diagnostic peritoneal lavage (DPL) which I think is more useful. Briefly the ventral abdomen is surgically prepped and a 14-16G 5-7” over the needle catheter (or custom DPL cannula) with additional side holes cut into it in a sterile fashion (but without compromising the rigidity of the cannula) is placed into the abdomen through a pre-placed bleb of suitable local anaesthetic and through a nick in the skin to avoid tissue drag on the cannula. The needle is advanced into the abdomen and the cannula advanced off this once the needle tip penetrates the abdomen – the bevel should be orientated ‘en-face’ to abdominal contents to avoid trauma. Approximately 10 – 20ml / kg body weight of warm, sterile, preservative free saline is infused through the cannula with a giving set and the patient gently rotated to ‘wash’ the abdominal contents with the fluid. It is then retrieved via the cannula. Kinking of the cannula is the main frustration with this technique. Note that fluid yield is very small compared with volume infused! Fluid retrieved can be analysed by centrifugation and analysis of a concentrated smear for cytology, and biochemical analysis performed for bilirubin (not valid in jaundiced animals), creatinine and amylase contemporaneously with serum levels of the same. Levels should be highly elevated compared with serum levels in bile peritonitis, uroperitoneum and pancreatitis respectively, though amylase levels may also be raised with bowel ischaemia. Specific gravity and protein content should also be assessed. Normal peritoneal fluid (usually <1ml / kg body wt) should be clear, yellow and have cell count <2500/mm³ comprising mainly macrophages and lymphocytes. There are usually very few neutrophils. Cell counts of <10,000/mm³ may be seen within 3 days of laparotomy and the neutrophil count will become raised. Finding plentiful neutrophils with frequent band forms indicates peritoneal inflammation but nothing more. Finding degenerate neutrophils is suggestive of sepsis – finding intracellular organisms is diagnostic and should prompt urgent consideration of laparotomy. In pancreatitis fluid is usually neutrophilic and ‘soap’-like fat droplets may be seen. This is not however pathognomonic – can also be seen with mesenteric inflammation and pansteatitis.
Tests for exocrine pancreatic insufficiency (EPI)

Trypsin-like immunoreactivity (TLI)

The TLI test has become the accepted test of choice for the diagnosis of EPI. It is a simple, sensitive and specific test, a subnormal result indicating the presence of EPI. It should be noted that there is no cross-reactivity between canine and feline TLI tests and the normal feline TLI range is significantly higher than that for dogs.

Faecal proteolytic activity

As mentioned previously this test is not as reliable as the TLI test as faecal proteolytic enzyme concentrations fluctuate with time such that many normal cats and dogs will sometimes have very low levels of faecal proteolytic enzymes. This assay is no longer recommended.

**DIAGNOSTIC TESTS FOR INTESTINAL FUNCTION AND ‘BACTERIAL OVERGROWTH’**

Serum Folate and Cobalamin (B12)

These two water soluble vitamins may be assayed to gain indirect information about small intestinal absorptive function and the possible presence of small intestinal bacterial overgrowth (SIBO) / antibiotic –responsive diarrhoea. Their use in the cat is not well described and they are most useful in canine patients.

Folate absorption occurs in the proximal small intestine and since it is plentiful in most canine diets (making nutritional deficiency unlikely), lowered serum levels may reflect proximal small intestinal disease. Folate (as folate polyglutamate) is absorbed in the proximal small intestine by reaction with the brush border enzyme folate conjugase, which is only found here. Folate levels may become increased in SIBO as a result of folate synthesis by intraluminal bacteria, though again this must be occurring within the proximal small intestine for serum levels to reflect this production as this is the principle site of the folate receptors.

In contrast cobalamin is principally absorbed in the distal small intestine after first undergoing a series of steps in which carrier proteins are first bound, then broken down by proteases then rebound to allow receptor-mediated absorption. Cobalamin is ingested protein-bound and is then release by the action of gastric pepsins and acid pH before becoming rebound to R-protein. The R-protein-cobalamin complex is broken down by a neutral pH, and pancreatic proteases within the proximal SI and then becomes bound by intrinsic factor. This complex is then recognised by specific ileal receptors. Low levels of cobalamin may be seen in distal small intestinal disease, SIBO as a result of bacterial competition for cobalamin substrate if present in high enough numbers, or in exocrine pancreatic deficiency (EPI) as a result of failure of pancreatic proteases releasing protein-bound cobalamin.
Thus whilst these two tests offer useful indirect evidence of malabsorptive disease or SIBO, they suffer from a lack of specificity. They are also relatively insensitive in that proximal or distal small intestinal disease has to be relatively long-standing and severe for changes to be seen. Since they can be affected by the presence of EPI a trypsin-like immunoreactivity test should be performed simultaneously.

**Other tests for S.I.B.O.**

The 'gold standard' test for SIBO is quantitative culture of duodenal juice aspirated endoscopically. This is a technically demanding and time-consuming test that is only available at certain research institutions. A diagnosis of SIBO cannot be made by faecal culture.

**Deconjugated bile acids**

Some intestinal bacteria will deconjugate bile acids in the distal small intestine – measurement of elevated serum unconjugated bile acids may therefore be a marker for intestinal disease.

**Urinary markers**

Metabolism of tryptophan by some small intestinal bacteria releases large amounts of the metabolite indicant which may be measured in urine.

**Other tests for malabsorption**

Other tests for intestinal malabsorption are usually confined to research institutions but may become accessible in general practice.

Most rely on tests of carbohydrate malabsorption by detecting levels of hydrogen in expired air after the feeding of a carbohydrate meal or a carbohydrate test substance like D-xylose. Normal mammalian cells do not metabolise carbohydrate to release hydrogen, though bacteria within the gut do. Thus increases in the amount of hydrogen absorbed and expired may reflect either an overgrowth of bacteria, or a lack of intestinal carbohydrate absorption allowing an increased amount of carbohydrate substrate to be utilised by the intestinal bacteria. This may be helpful in the diagnosis of intestinal malabsorption or of SIBO.

Another test which is becoming commercially available is the α-1 protease inhibitor (α-1-PI) test as an assay for protein-losing enteropathy. α-1-PI has a molecular weight comparable with albumin and thus is lost into the intestinal lumen in amounts parallelling those of albumin in protein-losing
enteropathies. However unlike albumin, it is not further degraded by luminal bacteria and thus offers the possibility of detecting PLE on a single faecal sample. This test is somewhat limited by expense and the need to send frozen faecal samples to the USA.

Differential sugar permeability tests can be used to assess the integrity of the absorptive capacity of the small intestine. These tests utilise usually one small sugar (such as rhamnose, arabinose) whose absorption is decreased by a reduction in absorptive surface area (eg by villous atrophy) and one large sugar (such as Lactulose or raffinose) whose absorption is increased by disruption of mucosal tight cell junctions. Thus altered mucosal function results in increased ratios of large sugar / small sugar detected in blood samples after oral administration. These tests may provide useful objective criteria by which to assess function but they are not generally helpful in answering the question 'what is causing the GI signs in this patient?'.

**DIAGNOSTIC TESTS FOR HEPATOBILIARY DISEASE**

**Enzymatic tests**

**Alanine aminotransferase (ALT)**

ALT is an enzyme found within the intracellular cytosol of hepatocytes and is considered liver-specific in dogs and cats. Raises usually reflect damage to hepatocytes and cytosolic enzyme leakage. Levels indicate the number of damaged hepatocytes but offer little information regarding specific diagnosis and prognosis, though the latter can be inferred by serially monitoring ALT levels which should gradually return to normal after an acute, self-limiting hepaticellular insult. Levels of ALT may be raised by corticosteroids and also mild raises (2-3 times the upper normal range) may be seen with non-hepatic disease causing 'secondary reactive hepatopathy' such as intestinal inflammation or sepsis. In general less marked raises in ALT in the cat may reflect more severe hepatocellular injuries than corresponding magnitudes of change in the dog.

**Aspartate aminotransferase (AST)**

AST is not liver-specific in the dog or cat being found in a variety of tissues. In hepatocellular injury, raises do however often parallel those seen in ALT. Much intracellular AST within the hepatocytes is bound to mitochondria prompting speculation that raises in AST may reflect more severe hepatocellular injury. The test, however, appears to offer few advantages over ALT assays.

**Alkaline phosphatase (ALKP, SAP)**

ALKP is a membrane-bound enzyme which is found in hepatocytes and also in biliary epithelial cells. ALKP is found in a number of tissues but with the exception of bone, the half-life of ALKP found in extrahepatic sites is too short to be clinically significant. Raises in ALKP usually reflect intra- or extra-hepatic cholestasis. The importance of two additional forms of ALKP (isoenzymes), the steroid- and
bone-isoenzymes should always be borne in mind when interpreting abnormal results. The bone-isoenzyme may cause mild to moderate elevation in ALKP in animals which are growing or which have destructive bone disease. Steroid-induced raises in ALKP are usually seen with any exogenous corticosteroid administration and may be dramatic. It should also be remembered that endogenous corticosteroid may also cause significant raises as may certain anticonvulsant drugs. The half life of ALKP in cats is significantly shorter than that of dogs and even mild elevations are more significant in feline patients.

**Gamma glutamyltransferase (GGT)**

GGT usually parallels changes seen in ALKP in the dog and does not appear to offer any significant advantages. In the cat however it may be a more sensitive, though less specific, marker for cholestatic disease. It may also be useful in the diagnosis of feline hepatic lipidosis in which, in contrast to most feline cholestatic disease, GGT does not usually become raised in parallel with ALKP. The mechanism for this is unknown.

**Bilirubin**

Total bilirubin levels reflect a balance between the release of haem-pigment from effete red blood cells, hepatocellular uptake, conjugation within the liver, and biliary excretion. Physiology of bilirubin metabolism is beyond the scope of this chapter. Essentially, rises in total bilirubin may reflect increased production overwhelming hepatocellular uptake (for example in massive haemolysis), reduced hepatocellular uptake due to hepatocellular dysfunction, or extrahepatic obstruction to biliary secretion. It is important to attempt to discern whether hyperbilirubinaemia (jaundice) is due to pre-, intra-, or extra-hepatic causes and this is usually achieved by a combination of haematological and biochemical testing and imaging of the liver and extrahepatic structures by ultrasound. Total bilirubin rarely, if ever, offers specific diagnostic information but is more an indication for further investigation. There is no diagnostic merit in determining the proportion of conjugated and unconjugated bilirubin ('Van den Bergh fractionation'). A low amount of bilirubin is a normal finding in the urine of dogs but is always abnormal in feline urine.

**Assessment of liver function**

Enzymatic tests may offer information about hepatocellular damage or cholestasis but offer no direct information about liver function. Function test may be divided into direct and indirect tests.

**Direct function tests - Bile Acid Stimulation Test**

The bile acid stimulation test (BAST) relies on assessing the integrity of the entero-hepatic circulation of bile acids. These are synthesised from cholesterol within the liver and are secreted via the biliary
system into the intestine where they are later reabsorbed within the ileum and recycled to the liver via the portal circulation. Thus abnormal liver function resulting in a failure of adequate re-uptake, or mixing of the hepatic portal circulation with the systemic circulation (as is seen with portosystemic shunting) will result in raises in serum bile acids. Serum levels are assessed after a 12 hour fast and again 2 hours after feeding (which should stimulate gall bladder contraction and thus bile acid release). The greatest magnitudes of rise are usually seen in portosystemic shunts though abnormal results do not usually offer specific diagnostic information other than the presence of abnormal hepatocellular function or of abnormal portal circulation. Abnormal BAST results are most productively followed up by liver biopsy. A problem with interpretation arises in cases where BAST results fall outside the laboratory reference range (which may be too narrow in some cases) but is not sufficiently high to be convincing of hepatocellular dysfunction for instance where results lie within the 15-50 umol/l range. This is a somewhat 'grey area' of interpretation and other evidence of hepatic dysfunction should probably be sought before liver biopsies are undertaken.

**Indirect evidence of hepatocellular dysfunction**

Decreases in albumin, cholesterol and urea may all be seen in hepatic dysfunction due to failures in synthesis. Glucose levels may also be subnormal. All of these are somewhat ominous findings if accompanied by direct evidence of hepatocellular dysfunction as their production is usually well preserved until hepatic dysfunction is advanced and hepatic failure is imminent.

**Serum ammonia levels**

Ammonia levels may be assayed in cases of suspected hepatic encephalopathy (HE) due to portosystemic shunting or severe hepatocellular dysfunction since it is the one toxin associated with HE that can be biochemically evaluated routinely. However samples should be assayed within 1 hour of collection and should be kept on ice. Red blood cells and muscle contain large amounts of ammonia and any haemolysis or recent muscular activity may falsely raise levels. Any abnormal results should be interpreted cautiously.

**FURTHER DIAGNOSTIC TESTS FOR THE ASSESSMENT OF GASTROINTESTINAL AND HEPATOCELLULAR DISEASE**

**DIAGNOSTIC IMAGING**

Imaging studies using radiography with or without the use of radiographic contrast agents such as barium or barium-impregnated polyspheres may offer further information as may ultrasonographic determination of normal intestinal 'layering' and thickness. Fraser will discuss diagnostic imaging in
greater detail in his notes. However, there are several areas of diagnostic imaging which I feel that from a ‘medical perspective’ bear emphasis

- I use diagnostic imaging findings to help me, as far as possible, exclude the impact of extra-intestinal disease on vomiting and diarrhoea when it is combined with laboratory assessments. It is particularly helpful in excluding
  - Gross structural GI disease (eg congenital pericardio-peritoneal diaphragmatic hernia)
  - Obstructive GI disease
  - Obvious neoplasia
  - Obvious pancreatitis
  - Obvious disease of the biliary tract
- The vast majority of dogs and cats I see with chronic vomiting and diarrhoea have no convincing abnormalities on radiography or ultrasonography. However, it is still an important and logical step to pursue, as it cases where such abnormalities exist, the course of investigation (eg endoscopic versus surgical evaluation) can be entirely changed by the finding
- Ultrasonography is a very mixed blessing to the internal medic. In the hands of excellent diagnostic imagers using excellent equipment, ultrasound examination of the GI tract and structures adjacent to it is a powerful diagnostic tool. Cases of pancreatitis, pancreatic abscessation, distal small intestinal tumours, mesenteric lymphadenomegaly and cholelithiasis are now diagnosed with reasonable ease by such individuals. However, as resolution of ultrasound becomes better and as more diagnostic imagers get involved with the murky world of GI diagnostics, there is a tendency to read an awful lot into ‘abnormalities’ which may be artefacts caused by greater equipment and imaging standards. Examples of this would include the interpretation of intestinal wall thickness, stippling / striping and duplex Doppler flow characteristics of bowel segments in attempts to differentiate causes of diarrhoea in dogs or cats. Such investigations hold allure but, if you’ll pardon the pun, GI ultrasound is seldom black and white, just shades of grey! No internist would consider ultrasound presently capable of differentiating between lymphangiectasia and IBD, dietary intolerance from antibiotic responsive diarrhoea when we cannot do this with histopathological examination. Imaging findings must be kept in context – they are only part of the puzzle and like any diagnostic test should only be undertaken to answer a clinical question, not as a ‘fishing expedition’.
- I don’t do many contrast studies – good endoscopy has reduced the need for this. Where contrast studies are done
  - Beware that false positive diagnoses for filling defects are common
  - Assessment of ‘GI motility’ by these methods is very crude
I, like many internists, am wary of BIPS. Their simplicity holds allure but I became rather disillusioned with them some time ago due to the rate of false positive diagnosis of apparently obstructive disease where focal functional bowel abnormalities are present and the lack of specificity of findings with them.

G.I. ENDOSCOPY

KEY POINTS

- To do endoscopy well you need to be doing it frequently, invest in decent equipment and most importantly maintain this well. Unless you have a high GI case-load in your practice you may find this is uneconomical.

- There is only one way, in my view, to get good at endoscopy and that is to train with an individual who is skilled at it – these skills do not develop quickly. I usually reckon on residents taking about a year of very frequent exposure to endoscopy before they begin to develop some confidence and aptitude at it.

- Endoscopy has many limitations
  - If you can’t see an area, you can’t tell there isn’t a lesion there
    - Blind spots
    - Areas covered by fluid / faecal matter / blood / food
    - Areas beyond reach of the endoscope
  - Overinterpretation of normal variation by inexperienced operators is frequent and is remedied by gaining experience.
  - Biopsies procured
    - Are tiny
    - Are superficial
    - May not be representative
    - In the presence of mucosal oedema may be useless.

INDICATIONS

- Oesophagus
  - Diagnostic
    - Evaluation of strictures
    - Evaluation of oesophagitis
    - Evaluation of hiatal hernia (take care – this can be very intermittent)
    - Evaluation of oesophageal tumours (rare)
    - Note that endoscopy is not useful in diagnosing megaoesophagus or oesophageal dysmotility and care should be taken to balance the risk of
aspiration pneumonia with anaesthesia for endoscopy in dysphagic patients versus expected diagnostic gain (usually little!)

- Therapeutic
  - Retrieval of foreign bodies
  - Performing balloon dilatation of strictures

O Stomach
  - Diagnostic
    - Evaluation for vomiting / haematemesis
    - Diagnosis of mass lesions, polyps, foreign bodies
    - Collection of gastric biopsies
  - Therapeutic
    - Retrieval of foreign bodies
    - Placement of PEG tube
    - Guidance of PEG-jejunostomy or nasojejunostomy tube
    - Removal of polyps

O Small intestine
  - Diagnostic
    - Evaluation of small intestinal diarrhoea
    - Evaluation of haematemesis
    - Collection of biopsies
    - Performance of ERCP
  - Therapeutic
    - Few indications

O Large intestine
  - Diagnostic
    - Evaluation of large bowel diarrhoea
    - Evaluation of ileocolic junction and caecum
    - Evaluation of distal small intestine by retrograde intubation of ileum
    - Evaluation of dychezia, haematochezia

EQUIPMENT

O Endoscope types
  - Rigid endoscopes may be used for oesophagoscopy and proctoscopy but are unwieldy, risk iatrogenic damage if injudiciously used and do not allow thorough examination of distal structures
  - Flexible endoscopes
Essentially 2 types

- Fibreoptic (‘fibrescope’) – have a coherent bundle of fibreoptic tubes which transmit image from distal tip to eyepiece
  - Are cheaper
  - Generally come in a wide variety of sizes down to scopes small enough to perform cystoscopy
  - Are very prone to damage to fibres causing breakage (black dots on image) – these cannot be replaced. When buying a second hand fibrescope this is an important consideration and negotiating point!
  - May be adapted by attaching a camera to the eyepiece to allow for better image quality and magnification

- Videoscopes
  - Have a CCD (charge-coupled device) unit at tip (‘chip at the tip’) which converts images into electrical signal transmitted to video processor unit
  - Are very expensive (expect to pay a few thousand for an entry-level veterinary scope, decent models of Olympus / Pentax / Fujinon can be £16K - £30K!)
  - Are more resistant to damage
  - Are easier to use providing superior image quality
  - Generally size limited

- A new generation of HD scopes is now available but these are eye-wateringly expensive at present. Additionally a number of ‘hybrid’ scopes are also available

- Parts of an endoscope
Components of endoscopy may include

- An **endoscope** either fibrescope or video-
- A **light source** and air source to illuminate what you see and to insufflate hollow structures that collapse (like the gastrointestinal tract) so you can see what you’re doing. Most light sources have an integrated air-pump
- An **image processor** which turns images from a videoscope CCD chip or the camera attached to a fibrescope to a picture that can be seen on a monitor
- A **monitor**
- A **suction unit and water supply** so the endoscope can be washed and so secretions, fluid and air can be removed
- A **printer** so you can record what you saw or video capture device / DVD storage
- Of these a good light source, an air-pump and water supply / suction unit are all essential – video capture and other bells and whistles are nice but not essential

**Things to look for in a scope**

- Scope type
  - Fibrescope (plus or minus video attachment) versus video
- Outer diameter of insertion tube
  - This depends on what patient size you are looking to scope – the limiting factor in most cases is intubation of the duodenum
  - Be careful – some scope manufacturers quote ‘minimum’ outer diameter when their scopes have a wider diameter at the angulating tip than the rest of the
insertion tube – the minimum diameter is irrelevant to you, it is the maximum you want to know

- Working length
  - Most scopes range from 80cm – 200cm. The working length is the insertion tube length – important if you are scoping a great Dane but also other deep-chested dogs like Irish setters

- Working channel
  - You need a channel to take biopsies, place graspers and other tools – is it big enough? The bigger the scope the bigger the channel, the bigger and better the biopsies you will get
  - The diameter of this (in mm) and the working length is what determines what instruments you can put down it

- Tip angulation
  - A tip that angulates in two directions is OK for bronchoscopy but is not sufficient for GI endoscopy – you must have 4-way angulation. In at least one of these directions you must be able to angulate the tip back 180° back on itself. Most scopes have 4-way deflection of 100-120° in 3 directions and 180° in the other – do not buy a second hand scope that cannot be angulated in this way unless it is really an unmissible bargain as it may well be a false economy!

- Service, repair and replacement
  - You get what you pay for with this
  - If you want large warranties, courier collection of scopes and instant replacements use Keymed / Olympus and expect to pay enormous amounts for scopes – if you want cheaper veterinary scopes expect that the service will not be as fast or as thorough

- What scope do I need?
  - Different scopes for different jobs – no one scope is suitable for all animals and all jobs
  - Need to assess what patients you are going to be scoping
    - Cats and very small dogs
      - You will find it hard to intubate the duodenum of small cats with any scope with an outer diameter greater than 7.9mm
      - It is easier to find scopes of this diameter or less that are fibrescopes unless you have seriously big buck to spend on newer videoscopes (can get down to about 5-6mm outer diameter but expect to pay £25K for these)
        - The market in second hand paediatric gastrosopes is fierce and there is a lot of dross out there, especially scopes with lots of broken fibres / poor angulation
If you can find one, an Olympus XP-10 or XP-20 are good workhorse fibrescopes for cats and can be adapted with video camera attachments to make scoping easier

- Length is less important though >80cm should be looked for
  - Medium to giant dogs
    - Need good length, preferably >150cm for big dogs
    - Can accommodate quite large diameters

Storage and maintenance

- Having scopes is an expensive past time
- Preferably have somewhere to hang them to dry after cleaning and somewhere warm and dry to store hanging up – purpose-built scope cabinets are ideal but are ludicrously expensive
- Can store in cases but make sure are thoroughly dry before packing away and realise that some curvature may develop
- Similarly forceps and other accessories are best stored hanging on racks (purpose build ones again are expensive for what they are!)
- Scopes should be thoroughly cleaned, disinfected and sterilised between patients – this is time consuming and takes up space and personnel time. Regular microbiological monitoring should also be considered best practice and is also expensive and should be factored in for client charging
- Biopsy forceps and instruments are designed for limited uses – they can be re-sterilised but will quickly lose their sharpness and should be regularly replaced.
TECHNIQUE

Tips

- Before doing endoscopy
  - Consider are clinical signs upper GIT, lower GIT or both i.e. where are you needing to scope
  - Check equipment before anaesthetising patient
  - Consider diagnostic imaging first
    - Guides endoscopy
    - Once you have insufflated air you will create artefacts / make ultrasound difficult
- Proper patient preparation is essential especially for lower GI tract endoscopy
- Always record your findings – we use a standardised sheet to record all endoscopic procedures so that we can compare findings if we have to re-scope animals
- Watch out for blind spots
  - Areas where you may miss lesions because of the direction the scope is facing
  - ‘pink out’ when the lumen is collapsed or the scope rests against the mucosal surface
  - Areas covered in food, blood, faeces, liquid etc
- Always take biopsies even if you see nothing abnormal
- Get as far as you can to begin with, then evaluate ‘on the way back’
- Practice and if possible try and get training from someone who is an experienced endoscopist – in practice this is difficult – courses designed to teach endoscopy are good but use cadavers which may not be realistic – there is also a real limit to what you can learn in one day. Endoscopy takes time to learn and no individual will be doing so many scopes in one day that you will realistically be able to go and see ‘endoscopy’ practice with them

Upper GI tract

- Preparation
  - GA, mouth gag, assistant monitoring, including ECG
  - Patient in left lateral recumbency (unless you are putting in a PEG)
- Oesophagus
  - Blind spot as enter through cricopharyngeal sphincter
  - Insufflate with air (may need to manually occlude proximal oesophagus around scope in large dogs)
  - Suction any fluid away to give good view and prevent aspiration
  - Examine for abnormalities and examine lower oesophageal sphincter (LOS)
  - Be careful not to overinterpret
    - Normal change in mucosal appearance of distal 1-2 cm prior to LOS
- Presence of pigment islands in distal oesophagus of pigmented dogs like Chow Chows (I've had these before referred for oesophagitis when they are normal)
- Normal herring-bone appearance of feline oesophagus
- You cannot diagnose oesophageal dysmotility / megaoesophagus routinely by endoscopy (though in the latter the oesophagus often appears baggy and fluid-containing)
  - Biopsies seldom useful unless of a specific lesion as normal mucosa is of thin layer of cornified stratified squamous epithelium and tends to ‘shred’ off in rather useless flaps
- Stomach
  - 3 key points
    - Once the stomach is entered, don’t hang around – go straight to the pylorus as fast as you can because it gets progressively more fiddly to intubate the longer you dally in the stomach
    - Don’t over inflate with gas – this will cause paradoxical movement of the endoscope (sic) and make the duodenum difficult to intubate
    - When you enter the stomach you will glide past the fundic recess and won’t see the gastric side of the LOS. This is like walking into a room oblivious to someone hiding behind the door – it is essential to evaluate these large blind spots on the way out.
  - The stomach can be disorientating – the major landmark is the angularis incisura – the sharp bend of the lesser curvature before entering the pyloric antrum. If you get lost – retroflex the scope so you can see yourself entering through the cardia and then let the scope ‘relax’ back into a neutral position – you will usually be facing the angularis
- When intubating the duodenum
  - Get yourself properly aligned and inch forward adjusting controls to keep the sphincter lumen within the centre of the screen all the time
  - Apply steady but not excessive forward pressure
  - Application of suction and tilting the hand holding the handpiece outwards (if you are right handed this is usually your left hand – roll it away from you) as you engage the sphincter directs the scope into the pyloric canal
  - You will lose vision (‘pink out’) when you are in the canal but you should appreciate a grainy / darker pink texture to the blurred image if you are in the duodenum
  - Once you are well engaged, apply insufflations and allow the scope to return to a neutral position – the duodenal lumen should become visible – you can tell it is duodenum because the surface is ‘velvety’ in appearance compared with the smooth gastric mucosa and you may see villi
Evaluate and take biopsies of the stomach after you have examined the duodenum and taken biopsies – do not spend time in the stomach before hand or you will find duodenal intubation difficult.

When examining the stomach evaluate (and record your findings!)

- Pylorus
  - And spend time just looking at it for signs of duodenal-gastric intussusceptions
  - Reflux of bile through it is a normal finding in many dogs and cats and does not equal 'reflux gastritis'!

- Antrum
- Body of stomach including lesser and greater curvature
- Fundus, fundic recess and cardia
  - These can only be evaluated by retroflexing the scope and in the case of the fundic recess it is usually necessary to contort yourself a little and, with the scope fully retroflexed, rotate it through 180° longitudinally so that the fundic recess is seen – you may have to suction fluid from this area
  - Do not neglect to image this area – in my experience it is common for occasional endoscopists to miss lesions in this area through not appreciating that it is a blind spot. In some cases this has lead to tumours or foreign bodies being missed and very angry clients who are justifiably aggrieved at having paid a great deal of money for incomplete procedures.

When taking biopsies

- The antrum is usually not a great place – antral mucosa is incredibly tough and you will often find that biopsies taken from here are tiny and shredded
- The lesser curvature is usually best – with a moderate degree of insufflations you can orientate this so that it is highly convex – this allows your biopsy forceps, if orientated perpendicular and at right angles to the longitudinal fold, to engage deeply gaining good submucosal biopsies
- You will find that the stomach mucosa is much more elastic than the duodenal mucosa and requires a sharp tug to free – sharp biopsy forceps are essential!

It is important to bear in mind the relationship between apparent mucosal thickness and degree of luminal distension with air – if you feel that a mass lesion is present – insufflate the area and see if it disappears – grossly thickened –looking rugal folds will often actually turn out to be nothing of the sort when this is done. You can also give structures a gentle prod with the biopsy forceps to appreciate if they are just adherent artefact (eg food particles) or attached and how solid they are. Beware indentation by the spleen which sometimes gives an odd mass-effect.
Duodenum

- You should be able to intubate the duodenum every time in cats and dogs – if you are not doing this the endoscopic examination should not be considered complete and you should consider further practice.

- Normal structures visible will include:
  - Major and minor duodenal papillae in dogs, single major duodenal papilla inmost cats.
  - Peyer's patches – these appear as well circumscribed depressions on the antimesenteric border of the duodenum – approximately half a dozen are generally seen – do not biopsy these areas as they are lymphocyte rich and may lead to false positive diagnoses of lymphocytic infiltration or worse, lymphoma.
  - Villi

- Abnormalities include:
  - Increased friability, erythema, ulceration, granularity, frequent distended villous lacteals (look like ‘golf-balls on a driving range’), tumours, parasites.
  
  *Note that gross appearance of the intestinal lumen has been shown to correlate very poorly with actual histopathologic diagnosis and it is common for people inexperienced with endoscopy to ‘over-read’ normal variation within the luminal appearance.*

  - The normal duodenal mucosa is quite friable and some ‘scope damage’ often occurs during proximal intubation – do not overinterpret fresh' linear striations – these are usually iatrogenic.

- In most large dog only the caudal duodenal flexure can be reached – this is a good place to take biopsies as the lumen curves away from you forming a nice convex surface from which to take deep biopsies. In cats and small dogs the proximal jejunum may be reached.

- NB – a major limitation of endoscopy is access – the duodenum represents around 10% of the small intestine i.e. 90% is generally inaccessible to the endoscopist. You must bear this in mind when it comes to diagnostic accuracy especially with distal small intestinal disease.

Lower GI tract

- In patients with haematochezia / dychezia a thorough rectal examination should **ALWAYS** precede endoscopy – you will not detect very distal rectal masses or perineal hernia with an endoscope as there is an area of ‘blindness’ when you enter the rectum. I have lost count of the number of dogs I have seen that have had endoscopy performed at great expense and with no diagnostic yield when had the clinician performed a simple rectal examination a diagnosis would have been instantly made!
If you are going to evaluate lower GI tract you need to prepare patient properly – if you just see faecal matter through improper preparation you will miss lesions and this is medically negligent

- Patient must be starved at least 24-36hrs
- Give bowel preparation by
  - Oral cleansing laxatives eg Klean Prep
  - Giving enemas
  - Our regimen is
    - that during the 24-36 hours before large bowel endoscopy we will give 3 x Klean prep by orogastric intubation in dogs or nasogastric intubation in cats – an amount of 20-30ml/kg per dose is used (this always seems like a huge amount!)
    - patients are walked very frequently or allowed access to an outside run – if you do not have the facility to do this you may find it impossible to adequately cleanse dogs as they will ‘hold on’ to it in the kennel!
    - Large dogs also receive 1-2 Fletcher’s enemas around 6-12 hours prior to procedure
    - Small dogs and cats are administered klean prep per rectum via soft red rubber tube
    - Patients are monitored for dehydration, patients with history of protracted explosive diarrhoea are placed on intravenous fluid therapy
    - Patients are ‘ready’ for endoscopy when they are passing translucent watery diarrhoea with no lumps! If they are still passing solid faecal matter don’t bother doing the endoscopy – it will be a waste of time
      - Alternatively some individuals advocate ‘washing out the colon’ under GA at the time of endoscopy by repeated irrigation – this is very time consuming, adds to anaesthetic time and risk of hypothermia and does not, in my experience, lead to as good visualisation as the above preparation regimen. I will generally only do this in extremely aggressive animals where there is no other option.

When examining the lower GI tract evaluate

- Descending, transverse and ascending colon – steering around the proximal and distal colonic flexure can be tricky but gets easier with experience – you may loose some vision going around these bends so evaluate them again on the way out
- The ileo-colic valve
  - This is highly variable in appearance – it may appear as an offset simple opening in the colon, more usually it is prominent and puckered and may look like a sea anemone / mushroom. It may be mistaken for a mass lesion by inexperienced
  - Sometimes the valve may be missed altogether if it is covered with liquid or is tightly recessed – usually in this situation you will pass the scope directly into the caecum inadvertently which becomes obvious as you can’t go any further – the
caecum usually has much more prominent submucosal vascularity than the colon.

- The caecum
  - Often contains nothing very exciting but is a popular place for whipworms to hang-out so always examine this area

- Distal ileum
  - In about 50% of dogs the distal ileum can be accessed with practice – intubation technique is similar to the duodenum

**DIETARY EXCLUSION TRIALS**

Properly constructed and adhered-to dietary exclusion trials and re-challenges are time-consuming and expensive but remain the only suitable diagnostic test for the evaluation of dietary intolerances; blood ‘allergy-tests’ currently marketed are not specific enough to be diagnostically useful. Dietary exclusion trials should be performed for about 8-12 weeks. Realistically owners will generally be non-compliant if improvement is not seen within 8 weeks

**HISTOPATHOLOGY**

Ultimately, however, all of these diagnostic endeavours seldom lead to a specific diagnosis and evaluation of pathological material by a veterinary pathologist is often required for a definitive diagnosis to be made. Note that the interpretation of biopsy specimens is problematic and depends on:

- the quality of the specimens provided
- whether these are representative of the affected portion of GI tract
- the experience of the pathologist

It is a truism that rarely do pathologists look at a GI tract specimen and say ‘this is normal tissue’. Most pathology reports will include references to ‘lymphoplasmacytic infiltration’ or similar – **this is not the same as a diagnosis of inflammatory bowel disease**! The mindful clinician should accept that IBD is not a diagnosis made by finding inflammatory changes on a gut biopsy – it is a clinical diagnosis that can only be made by logical problem solving, attention to serially ruling out differential diagnoses and ultimately by response to therapy. The gut has a limited ‘pathological repertoire’ of how to respond to any insult and inflammation is the main one of these. Another diagnostic cul-de-sac to steer away from is the fact that many pathologists will equate finding eosinophilic inflammation with a dietary intolerance / allergy. Again this is over-interpretation which must be guarded against – IBD will
just as often be associated with eosinophilic inflammation as will conditions where a dietary response is seen.

As a general rule we take changes in mucosal architecture (villous blunting, fusion, erosion) providing that biopsies are well orientated, as far greater evidence of genuine intestinal disease than a simple description 'lymphoplasmacytic infiltration'.
APPRAOCH TO VOMITING

KEY POINTS
- always assess the global state of health of vomiting dogs and cats especially
  - cardiovascular system for signs of interstitial / intravascular fluid loss
  - signs of depression out of keeping with severity of vomiting
    - dehydration
    - sepsis
    - perforation
    - GI blood loss
- electrolyte / acid-base disturbances especially profound hypokalaemia, hypochloridaemia, severe metabolic alkalosis / acidosis
- vomiting associated with anorexia / weight loss
- warning bells
  - evidence of shock (compensatory Vs decompensatory)
  - vomiting large volumes of fresh / changes blood
  - vomiting + abdominal distension
  - vomiting plus abdominal pain
- vomiting and anorexia in older collies and collie X, especially Bearded and Rough – high incidence of gastric carcinoma
- true faecal vomiting – nearly always a sign of complete lower SI or LI obstruction
- true projectile vomiting – often associated with true gastric vomiting due to pyloric obstruction and may results in spectacular hypochloridaemia and metabolic alkalosis
- vomiting accompanied by azotaemia which always responds spectacularly to fluids – rule out hypoadrenocorticism

PATHOPHYSIOLOGY OF VOMITING

Mechanical events during vomiting
- >vomiting is a reflex pathway and a natural protective mechanism versus the potentially deleterious effects of toxin ingestion
includes prodromal signs of nausea, depression, anxiety, shivering, hiding, yawning, licking, ptyalism hypersalivation
induces repeated reflex swallowing which produces relaxation of gastrooesophageal sphincter in preparation for ejection of gastric contents

- salivary bicarbonate may help neutralise gastric acid prior to vomiting

- prior to vomiting small intestinal relaxation occurs followed by retrograde giant contractions (RGCs) within the small intestine which empties some SI contents into stomach (?again to neutralise gastric pH?), then SI intestinal motility is again inhibited -> retching begins with onset of the RGC

- forceful contractions of the abdominal muscles and the diaphragm with the glottis closed - leads to large increases in intra-abdominal pressure -^disordered and then retrograde antral contractions follow and motility is inhibited in the body of the stomach causing relaxation ^relaxation of gastrooesophageal sphincter, pharyngoesophageal sphincter and oesophageal body

- vagally mediated contraction of the longitudinal muscles of the oesophagus results in G-O sphincter being pulled from the intra-abdominal (high external pressure) position to the intrathoracic (low pressure) position and aids relaxation
  - driving force for vomition is abdominal musculature and diaphragm NOT stomach and small intestine which cannot generate enough inertia

- as vomitus passes through pharyngeal cavity, glottis and nasopharynx are closed to prevent aspiration and nasal reflux

**Physiology of vomiting**

- several components to vomiting apparatus
  - visceral receptors
  - vagal and sympathetic afferents
  - vagal efferents
  - the Chemoreceptor Trigger Zone (CRTZ) in the area postrema (floor of the 4th ventricle astride the opening of the spinal canal)
  - the vomiting centre within the reticular formation of the medulla oblongata

- vomiting is mediated through
  - humoral mechanisms - blood-borne emetic agents reaching the CRTZ
  - neural mechanisms - stimulation of the vomiting centre by CRTZ, vaso-sympathetic afferents, vestibular afferents
PHARMACOLOGY AND PHARMACOLOGICAL MANIPULATION OF VOMITING

- Pharmacological manipulation is aimed at using receptor antagonists at different points in the vomiting pathway.
- Most is known about neurotransmitter/receptor interactions in the CRTZ; therefore, most knowledge concerns humorally mediated emetic factors e.g., drugs, uraemia, toxins, etc.
- Manipulation of the VC probably more useful.

Neurotransmission in the CRTZ

- Several neurotransmitters are involved:

<table>
<thead>
<tr>
<th>Transmitter</th>
<th>Receptor</th>
<th>Degradative Enzyme</th>
</tr>
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<tbody>
<tr>
<td>Dopamine</td>
<td>D2-dopaminergic</td>
<td>DOPA decarboxylase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dopamine beta-hydroxylase</td>
</tr>
<tr>
<td>Noradrenaline</td>
<td>α2-adrenergic</td>
<td></td>
</tr>
<tr>
<td>5-hydroxytryptamine</td>
<td>5HT-3 serotonergic</td>
<td>5HT decarboxylase</td>
</tr>
<tr>
<td>(5HT, serotonin)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetylcholine</td>
<td>M1-cholinergic</td>
<td>Choline acetyltransferase</td>
</tr>
<tr>
<td>Histamine</td>
<td>H1and 2 histaminergic</td>
<td>Histidine decarboxylase</td>
</tr>
<tr>
<td>Enkephalins</td>
<td>ENKμ + δ</td>
<td>Enkephalinase</td>
</tr>
</tbody>
</table>

- Several interspecies differences exist.
  - Apomorphine (D2-agonist) is a powerful emetic in the dog but ineffective in cats.
Neurotransmission in the vomiting centre
- 5HT1a and α2 receptors are the only documented
- 5HT1a receptor antagonists can inhibit motion sickness
- α2 receptors (in vomiting centre and CRTZ) may be inhibited with α2 antagonists eg yohimbine, or α1/α2 antagonists (eg chlorpromazine, prochlorpromazine)
- most anti-emetic effect is probably from CRTZ α2 antagonism

Neurotransmission in the vestibular apparatus
- acetylcholine and M1-muscarinic receptors seem to mediate motion sickness
- mixed M1/M2 antagonists such as atropine and scopolamine may inhibit motion-sickness induced emesis but usually cause ileus and delayed gastric emptying
- pirenzepine a pure M1 antagonist is probably best in dogs and cats

Neurotransmission in the cerebral cortex
- mainly a problem in people undergoing chemotherapy and developing anticipatory emesis
- opioids and benzodiazepines can help

Neurotransmission in GIT efferents
- emesis induced by ingested toxins, cell degeneration, luminal distension, inflammation, chemotherapy
- 5HT3 receptors most important
- cytotoxic agents can cause 5HT3 release from enterochromaffin cells in the gut activating vagal afferent fibres by binding to 5ht3 receptors
- ondansetron is the best 5HT3 antagonist in these cases; metoclopramide has some 5HT3 antagonism but it is poorly effective in cases of chemotherapy-induced emesis

Neurotransmission in vagal efferents
- vagal efferents and myenteric neurones mediate the excitation and relaxation of GI smooth muscle that results in the act of vomition
- main receptors involved are D2, 5HT4, M2 and motilin
- metoclopramide’s ability to stimulate gastric emptying is thought to arise from D2 antagonism
- 5HT3 antagonists also increase gastric emptying but only because they stimulate 5HT4
- cisapride works in this way
- gastric emptying is also stimulated by motilin which is periodically released from GI endocrine cells - initiates phase II of migrating myoelectric complexes and facilitates gastric emptying during fasted state
- low dose erythromycin can stimulate this effect

Classification of antiemetic drugs

<table>
<thead>
<tr>
<th>Classification</th>
<th>Examples</th>
<th>Anatomic site of action</th>
<th>Side effects</th>
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</thead>
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<tr>
<td>α2 adrenergic antagonists</td>
<td>PROCHLORPERAZINE</td>
<td>CRTZ, vomiting centre</td>
<td>hypotens., sed.</td>
</tr>
<tr>
<td></td>
<td>CHLORPROMAZINE</td>
<td>CRTZ, vomiting centre</td>
<td>hypotens., sed.</td>
</tr>
<tr>
<td></td>
<td>YOHIMBINE</td>
<td>CRTZ, vomiting centre</td>
<td>hypotens., sed.</td>
</tr>
<tr>
<td>D2-dopaminergic antagonists</td>
<td>METOCLOPRAMIDE</td>
<td>CRTZ, GI smooth muscle</td>
<td>extrapyramidal signs</td>
</tr>
<tr>
<td></td>
<td>DOMPERIDONE</td>
<td>GI smooth muscle</td>
<td>none</td>
</tr>
<tr>
<td>Category</td>
<td>Drugs</td>
<td>Effects</td>
<td></td>
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<tr>
<td>H1-histaminergic antagonists</td>
<td>HALOPERIDOL, CHLORPROMAZINE, PROCHLORPERAZINE</td>
<td>CRTZ, sedation</td>
<td></td>
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<tr>
<td>M1-cholinergic antagonists</td>
<td>DIPHENHYDRAMINE, CHLORPROMAZINE, PROCHLORPERAZINE</td>
<td>CRTZ, vestibular, sedation, ileus xerostomia</td>
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<tr>
<td>5HT3-serotonergic antagonists</td>
<td>SCOPOLOMINE, PIRENZEPINE</td>
<td>CRTZ, vestibular, sedation, lip licking</td>
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<tr>
<td>5HT4-serotonergic agonists</td>
<td>ONDANSETRON, METOCLOPRAMIDE</td>
<td>CRTZ, vagal afferents, head-shaking</td>
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<tr>
<td>motilin agonists</td>
<td>CISAPRIDE</td>
<td>myenteric neurons</td>
<td></td>
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<tr>
<td>NK-1 antagonists</td>
<td>ERYTHROMYCIN</td>
<td>GI smooth muscle, vomiting at microbial</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MAROPITANT</td>
<td>vomiting centre, caution with cardiac</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>liver Dz and hypoalbuminaemia</td>
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</tbody>
</table>
CONSEQUENCES OF UNCONTROLLED VOMITING

ELECTROLYTE AND ACID-BASE DISTURBANCES

-> gastric secretions contain less sodium and more potassium and chloride than e/acellular fluid
-> secretion is isoosmotic and number of anions and cations is the same as ECF
-> when acid secretion in the stomach is high hydrogen and chloride levels within secretions are high and sodium is low; when secretion is low H and Cl are low and Na is high - nearly that of the ECF
-> upper small intestinal secretions have a composition similar to that of ECF except have more chloride and bicarbonate
-> acid-base disturbances vary according to the site of vomiting and the amount of acid being secreted

Uncomplicated vomiting
-> if vomiting gastric and duodenal contents, acidosis and dehydration result from loss of sodium and bicarbonate in SI
-> gastric acid secretion is usually low especially in anorexic animals
-> potassium losses are usually due to decreased intake and small amounts lost in gastric fluid - potassium loss in uncomplicated vomiting is much less than in true gastric vomiting
-> metabolic acidosis results from
  - lactic acidosis due to decreased tissue perfusion and anaerobic metabolism (increased anion gap)
  - GI bicarbonate losses from small intestine (normal anion gap)
-> treatment of choice is Lactated Ringers + moderately supplemented potassium

True gastric vomiting
-> usually results from gastric outflow obstruction or proximal duodenal obstruction
-> usually gastric acid secretion is normal or increased (very high in Zollinger-Ellison Syndrome)
-> principal losses are Hydrogen and chloride ions with eventual profound hypokalaemia
-> alkalosis is due to
  - hydrogen ion loss
  - chloride ion loss which stimulates bicarbonate resorption in the proximal renal tubule
  - ECF volume contraction leading to decreased filtered bicarbonate
  - aldosterone release due to ECF volume contraction which stimulates sodium resorption and potassium and hydrogen ion secretion
  - excretion of potassium ions to try to compensate for hydrogen ion loss causes worsening of hypokalaemia - chloride ions unavailable to secrete as partner ion and hydrogen ions are secreted instead worsening alkalosis
  - hypokalaemia stimulates renal ammonia production and bicarbonate production
-> sodium chloride plus aggressive potassium supplementation is necessary
GENERAL APPROACH TO THE CHRONICALLY VOMITING DOG

Key Points
- Distinguish vomiting from regurgitation early
- Consider systemic causes of vomiting (especially hypoadrenocorticism) and local abdominal disease (especially pancreatitis) as well as primary GI disease
- Some dogs may frequently vomit bile, first thing in the morning as a frustrating but entirely benign ‘chronic bilious vomiting syndrome’
- Corticosteroids are not a treatment for vomiting unless a diagnosis of IBD has been made

History
- Questions about appetite, weight and global health are essential
- Question nature of vomitus, confirm presence of abdominal heaving, timing after eating, presence / absence of blood and volume
- Very sticky clear fluid is often saliva pooled in the oesophagus rather than vomit
- Presence of bile suggests no pyloric obstruction
- Recent barbeques / other dietary indiscretion

Physical examination
- Described previously
## Differential diagnoses – canine vomiting

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<th>Local intra-abdominal disease</th>
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<td>Pancreatitis</td>
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<td>Renal failure</td>
<td>Hepatobiliary disease</td>
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<tr>
<td>Hepatobiliary disease / encephalopathy</td>
<td>Focal peritonitis, abscess, adhesion</td>
</tr>
<tr>
<td>Systemic mastocytosis</td>
<td>Steatitis</td>
</tr>
<tr>
<td>Drug administration</td>
<td>Diffuse neoplasia</td>
</tr>
<tr>
<td>Sepsis</td>
<td>Diaphragmatic hernia</td>
</tr>
<tr>
<td>Diabetic ketoacidosis</td>
<td>Torsion / entrapment of GI viscus</td>
</tr>
<tr>
<td>Drug therapy</td>
<td></td>
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<tr>
<td>Intoxication</td>
<td></td>
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<tr>
<td>Neurological disease especially affecting vestibular system</td>
<td></td>
</tr>
</tbody>
</table>

## Primary gastrointestinal disease

- regurgitation mistaken for vomiting

### Gastric disease

- infectious
  - bacterial – ?Helicobacter-like organisms (debatable whether cause gastric disease)
  - viral eg parvovirus
  - protozoal
  - parasitic – *Physaloptera spp*
  - foreign body
  - neoplasia – single massive or diffuse (eg lymphoma)
  - polyps
  - gastric ulcers
  - pyloric stenosis / antral hypertrophy
  - chronic gastritis
  - dietary intolerance
  - gastrinoma-ulceration syndrome
  - glutony
  - motility disorders
  - drug intolerance / side effects

### Small intestinal disease

- infectious
  - bacterial (?SIBO / ARD)
  - viral
  - protozoal eg giardia
  - parasitic
  - foreign body
  - neoplasia
  - polyps
  - ulceration
  - intussusception
  - mechanical or functional ileus
  - inflammatory bowel disease
  - diverticular disease
  - large intestinal disease
  - vomiting sometimes seen with colitis / obstipation, IBD

## Diagnostic approach

- assess first
  - state of dehydration
  - no acute abdomen likely
  - acid-base / electrolyte disturbances especially hypokalaemia, hypochloraemia, alkalosis
  - whether fluid therapy should be an early priority

- rule out hypoadrenocorticism as early as you can – remember that 10% will have no electrolyte disturbances. ACTH stim test is very sensitive and specific.

- bloods to explore evidence of uraemia, encephalopathy, causes or consequence of vomiting?
  Beware azotaemia – may reflect hypovolaemia and in hypoadrenocorticism urinary
concentration may be poor (lack of sodium in renal medullary interstitium) so SG may be isos- or even hyposthenuric. Raised urea may be due to GI bleed

- consider pancreatitis (see earlier)
- imaging
  - radiography
  - ultrasonography
  - contrast studies rarely indicate now in vomiting – replaced by good quality endoscopy

- endoscopy
  - stabilise patient first
  - may have to withhold food longer in patients with gastric outflow obstruction

- endoscopy tips:
  - practice, practice, practice
  - use one pathologist and stick with them – develop a consistent working relationship
  - GI pathology is very subjective
  - first goal is to intubate the duodenum (always examine the duodenum even if you are sure that the stomach is the source of the problem) – intubation gets progressively more difficult with time!
  - then view everything as you come back out
  - do not endoscope without biopsying, EVER!
  - spend a little time watching for herniation at pyloris and at gastro-oesophageal junction. Diagnosis of pyloric stenosis is difficult; gastric antral hypertrophy is much easier to diagnose
  - be aware of blind spots and make sure you do not miss them – the most frequently missed is the fundus which cannot be seen as you enter the stomach – you need to retroflex and twist the scope on the way out to see this and the gastric side of the cardiac sphincter
  - the incisura angularis (lesser curvature) is the best spot to biopsy
  - not recommended to biopsy – Peyer’s patches in the duodenum, major and minor duodenal papillae, pylorus, antrum and oesophagus (these last three are all very fibrous and attempts to biopsy them usually results in non-diagnostic tiny fragments)

- these investigation should rule out structural and systemic diseases
in many cases focal ulceration may be seen – this may respond to symptomatic therapy, but recurrent / deep ulceration should be investigated further:

- rule out NSAID use. NSAID-induced ulceration is usually marked around the pyloric region and usually appears as multiple punctuate coffee-coloured haemorrhages
- consider gastric neoplasia especially if ulceration is marked around lesser curvature. Be aware that biopsies of this area will frequently show inflammatory change overlying tumours – warn owners that in cases of gastric neoplasia frequently surgical biopsies are needed.
- consider endocrine tumour such as gastrinoma (gastrin levels can be difficult to get measured – Michigan State runs an assay)
- consider speculative therapy for ‘Helicobacter gastritis’ especially if organisms are seen – the story of Helicobacter in dogs is incompletely understood at present and this diagnosis should always be regarded as a doubtful one

in cases with gastrointestinal inflammation of unknown cause consider:

- dietary elimination trials
- immunosuppression in severe cases / part of generalised IBD if all other diagnostics have been performed to a high standard

gastric ‘motility’ disorders

- this is a tricky area. Be aware that there are no diagnostic tests which can prove / disprove the vast majority of suspected gastric motility disorders (there is simply too much individual variation to make diagnostic tests interpretable). Contrast radiographs may show complete obstruction or ileus but beyond that are not helpful. The same with BIPS
- therapeutic trials with gastric Prokinetics (eg cisapride, ranitidine, Metoclopramide, erythromycin) may be considered
GENERAL APPROACH TO THE CHRONICALLY VOMITING CAT

General points

Cats frequently vomit on an occasional basis without being ill or requiring definitive diagnosis. Hairballs are a frequent cause of this especially in long-haired and oriental breeds. Occasional vomiting in an otherwise well cat may require no more than reassurance be dispensed. Of course there is little indication to administer medication if the frequency of vomiting is such that a response to treatment is not possible to evaluate!

Investigation should be pursued

- if signs of systemic illness are seen
- in the acutely vomiting cat that is unwell
- in the cat that is vomiting and losing weight
- where vomiting is increasing in frequency with no identified cause
- where vomiting is accompanied by diarrhoea and is not self-limiting
- where vomiting is accompanied by the production of more than isolated flecks of fresh or changed blood
- where owner will for pursuit of a definitive diagnosis exists

It seems to be an ever-more frequent occurrence in these days of client impatience, internet access and medical over-exposure that some owners may pressurise vets into performing on their pets what can be medically intrusive diagnostic investigation for what may (and usually is) and acute and self-limiting problem. The fires of this desire can be fanned by a wish on the part of we vets to be ‘seen to be doing something’ and its twin sin of practising ‘defensive medicine’ lest we be sued. I am a firm believer that a dose of common sense, clinical judgement based on experience and communicative reassurance should be effectively employed to protect such patients from medical intrusion. Obviously if such a course of (in)action is pursued it must be done so flexibly and with contingency plans of re-examination and a plan that further investigation be pursued if the expected resolution is not seen.

Key points

- the history and physical examination are key
- antibiotics are not treatments for vomiting
- corticosteroids are not advisable until a definitive diagnosis is made
- if you treat
  - use one agent / dietary manipulation at a time so if it works / does not work you can evaluate this rather than trying to decide which of the 4 drugs given caused the miraculous improvement!
Diagnosis approach

History

- As outlined above the history should comprise
  - Basics / background
    - Review of patient signalment
    - Environmental history including plant-eating and scavenging / hunting behaviour
    - Dietary history
    - In contact animals and their health status
    - Vaccination and worming history including whether retroviral testing has been performed
    - Review of previous medical history, previous / long term / current medications including any over-the-counter, 'alternative' medications and home-remedies
  - Questioning with regards to the vomiting especially
    - Distinguish vomiting from regurgitation
    - Appearance
      - Solid / liquid
      - Digested / undigested
      - Presence of fresh / changed (coffee-grounds) blood
      - Presence of hair, bile, faecal odour (rare and usually obvious)
    - Frequency and Duration and whether getting better / worse / waxing –waning
    - Presence / absence of pain
    - Relationship to eating
      - >8hrs implies delayed gastric emptying (structural or functional)
      - Immediately often associated with structural / ulcerative disease of upper GI tract
  - General / systems based questioning
    - Must include whether weight loss or other signs of systemic illness
    - All body systems should be asked about, whether they seem immediately relevant or not

Physical examination

- It is a good habit to evaluate the rest of the patient first before concentrating on the GI tract so that errors of omission are not made due to being 'tunnel- visioned' about the GI tract being primary source of disease
• In most cats the entire GI tract can be well palpated and this can sometimes lead to errors of over diagnosis especially:
  o Ileo-colic valve being mistaken for a mass lesion
  o Faecal matter being mistaken for a mass lesion
  o Areas of intestinal spasm being mistaken for ‘gut thickening’
• Abdominal palpation should be used to interrogate
  o Are there any signs of systemic illness / dehydration / shock which need addressing first
  o Is there anatomical change here i.e. does this patient differ from the normal (of course the only way to determine this is to thoroughly palpate lots of normal abdomens)?
  o Is there identifiable discomfort either focal or generalised?
  o Is there any evidence of overtly focally thickened bowel tissue, mesenteric lymph nodes etc
  o Plication due to linear FB and intussusceptions may be palpated easily
### Differential diagnoses – feline vomiting

#### Systemic / metabolic
- Hyperthyroidism
- Renal failure
- Hepatobiliary disease / encephalopathy
- Systemic mastocytosis
- Drug administration
- Cardiac failure
  - congestive HCM
  - heartworm in travelled cats
- Diabetic ketoacidosis
- Drug therapy
- Intoxication
- Neurological disease especially affecting vestibular system

#### Local intra-abdominal disease
- Pancreatitis
- Hepatobiliary disease
- FIP
- Focal peritonitis, abcess, adhesion
- Steatitis
- Diffuse neoplasia
- Diaphragmatic hernia
- Torsion / entrapment of viscus

#### Primary gastrointestinal disease
- regurgitation mistaken for vomiting
- gastric disease
  - infectious
  - bacterial – Chlamydial, ?Helicobacter-like organisms
    (debatable whether cause gastric disease)
  - viral
  - protozoal –Toxoplasma granuloma
  - parasitic – Ollulanus tricuspidis, Physaloptera spp
  - foreign body
  - neoplasia – single massive or diffuse (eg lymphoma)
  - polyps
  - gastric ulcers
  - pyloric stenosis / antral hypertrophy
  - chronic gastritis
  - dietary intolerance
  - hairballs
  - glutony
  - motility disorders
  - drug intolerance / side effects

- small intestinal disease
  - infectious
  - bacterial (SIBO / ARD)
  - viral esp FIP
  - protozoal eg giardia, toxoplasma
  - parasitic
  - foreign body
  - neoplasia
  - polyps
  - ulceration
  - intussusception
  - mechanical or functional ileus
  - inflammatory bowel disease

- large intestinal disease
  - vomiting sometimes seen with colitis /
  - obstipation, IBD

#### Laboratory tests
- PCV and TP should be checked as minimum
- Preferably complete blood count and biochemistry to include urea, creatinine, ALT, Tbil, fasting bile acids, proteins, glucose and electrolytes
- Urinalysis useful
- Total T4 in any vomiting cat >5yrs of age
- FeLV / FIV testing
Coronavirus serology may be considered but is not a ‘test’ for FIP, neither should FIP be excluded with a negative test if minimal threshold of test is high (consult individual labs)
If pancreatitis suspected then fTLI, fPLI considered but interpretation may be difficult
Microscopic examination of vomitus is generally not helpful unless parasites are seen – *Ollulanus* is very small and examination of vomitus may be only way to diagnose it

Diagnostic imaging
- Survey abdominal radiography
- Abdominal ultrasound if performed by skilled operator
- These two are complementary, neither fully replaces the other

Further evaluation of the upper GI tract
- 3 principal options, each having advantages and disadvantages
  - contrast studies
  - upper GI endoscopy
  - exploratory celiotomy (or celioscopy)
- contrast studies
  - cheap and widely available equipment
  - skills needed inherently available
  - time consuming
  - requires following for some time
  - low diagnostic sensitivity and specificity – false positive diagnoses common
  - allows crude assessment of GI motility
  - extra-GI tract disease cannot be evaluated well
  - cannot take biopsies if lesion seen
- upper GI endoscopy
  - expensive if equipment properly maintained
  - requires some practice to do properly and develop skilful technique
  - requires GA
  - minimal patient morbidity, is ‘non-invasive’
  - can take biopsies of regions of interest
  - can combine with lower GI study
  - can very well evaluate mucosal surface and lumen
  - cannot evaluate extra-GI tract disease, muscularis defects or serosal abnormalities, deep mural lesions may be missed
  - only 10% of upper GI tract accessible
  - cannot assess function well
  - fairly low diagnostic specificity
- celiotomy
  - expensive but very widely available
- skills needed inherently available but to be done properly requires a systematic and thorough approach and not doing through a tiny incision!
- Increased hospitalisation and recovery time
- Owner (and veterinary) resistance due to (mis-)perceived advantages of endoscopy
- Can biopsy region of interest
- Can evaluate local abdominal disease, serosal surface, entire length of GI tract
- Cannot easily evaluate lumen except in limited way by elective gastrotomy, duodenotomy etc
- Can take full thickness biopsy evaluating muscularis layer as well
- Some risk of peritonitis with intestinal biopsy

Whichever method is chosen

- Recognise the limitations of the method and discuss in advance with the owner – none of these are perfect and we don’t need to beat ourselves up for this – we do need to honestly appraise owners though!
  - Discuss in advance that further investigation may be needed e.g. I make a habit of discussing with owners the limited access of endoscopy and that surgery may still be needed, in advance of doing the procedure.
  - If you perform endoscopy or celiotomy for diagnostic purposes – TAKE BIOPSY! Not to do so is medically irresponsible and a source of client complaint if subsequent surgery is needed. An exploratory celiotomy is not an exercise in ‘letting the bad spirits out’!

TREATMENT

Treatment may be undertaken for one of three purposes:

- Definitive treatment when a diagnosis is made with certainty
  - eg methimazole or carbimazole treatment in a vomiting hyperthyroid cat
- Trial treatment to answer a clinical question
  - eg ‘has this cat got evidence of dietary intolerance?’
- Empirical supportive therapy
  - eg all I can find in this chronically vomiting cat is some low grade GI ulceration – maybe sucralfate and ranitidine may help

Empirical supportive therapy and definitive treatments are self-explanatory

Performing treatment trials is unfortunately a fact of life in chronic GI cases but it is important to be honest and scientifically rational about how and when we use them. Examples are typically

  - when biopsies show a degree of lymphoplasmacytic inflammation and no other abnormalities are found
  - where no changes other than gastritis and Helicobacter-like organisms are found.
Neither is sufficient evidence for a diagnosis of IBD or Helicobacter-gastritis respectively. IBD is a diagnosis reached, only by meticulous exclusion of all other diseases – the biopsy changes are not pathognomonic! In these cases usually our major differential diagnoses are functional bowel diseases and dietary intolerance – a food trial is indicated first and foremost. Helicobacter-like organisms are found in the stomachs of most cats and a diagnosis of ‘helicobacter-induced gastritis’ is always a dubious one!

Some rules apply when employing treatment as a diagnostic trial

- do not use corticosteroids as a diagnostic trial unless you and the owner have agreed that no further diagnostic testing in the future is practical or desirable
- you must
  - have a plan for what you are expecting to see as a positive outcome for your trial and this must be communicated freely to the owner
  - establish a one-vet relationship with the animal and this therapeutic plan
  - only ever institute one change at a time – this sounds obvious but it is amazing how many vets I see that put a vomiting animal on 4 or 5 medications and then get upset because they cannot tell whether one, some, all or none of them are helping!
  - Institute any management change for an adequate length of time – this must be based on the frequency of the clinical signs. A cat which has a bout of vomiting once a month should be treated for 2-3 months before you could be sure that any improvement isn’t just down to chance alone
  - Re-evaluate response or lack of response with owners and believe them. Again, it sounds obvious, but as vets we are all guilty of assuming that just because we prescribe something it is going to work. Owners have no preconceptions.
  - Make sure that your therapeutic trial could not be expected to help with more than one problem, by using agents without multiple mechanisms of action (eg metronidazole has both antibiotic and immunomodulatory properties)

GENERAL APPROACH TO DIARRHOEA IN DOGS and CATS

History and physical examination covered above. Remember to always do a rectal examination in any dog or cat with large bowel diarrhoea

key points

- beware the difficulties in interpreting faecal cultures, most labs in the UK will grossly overinterpret microbiology results
- there are no short cuts in diagnosing dietary sensitivity – food elimination trials are the only way
o rule out systemic (especially hypothyroidism in dogs, hyperthyroidism in cats and hypoadrenocorticism) and exocrine pancreatic insufficiency before embarking on more expensive investigations.

o consider the categories of disease above (primary GI, local disease, systemic disease with GI consequences) – always bear these in mind

o owner education and discussion of expectations is important

o chronic diarrhoea cases are not suited to a multi-person approach. Have a diagnostic plan / therapeutic plan and stick to it. Re-evaluate at regular intervals

o at an early stage try and determine the site of the diarrhoea:

First some basics

Diarrhoea

Diarrhoea is quite simply excess faecal water. This may develop through decreased intestinal absorption or by increased intestinal secretion or both. Additionally osmotic diarrhoea may compound fluid loss by attracting fluid within the bowel lumen and altered intestinal motility may be both cause and effect of diarrhoea. Because most fluid is absorbed in the large bowel, small intestinal disease will only cause clinical signs which are discernible as diarrhoea if the rate of fluid egress from the small intestine exceeds the absorptive capacity of the large intestine. This is an important point – you cannot rule out significant small intestinal disease just because an animal does not have diarrhoea.

In essence, when we are investigating (or deciding whether to investigate) diarrhoea we try to decide:

- Is the diarrhoea small intestinal, large intestinal or both?
- Is the diarrhoea chronic or is it likely to be acute and self-limiting?
- Is the diarrhoea due to primary gastrointestinal disease or may it be due to either systemic disease with a gastrointestinal component or local abdominal disease in which the gut may be affected as an ‘innocent bystander’?
- Is there a very good ‘common-sense’ cause for the diarrhoea?

Intestinal flora

The intestinal flora is mightily complex in both cats and dogs and there are few areas of veterinary medicine where so much nonsense, mis-information, wishful thinking and naïve interpretation occurs as this area. This is not helped by the shameless promotion of agents purporting to substantially alter GI flora in ways that are claimed to be beneficial; some of these maybe but I, like most specialists, believe that there should be a certain ‘burden of proof’ before a treatment can be recommended. There are several reasons why assessment of intestinal flora is confusing:

- The majority of bacteria within the gut are anaerobes and these outnumber aerobes by a factor of 1000:1 – cultures of anaerobic bacteria are technically very difficult to achieve
• The numbers of bacteria and the size of various populations of bacteria may alter over time and may be altered by factors such as time since eating, intestinal motility and diet

• There has been shown to be enormous variation in measurable intestinal flora composition both between individual dogs and cats and in the same individual over time

• As clinicians, very often our assessment of intestinal microflora is limited to those procedures that are accessible to us; in practice this very often means simply culturing faeces. Unsurprisingly, culturing a sample of a substance that is packed with bacteria, yields growth of those bacteria! Faecal cultures really cannot be used to ascertain the composition of intestinal flora and many laboratories are guilty of gross overinterpretation of faecal results

• Many bacteria that we often consider as ‘pathogenic’ (such as coliforms, clostridia, campylobacter and salmonellas) are usually isolated from normal cats and dogs. Their presence in a faecal sample does not necessarily imply either that this is abnormal, or that there is any causal relationship with disease

Drug companies and those who have no particular specialist interest in this field love to throw around convincing terms such as ‘dysbiosis’, ‘bad bacteria’ and ‘good bacteria’ without a sound understanding of how to define these terms, difficulties in assessing just what constitutes ‘normal’, and how one can assess intestinal flora.

### Intestinal motility

Gastrointestinal motility is largely (with the exception of the oesophagus which is almost entirely striated muscle, though in the cat, the distal section comprises increasing proportion of smooth muscle) a function of control of smooth muscle contraction. However the regulation of this smooth muscle contraction is fabulously complex and rather difficult to assess, relying as it does on integrated functions of local myogenic, neurogenic (both local and systemic), and hormonal regulation. A full description of factors influencing intestinal motility is beyond the scope of these notes and would certainly run to a few dozen pages – interested readers are referred to the very nice descriptions of intestinal motility in Strombeck’s Small Animal Gastroenterology, still the ‘bible’ of small animal GI medicine for specialists. It is perhaps not very surprising, given the complexity of neural, myogenic and humoral control of this system, that clinical assessment of intestinal motility is fraught with difficulty. I have a personal distaste of textbooks and lecturers who glibly describe ‘motility’ disorders as though their diagnosis is simple and assessment of this most complex of bodily functions a trifling act. Even with more sophisticated diagnostic testing such as scintigraphic assessment of transit of radiopharmaceuticals (which is limited by anatomical specificity), high definition ultrasound, octanoic acid breath testing, and wireless measurement devices which can assess manometry / pH and intestinal contraction, our ability to assess motility is crude at best, and the simple questions of ‘what is normal?’ and ‘does my patient deviate from it?’ and if so ‘what does it mean?’ are extremely difficult to answer. We can diagnose one form of dysmotility, ileus, with relative ease – this is not a diagnostic challenge (though finding the underlying cause
may be!) – but assessment of other motility disorders in the veterinary clinic may seem nigh-on impossible. Use of plain radiography and ultrasonography may be examined though these are limited by a tendency towards over-interpretation with the former (especially when contrast agents are employed) and lack of experience and technical proficiency hampering the latter (I am afraid that I believe that the state of the art of ultrasound is such that there is now a huge difference in diagnostic accuracy between what can be achieved in practice by someone doing ultrasound as a small part of a very busy and varied amount of clinical work and what a diagnostic imaging specialist who has undergone intensive training and is using high definition equipment who evaluates the GI tract of dogs and cats all day, every day can achieve).

**Intestinal inflammation**

Again, mechanisms and interpretation of intestinal inflammation are highly complex areas of medicine and a full description of GI immunology is beyond the scope of these notes. As with any area of medicine that is complex, frustrating to understand and requires a fair amount of dedication on the part of the clinician to delve into, there is a huge amount of over-simplification, misunderstanding and, to be frank, sheer nonsense both written about intestinal inflammatory responses and their inciting causes. A good place to start in understanding intestinal inflammatory responses (as well as refreshing what is usually pretty basic undergraduate teaching in immunology) would be the excellent review article by Alex German, Ed Hall and Mike Day in Journal of Veterinary Internal Medicine (German, A. J., Hall, E. J. & Day, M. J. (2003) Chronic intestinal inflammation and intestinal disease in dogs. *J Vet Intern Med* 17, 8-20) and the chapter on small intestinal disease in the latest edition of Ettinger’s Textbook of Veterinary Internal Medicine. It is very important to recognise that intestinal inflammation occurs with many gastrointestinal pathologies and that the finding of intestinal inflammation on a biopsy, whether obtained by endoscopy or surgically, is not the same thing as a diagnosis of inflammatory bowel disease! It should also be recognized that there can be an enormous amount of variation between interpretation of pathological findings amongst pathologists (if you want to read a rather depressing paper on the subject see: Willard, M. D., Jergens, A. E., Duncan, R. B., Leib, M. S., McCracken, M. D., DeNovo, R. C., Helman, R. G., Slater, M. R. & Harbison, J. L. (2002) Interobserver variation among histopathologic evaluations of intestinal tissues from dogs and cats. *J Am Vet Med Assoc* 220, 1177-1182).

Acute diarrhoea

- There is no rationale whatsoever in the administration of antibiotics for acute, self-limiting diarrhoea (except in the very rare instance where it is accompanied by signs of systemic sepsis)
- There is no rationale whatsoever in the administration of glucocorticoids for acute, self-limiting diarrhoea
- There is absolutely never, ever any rationale in administration of any sort of NSAID to an animal with any form of gastrointestinal disease

Of course, when diarrhoea first occurs there is no way to tell whether it may be acute and self-limiting or of a more chronic nature and a certain amount of clinical acumen and common-sense must be applied. Diarrhoea that is associated with known dietary change, dietary indiscretion, ingestion of carrion or spoiled food or that is associated with predictable stress such as surgery, hospitalisation or travel does not warrant investigation or specific medical therapy unless there is a suspicion of foreign-body full or partial obstruction. Do not underestimate the influence of emotional and autonomic disturbance in causing self-limiting diarrhoea, especially in the hospital setting – it may often be tempting to overdiagnose / overtreat what is essentially an iatrogenic problem rather than evidence of ‘hospital-acquired infection’.

The use of antimicrobial agents in diarrhoea cases should be critically evaluated and the veterinary profession is under external scrutiny as never before that is questioning (quite rightly) some of our prescribing practices. If we developed diarrhoea and our GP’s first response was to give us antibiotics we would, and quite rightly, question their clinical judgement, yet as a profession we are guilty of gross over-prescription of antibiotics where there is no indication for their use. Prescribing them, ‘because the owner expects it’ is simply not ‘on’ – we should be confident and professional enough to withstand this.

Osmotic causes of diarrhoea are quite rationally treated by withholding of food for 24-48 hours and provision of plenty of water or balanced oral rehydration / electrolyte solution in small animals with gradual reintroduction of small amounts of an easily digestible protein source with moderate fat content after this time.

In cats, restriction of fat intake does not appear to be as necessary as in dogs and provision of a white poultry only diet or white steamed fish at this time may be all that is necessary. Assessment for interstitial and intravascular volume depletion in acute diarrhoea patients should be able to be made on a careful physical examination and intravenous fluid therapy will be necessary in some cases. Adsorbant / antidiarrhoeals such as kaolin/pectin-based medications, with or without opiate motility modifiers such as loperamide and diphenoxylate may be helpful in those cases where secretory diarrhoea is likely present. Opiates stimulate segmental motility slowing transit and promote absorption as well as reducing secretion. Their use should probably not be continued beyond three days or so. Often these agents are combined with an oral electrolyte product and sometimes with probiotics. These are unlikely to be harmful but their benefit may be debated.

Probiotics are orally administered live bacterial organisms (though evaluation of random samples of some products has shown no viable organism to be present!) purported to have health benefits beyond any
nutritional worth. There is intriguing evidence for modulation of mucosal immune-responses with this group of agents though objective evidence for efficacy in veterinary species in clinical cases is scant and these products are marketed largely by anecdotal evidence and testimonials.

Acute and self-limiting large intestinal diarrhoea appears to be relatively uncommon in cats compared with dogs, in which it often appears to be precipitated by emotional stress and environmental change, especially in small-breed dogs.

**Approach to chronic diarrhoea in dogs**

**Investigation**

- determine if small or large bowel diarrhoea, or both – this is important for guiding diagnostic imaging and endoscopy
- determine likelihood of systemic disease – rule these out first if in doubt
- blood tests– in particular pay attention to protein status, haematology, electrolyte disturbances
- rule out EPI early in the case of SI diarrhoea (by TLI not faecal analysis)
- perform multiple faecal analyses early. Note that Giardia is an important cause of diarrhoea in dogs in the UK and, being intermittently shed, may avoid detection in faecal analysis. Speculative therapy with 1-2, 5day courses of fenbendazole at 50mg/kg/day (fenbendazole not the total weight of powder) should be considered and may be useful whilst awaiting test results. Repeat contamination from environment and coat appears common and 2 courses with thorough washing of the dog in between should be considered.
- Faecal cytology and rectal cytology is useful –in particular dogs and cats with large bowel diarrhoea should always have faecal cytology and a rectal scrape examined. In young cats *Tritrichomonas foetus* is an emerging and important cause of chronic large bowel diarrhoea and may often be diagnosed on rectal cytology
- Faecal cultures for *Campylobacter, Salmonella, Clostridia* and *Enteropathogenic E.coli* should be considered but be wary of labs who are reporting *E.coli* that are not specifically using PCR restriction to examine pathogenic determinants. Be aware that *Campylobacter, Salmonella* and *Clostridia* are found in normal dogs and cats and a positive culture does not constitute a diagnosis that it is this organism causing the clinical signs. Most veterinary laboratories are guilty of overinterpretation of faecal culture results
- assess B12 and folate – the story of ‘SIBO’ is not at all straightforward and many people doubt that this is a genuine ‘disease’. Nevertheless, low B12 levels may result in significant enterocyte dysfunction and without therapy will exacerbate other GI disease
- imaging of the GI tract by plain radiography and ultrasonography is a high-cost, low-yield endeavour in most cases but should always be considered as it may identify surgical disease (eg intussusception). Contrast radiography of the upper GI tract is less helpful than that of the colon
endoscopy and biopsy / surgical biopsies should be considered dependent on site of disease

**Endoscopy** Vs Surgery

*Endoscopy pros*

● Non-invasive
● May avoid need for surgery
● Allows direct examination of mucosal surface
● In most circumstances because disease is diffuse, biopsies are representative of widespread process

*Endoscopy cons*

● Equipment costly / maintenance
● Operator experience
● Low specificity
● Access
● Cannot Dx disease of the deep submucosa / muscularis
● Cannot evaluate extra-GI structures
● Oedema
● Small sample size

**Surgery** Vs Endoscopy

*Surgery pros*

● Much more widely available
● Whole GI tract and extra-GI structures can be examined
● Biopsies are large and can be taken from any site
● Oedema less of a problem
● Usually diagnostic

*Surgery cons*

● Many owners resistant to it as diagnostic exercise
● Risk of peritonitis (technique)
● Risk in hypoproteinaemic animals
● Recovery time
● Cannot examine wide areas of mucosa
Personal philosophy

- If you have endoscopic access
  - If no overwhelming indication for one endoscopy first but warn owner that surgery may be needed
  - If oedema likely – surgical biopsies, meticulous technique
  - If muscularis layer abnormal on u/sound – surgical biopsies
- If you don’t, or if you cannot take biopsies or guarantee to always intubate the duodenum
  - absolutely nothing wrong with going straight for laparotomy providing that multiple, good quality biopsies are taken

ex-laps / ex-celiotomy

Never, ever perform an ex-lap in an animal with GI signs without taking biopsies. A thorough and diagnostic ex-lap cannot be performed through a tiny incision! Examine EVERYTHING! Record what your findings are at the time. I think it is a very good practice to keep a proforma / tick sheet that ensures that you examine everything in a systematic way and record your findings on it.

Approach to chronic diarrhoea in cats

A reasonable order in which to investigate chronic diarrhoea in cats might be:

- To perform a faecal analysis, especially to evaluate for parasitism and protozoal infections. Bacterial-associated diarrhoea is less likely and caution must be exercised in not over-interpreting faecal cultures, which are generally of poor diagnostic utility
- To establish whether there is evidence of systemic illness that may be causing diarrhoea, especially hyperthyroidism in cats over 8 years of age by evaluation of blood samples
- To establish whether diarrhoea is associated with hypoproteinaemia, hypokalaemia or other electrolyte disturbances
- To establish whether diarrhoea is associated with hypocobalaminaemia
- To establish whether exocrine pancreatic insufficiency may be present
- To establish whether diarrhoea is associated with local abdominal disease that may affect the GI tract as an ‘innocent bystander’ by performance of diagnostic imaging such as radiography and ultrasound*
- To establish whether diarrhoea is associated with imaging evidence of structural GI disease by performance of diagnostic imaging such as radiography and ultrasound*
- To establish evaluation of the mucosa and to obtain a histological assessment by endoscopy and biopsy and / or to evaluate the serosal surface, abdominal contents and obtain a histological assessment by exploratory celiotomy and biopsy.
- To pursue logical, appropriate-duration and non-conflicting therapeutic trials
*abdominal ultrasound neither wholly replaces nor precludes the need for abdominal radiography and these two imaging techniques should be viewed as offering complementary information.

**Laboratory testing**
Covered above

**Diagnostic imaging**

**Plain radiography**
The major use of plain radiography is in assessment of abdominal pain, obstruction, mass lesions, extra-intestinal compression, intussusception, focal loss of serosal detail, ileus and in disorders causing secondary diarrhoea due to intestinal entrapment / malpositioning (such as in adhesion-disease after previous surgery and in pericardio-peritoneal diaphragmatic hernia). Diagnostic utility is enhanced by taking orthogonal views and by taking both lateral views. Diagnostic utility is poor where ascitic fluid is present and in very thin animals since in both situations serosal detail will be lost. A recently developing fallacy, is the erroneous belief that the need for radiography is replaced by diagnostic ultrasound – it is not.

*It is not possible to assess intestinal wall thickness by plain radiography!*

**Contrast radiography, BIPS**
Whilst contrast radiography using microfine barium suspensions may occasionally delineate mucosal ulceration, mural lesions, intestinal obstruction and foreign bodies, this technique has really been superceded by endoscopy which allows much better specificity. Limitations of contrast radiography are often that studies are followed for an insufficient length of time (this should be over 6-8 hours or at least hourly until the contrast reaches the colon) and that false positive diagnoses of apparent ‘filling defects’ may be frustrating.

Contrast radiography of the large intestine, especially after suitable bowel-preparation as for large bowel endoscopy and in combination with cautious air insufflation using a rectal Foley catheter to produce a double-contrast colonogram, is generally more rewarding than contrast radiography of the upper gastrointestinal tract.

Barium-impregnated polyethylene spheres (BIPS) are capsules containing both small (1.5mm diameter) and large (5mm diameter) radio-opaque spheres, designed to mimic liquid and solid-phase gastric emptying respectively and intestinal transit when administered with a standard meal. Normal gastric emptying and intestinal transit times are provided by the manufacturer but clinical utility of BIPS in small animals is generally disappointing and I have seen many false positive diagnoses of intestinal obstruction made with these.

**Ultrasound**
Good quality abdominal ultrasound is very useful in assessment of chronic diarrhoea in cats. However, caution must be undertaken in terms of the limitations of operator skill and equipment available in making a gastrointestinal assessment of patients by ultrasound. This is an extremely skilled technique and in order to thoroughly evaluate the GI tract of cats and dogs, without failures of omission or misinterpretation takes a lot
of practice and training and should preferably be something that is performed every day to gain the requisite level of skill. Many ultrasonographic artefacts occur within the GI tract and knowledge and experience of these is a prerequisite. High frequency transducers (preferably 10-18MHz) should be used to image the feline gastrointestinal tract, and a systematic evaluation should be performed in the same order on every patient in order to allow thorough examination. Examination should include interrogation of the distal oesophagus, stomach, duodenum, jejunum, ileum, ileocolic valve and colon including the wall thickness, integrity of wall layering, mucosal appearance, luminal structure, motility and vascularity. Evaluation of all abdominal lymph node anatomy and good quality vascular assessment should be made. The pancreas, common bile duct and intrahepatic biliary structures should also be assessed. A complete review of feline gastrointestinal ultrasound is beyond the scope of these notes but a very comprehensive review of technique can be found in the latest Consultations in Feline Internal Medicine (Volume 6) by John R August.

**Endoscopy**

The advantages and limitations of endoscopy should be understood, and should be discussed with the owner, prior to performance of it. Principle limitations are technical skill of the operator, the small size of biopsies obtained, and lack of ability to adequately assess the distal small intestine in cats. Prior to undertaking endoscopy, the clinician should characterise whether diarrhoea is small intestinal, large intestinal or both. In the latter two situations, adequate time and preparation of the patient should be performed using osmotic bowel cleansing agents such as ‘Klean-prep’ for at least 24 hours prior to the procedure in order to eliminate obscuring faecal matter from the colon. Failure to do this will lead to a non-diagnostic evaluation and it is inappropriate to anaesthetise a patient for colonoscopy without doing this. A great frustration of veterinary surgeons is that gastrointestinal endoscopy has a very steep and long learning curve and in order to gain basic proficiency it is usually necessary to be taught on clinical cases on a frequent basis over a long time. I do not believe that this is a skill that can be taught on courses or by ‘seeing practice’ (though useful pointers can be given) and in my experience it usually takes internal medicine residents, about a year of very frequent (i.e. several times a week and preferably daily) supervised training with endoscopy before they attain basic proficiency. As a minimum, the operator should be able to intubate the duodenum in every patient before undertaking endoscopy as part of assessment of patients with diarrhoea.

In feline patients, a flexible endoscope of maximal outer insertion tube diameter of 7.8mm is necessary, though this will only permit safe intubation of the duodenum in larger cats. ‘Scope sizes of 5 – 7mm outer insertion tube diameter are preferable and four-way tip deflection, a biopsy channel, irrigation, a good light source and biopsy forceps are essential. Endoscopy should not be undertaken without biopsy. Video-endoscopy greatly aids diagnostic perspicuity though good quality fibrescopes are perfectly acceptable.

Multiple biopsies should be taken from all areas examined and should be orientated as close to perpendicular to mucosa as possible in order to avoid tangential cutting of superficial mucosa (so-called endoscopic
‘coleslaw’). Findings should be recorded according to WSAVA standard reporting methods and adequate information should accompany biopsies to the histopathologist.

Exploratory celiotomy

Ultimately celiotomy and biopsy may be required in those situations when a diagnosis remains elusive despite exhaustive non-intrusive testing, where structural disease is identified on diagnostic imaging that is either beyond the ‘reach’ of endoscopy / skill of the endoscopist, where structural changes affect predominantly muscularis / serosal layers or where endoscopy is not available. If the decision to perform celiotomy is taken then it absolutely must be performed in a thorough and logical way (and should really be documented). It is completely inexcusable to attempt to perform a thorough exploratory celiotomy through a short incision which is clearly inadequate for proper exposure of the gastrointestinal tract. Representative biopsies should be taken; failure to do so, should this become necessary at a later stage leads to, at the very least, owner dissatisfaction and frequently may lead to a formal / legal complaint. Systematic exploration should be undertaken and the surgeon should familiarise themselves with the proper technique for complete exploration.

Assessment of dietary intolerance

The use of serological tests for diagnosis of dietary intolerance / ‘allergy’ is appealing though limited by lack of specificity. Serological measurement of IgG and IgE to dietary proteins is strongly marketed but is limited by being based on a somewhat flawed premise that the detection of immunoglobulins directed against specific dietary antigens implicates a dietary intolerance. Of course, any cause of disruption of the intestinal mucosal barrier no matter what the aetiology may result in loss of immune ‘tolerance’ and elaboration of immunoglobulins; it is not necessarily the case that these are implicated in further development of intestinal inflammation. There may be some rationale in viewing the results of serological testing as a potential basis for constructing dietary trials based on a protein-source where no dietary-specific immunoglobulin is detected, but most specialists, including myself, view these rather expensive tests as clinically being rather poor diagnostic value for money and do not regularly use them. There are elegantly constructed veterinary trials published documenting the very poor specificity of these tests. Properly constructed and monitored dietary exclusion trials remain the mainstay of diagnosis of dietary intolerance in the cat.

The ‘iterative’ diagnostic path to inflammatory bowel disease

A common misconception is that IBD merely requires demonstration, by either endoscopic or surgical biopsy, of intestinal inflammation. As discussed earlier, this assumption is erroneous since any intestinal pathology may result in intestinal inflammation. A diagnosis of IBD may only be arrived at with confidence, and without risk of causing unnecessary risk of adverse events with inappropriate immunomodulatory therapy, if all other potential causes of the clinical signs have been excluded with logical and meticulous diagnostic planning, if inflammatory changes have been identified (preferably accompanied by demonstration of structural change) and if dietary exclusion trials have failed to demonstrate any clinical improvement.
# Differential diagnostic ‘aide-memoir’ for diarrhoea in cats

## Primary GI disease: non-infiltrative Infectious causes

<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions</th>
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</thead>
<tbody>
<tr>
<td><strong>Parasitic</strong></td>
<td>• Toxacara cati, Toxascaris Leonina</td>
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<tr>
<td></td>
<td>• Uncinaria stenocephala, (Ancylostoma tubaeforme, braziliense, caninum)</td>
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<tr>
<td></td>
<td>• Trichuris serrata, campanula, caninum</td>
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<td></td>
<td>• Dipylidium caninum, Taenia taeniaformis</td>
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<tr>
<td><strong>Protozoal</strong></td>
<td>• Cryptosporidium felis, Isospora felis + rivolta</td>
</tr>
<tr>
<td></td>
<td>• Giardia duodenalis</td>
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<tr>
<td></td>
<td>• Tritrichomonas foetus</td>
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<tr>
<td><strong>Bacterial</strong></td>
<td>• Campylobacter jejuni and upsaliensis (sometimes)</td>
</tr>
<tr>
<td></td>
<td>• Anaerobiospirillium succiniciproducens</td>
</tr>
<tr>
<td></td>
<td>• Salmonella spp</td>
</tr>
<tr>
<td></td>
<td>• Cl. perfringens (enterotoxin), Cl. difficile (Toxin A / B)</td>
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<tr>
<td></td>
<td>• Enterotoxigenic and enteropathogenic E.coli</td>
</tr>
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<td></td>
<td>• Yersinia TB, Shigella spp, Bacillus pilliformis</td>
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<tr>
<td><strong>Viral</strong></td>
<td>• Panleukopenia ($FPV$, $CPV2$a, 2$ b$)</td>
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<tr>
<td></td>
<td>• Feline enteric coronavirus</td>
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<td></td>
<td>• Torovirus (CD/PMN)</td>
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</table>

## Primary GI disease: others

<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions</th>
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<tbody>
<tr>
<td><strong>Inflamatory</strong></td>
<td>• Idiopathic inflammatory bowel disease</td>
</tr>
<tr>
<td></td>
<td>• Dietary intolerance</td>
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<tr>
<td><strong>Dietary</strong></td>
<td>• Food allergy</td>
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<tr>
<td></td>
<td>• Food intolerance</td>
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<tr>
<td><strong>Infiltrative</strong> (diffuse or mass-like)</td>
<td>• Lymphoma</td>
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<tr>
<td></td>
<td>• FIP</td>
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<td></td>
<td>• Visceral mast cell tumour</td>
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<tr>
<td></td>
<td>• Mycobacterial infection, especially M.avium complex</td>
</tr>
<tr>
<td></td>
<td>• Amyloidosis (with hepatic, renal usually)</td>
</tr>
<tr>
<td>Condition</td>
<td>Description</td>
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<td>-----------------------------------</td>
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<tr>
<td>Other neoplasia</td>
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<tr>
<td>Maldigestion</td>
<td>• Feline exocrine pancreatic insufficiency</td>
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<tr>
<td>‘Structural’ impairment</td>
<td>• Partial obstruction, e.g. polyp, some foreign bodies</td>
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<tr>
<td></td>
<td>• Intermittent / partial / self-relieving intussusception</td>
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<tr>
<td></td>
<td>• Adhesion disease / fixation / entrapments</td>
</tr>
<tr>
<td>Motility disorders</td>
<td>• Feline dysautonomia</td>
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<tr>
<td></td>
<td>• ?IBS</td>
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