Clinical Reasoning

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Veterinarians make decisions every day about diagnostic and treatment options for their patients. Clinical reasoning, along with a sound and relevant knowledge base, forms the cornerstone of these decisions. Undergraduate and continuing education tend to focus on acquisition of knowledge; however, knowledge is only useful if it can be accessed, formulated, and applied to the problem at hand. Thus, successful case assessment requires knowledge, understanding, and clinical reasoning.

Case Example

Sheba, a 3-year-old spayed rottweiler located in New York, is presented with an acute history of melena and collapse overnight. She had vomited bile once a few hours prior, had been active and normal the preceding day, and had eaten well the preceding afternoon. On physical examination, she is overweight and weak with pale mucous membranes, a prolonged capillary refill time (>2 seconds), a heart rate of 160 bpm, and a normal rectal temperature. A systolic heart murmur (grade 2/6) is auscultated on the left-hand side. Her spleen appears large on abdominal palpation. She is up-to-date on vaccinations and parasite preventives and has not recently traveled.

Clinical Reasoning Models

Clinical reasoning is a complex process that varies widely depending on the clinician's preferred thinking and learning style, past experiences and expertise, the clinical problem itself, and the context in which the problem is encountered. Clinical reasoning used by clinicians can be broadly classified as

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Type 1 (nonanalytic) or Type 2 (analytic). A blended approach or triangulation of both types (to cross-check clinical reasoning and diagnostic conclusions) is advocated for successful diagnostic decision-making.[1]

Nonanalytic Clinical Reasoning

Nonanalytic reasoning, often referred to as *pattern recognition*, occurs quickly and subconsciously and primarily relies on the clinician accessing knowledge and patterns from past experiences that can be applied to the present case. Thus, limited previous case exposure may hinder pattern recognition in students and new graduates, veterinarians returning to practice after a prolonged break, or veterinarians changing their area of practice. Nonanalytic reasoning based on pattern recognition can be also be flawed if the clinician recognizes only a small number of salient factors in the case.

Use of pattern recognition as the primary mode of clinical reasoning works well for many common disorders and has the advantage of being quick and cost-effective, provided that the diagnosis is correct. Pattern recognition is also effective in cases for which:

- A disorder has a unique and recognizable pattern of clinical signs
- There are only a few diagnostic possibilities that can be easily remembered or ruled in or out by routine tests
- The clinician has extensive experience (and thus a rich bank of illness scripts to recall), is well read and up-to-date, reviews all diagnoses made regularly and critically, and has an excellent memory

Alternatively, pattern recognition as the primary clinical reasoning process can be problematic:

- For uncommon diseases
- For common diseases that present atypically
- When the patient is exhibiting multiple clinical signs that are not immediately associated with a specific disease and may or may not be related to a single diagnosis
- If the pattern of clinical signs is suggestive of certain disorders but not specific for them

For an experienced clinician, the success of pattern recognition relies on a correct diagnosis for the previously observed pattern. In general practice, the clinician must often form a provisional diagnosis and make treatment decisions in the absence of complete knowledge or data and without confirming the diagnosis.[2] These decisions will likely be reinforced by the presumption that the diagnosis was correct if the patient clinically improves with treatment.

TABLE

DIAGNOSTIC BIASES IN CLINICAL MEDICINE

Bias	Description
Availability bias	A tendency to favor a diagnosis because of a case the clinician has seen recently
Anchoring bias	An initial diagnosis is favored but is misleading. The clinician persists with the initial diagnosis and is unwilling to change his or her mind.
Framing bias	Features that do not fit with the favored diagnosis are ignored.
Confirmation bias	When information is selectively chosen to confirm—not refute—a hypothesis. The clinician only seeks or takes note of information that will confirm his or her diagnosis and does not seek or ignores information that will challenge it.
Premature closure	Narrowing the choice of diagnostic hypotheses too early

Even experienced clinicians are vulnerable to bias (***Table***) in nonanalytic reasoning. Such bias is generally subconscious, although some authors suggest that an awareness of bias can help avoid such errors. Diagnostic error can involve a combination of biases. Cognitive skill errors (ie, processing biases) are reported to be a more common reason for diagnostic error as compared with errors caused by knowledge gaps.[1] Overconfidence is believed to be a major factor contributing to diagnostic error and bias, even among specialists.[3]

In Sheba's case, the range of diagnoses that will be suggested by veterinarians based on pattern recognition may include an acute GI disease, a bleeding disorder, acute cardiac failure, splenic torsion, splenic hemangiosarcoma, hypoadrenocorticism, and hemolytic anemia. All of these are feasible and all require different diagnostic and treatment strategies.

The Minimum Database

Routine diagnostic tests (eg, hematology, serum chemistry profile, urinalysis) can be useful and often essential in understanding a patient's clinical condition. Relying on a minimum database to provide more information about the patient before clinical reasoning is engaged may be reasonable for some diseases but unhelpful for others. Serious, even life-threatening, disorders of the GI tract, neuromuscular system, pancreas (especially in cats), and heart rarely cause significant diagnostic changes in the routine hematologic and biochemical parameters measured in general practice. In addition, diagnostic tests are rarely 100% sensitive or specific. Using blood testing to screen for diagnoses can therefore be misleading, as the positive and negative predictive value of any test is influenced by the prevalence of a disorder in the population.

Abnormal results in an unwell patient can create confusion if not critically reviewed as an integral part of the clinical assessment of all data relevant to the patient and related to the presenting problem(s). Veterinarians may overestimate the information gained from laboratory and imaging results,[1] especially if the fundamentals (ie, comprehensive history, thorough clinical examination) are bypassed in favor of tests. It is recommended to avoid performing a test if not looking for a specific disease, as results can be misleading. For example, total thyroxine and fecal panels are tests that are requested frequently but that may be misinterpreted.

Analytic Clinical Reasoning

For cases in which nonanalytic reasoning is not helpful, analytic reasoning is required. An analytic approach to clinical reasoning is also needed to double-check presumptive diagnoses that are based on pattern recognition.

In contrast to nonanalytic reasoning, analytic reasoning is reflective and systematic, permitting hypothesis formation and abstract reasoning.

Analytic reasoning is less prone to bias than nonanalytic reasoning[2] but is limited by working memory capacity, unless strategies are developed to provide the clinician with a logical, methodical, and memorable process through which to problem-solve any case presentation.

Problem-Based Inductive Reasoning

In problem-based inductive reasoning, also described as *logical clinical problem-solving*, each significant clinicopathologic problem is assessed before being related to the patient's other problems. Using this approach, the pathophysiologic basis and key questions for the most specific clinical signs the patient is exhibiting are considered before a pattern is sought. This ensures that the clinician's mind remains more open to other diagnostic possibilities beyond the most obvious based on pattern recognition and thus helps prevent diagnostic bias.

The Problem List

The initial step in problem-based inductive reasoning is to clarify and articulate the patient's clinical signs by constructing a problem list. Constructing a problem list (either mentally, orally, or in written form) helps make the clinical signs explicit to the clinician's current level of understanding, transforms vague presenting information to specific problems, and helps the clinician determine the key clinical problems (ie, hard findings) versus the "background noise" (ie, soft findings). Most importantly, it helps prevent the clinician from overlooking less obvious, but nevertheless crucial, clinical signs and becoming overwhelmed with information. Incidental findings can mislead the clinician, particularly in older patients (eg, by focusing on the chronic diseases present instead of recognizing that it may be an acute disease that is responsible for the current clinical signs). Constructing and critically assessing a problem list can help prevent this. Problems should be prioritized, and those that are most specific and/or diagnostically useful can act as "diagnostic hooks."[4]

Each acute problem is important, and answering key questions related to each can provide important clues to guide diagnosis.

Sheba's problem list would include:

- Profound weakness
- Melena
- Pale mucous membranes
- Systolic murmur and tachycardia
- Vomiting
- Splenomegaly
- Obesity (which would not contribute to the diagnostic plans but would need to be addressed at a later stage)

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Problem Assessment

Problem-based inductive clinical reasoning provides steps to bridge the gap between the problem list and the list of differential diagnoses via a structured format. Once the problem list has been formulated, it can be used as the foundation for problem-based reasoning. After the key problems have been assessed as below, rather than listing every possible differential diagnosis for every problem on the problem list, a list of feasible differential diagnoses based on the problem list as a whole should be made.

The specific problems identified should be investigated through rigorous use of key steps:

- Define and refine the problem (What is the problem?).
- Define and refine the system (What system is involved and how is it involved?).
- Define the location (Where in the system is the problem located?).
- Define the lesion (What is the lesion?).

This structured approach to defining and refining the problem and system in particular will help determine the appropriate questions to ask when obtaining the history. The owner responses may alert the clinician to pay particular attention to aspects of the physical examination, indicate the most appropriate diagnostic test(s) to use, and prepare the clinician intellectually to assess the results of the chosen tests.

Define & Refine the Problem

When assessing a patient's clinical signs, it is essential to define the problem as accurately as possible. Considering whether there is another clinical sign with which the problem could be confused is a vital first step, as failure to define the problem correctly can derail a clinical investigation that might otherwise have been relatively straightforward.

In Sheba's case, melena in particular requires careful problem definition, as digested blood in the GI tract can be a result of either GI bleeding or swallowed blood (eg, from eating raw red meat, a bleeding lesion in the mouth or nasopharynx, coughing up then swallowing blood, licking a bleeding wound). It should be confirmed that the melena is due to GI bleeding by ruling out possible sources of ingested blood.

Define & Refine the System

Once the problem is defined, the body system that is malfunctioning should be considered. For every clinical sign, there is a system(s) that must be involved or that "creates" the clinical sign. However, the most important question is *how* it is involved. The key specific questions are what system could be involved in causing this clinical sign and is it a primary (ie, structural) problem of a body system or a secondary (ie, functional) problem whereby the system involved in creating the particular clinical sign is secondarily affected in the pathophysiologic process. An alternative, although closely related, question for some problems is if the problem is local or systemic.

In Sheba's case, the key questions related to system definition include:

- Is her profound weakness due to primary or secondary neuromuscular disease? Given the other clinical signs, secondary (eg, cardiovascular, hematopoietic) is most likely.
- Is her melena a result of GI bleeding due to local disease (eg, parasites, foreign body, neoplasia, drug damage [eg, NSAIDs]) or systemic disease, such as coagulopathy or GI ulceration due to nonGI disease (eg, hypoadrenocorticism, mast cell tumor, hepatic disease, uremia, gastrinoma)?
- Are her pale mucous membranes due to anemia or decreased peripheral perfusion?
- Are her systolic murmur and tachycardia due to primary cardiac disease or secondary noncardiac disease (eg, anemia)?
- Is her vomiting a result of primary or secondary GI disease?

The range of diagnoses to consider, diagnostic tools used, and potential treatment or management options for primary structural problems of a body system are often very different from those relevant to secondary functional problems of that system. Investigation of primary structural problems often involves imaging (eg, radiology, ultrasonography, advanced trans-sectional imaging, endoscopy, surgical exploration) and/or biopsy. Routine hematology, serum chemistry profile, and urinalysis are often of little value in confirming the diagnosis but can be helpful in assessing the consequences of the underlying pathology (eg, anemia from GI bleed, metabolic perturbations as a result of vomiting and diarrhea in primary GI disease).

In contrast, for secondary functional disorders, hematology and serum chemistry profile are often critical in reaching a diagnosis.

In Sheba's case, the problem-based approach has clarified that there are several key questions that need to be answered:

- Are the pale mucous membranes due to anemia or poor peripheral perfusion? This signals that packed cell volume (PCV) and total protein values should be obtained.

- Is the systolic murmur due to cardiac disease or anemia?
- Is the melena due to GI ulceration (primary or secondary) or a coagulopathy? This signals that platelet count and rapid assessment of clotting capability (eg, activated clotting time) should be obtained. Coagulation status should be established before any invasive diagnostic procedures (eg, endoscopy) are performed (if needed).
- Is the vomiting due to primary or secondary GI disease? Serum chemistry profile and hematology should help identify whether secondary (ie, metabolic) GI disease is present.

For some cases, once the system and its involvement are defined, the location within the system may need to be determined. For all problems, once the system and its involvement are determined, the lesion should be defined (ie, the differential diagnosis list).

In Sheba's case, the key findings include:

- Significant anemia (PCV, 18%); it should now be determined whether anemia is due to decreased RBC production (ie, bone marrow disease), hemolysis, or hemorrhage.
  - The acute onset of the clinical signs suggest that hemorrhage or hemolysis is more likely than bone marrow failure.
- A total plasma protein level of 7.8 mg/mL, signaling that external hemorrhage from the GI tract was not the sole cause of the anemia. Loss of at least 50% of RBCs through the gut (for the PCV to drop to 18%) would result in a plasma protein in the lower reference range. Thus, the patient has either internal (abdominal) hemorrhage or hemolysis.
- Profound thrombocytopenia (10×10^6/mL); it should be determined whether this is due to decreased platelet production (ie, bone marrow disease), platelet consumption (eg, disseminated intravascular coagulation), platelet destruction (eg, immune-mediated disease), or infectious causes. Of note, bleeding alone will reduce platelet numbers but rarely below about 50×10^6/mL; thus, melena is likely a result of the thrombocytopenia and not vice versa.

PCV = packed cell volume

Helpful diagnostic tools would include a full hemogram and blood smear examination to assess RBC, WBC, and platelet morphology; a full coagulation profile; assessment for infectious diseases if in an endemic area; and abdominal imaging to check for abdominal hemorrhage and assess the liver and spleen.

Sheba's final diagnosis is primary immune-mediated anemia and thrombocytopenia (ie, Evan's Syndrome). She is treated successfully with corticosteroids and azathioprine.

Conclusion

As with all skills, it takes time to develop the knowledge base and mental discipline required for successful logical clinical problem-solving. However, once the logical clinical problem-solving approach is embedded (and, ideally, becomes part of the clinician's nonanalytic reasoning), it can save time by quickly eliminating extraneous information and helping the clinician focus on the information that is truly important for patients and owners.

References

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