A Bayesian approach to chest pain?

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Life is really simple, but we insist on making it complicated.
– Confucius[1]

My medical school educational experience was a rather structured affair. Following a lengthy science course, we moved to exploring the clinical method of history, examination and special tests. Looking back from a distance, my teachers' choice of chest pain as the illustrative example of the clinical presentation was ideal. Cardiovascular disease was, back then and remains today, the most common cause of death. Management of myocardial infarction at that time had not yet moved to the sophisticated processes readily available today. The pathological causes of chest pain could be easily listed and understood. However, in the absence of ready access to the sophisticated tests available today, matching the clinical presentation of chest pain in an individual patient to the range of pathological causes was challenging. I still remember watching in awe as the cardiologists would make a specific diagnosis from the history, examination and electrocardiogram alone, a task non-experts found challenging.

Despite chest pain continuing to be an extremely common presentation, translating the patient's experience of pain in the chest to a specific pathology continues to haunt the workload of clinicians. The consequences of an incorrect diagnosis are, at times, severe – misdiagnosing a heart attack as minor musculoskeletal pain could mean death.

Unfortunately, many clinicians have been confronted with an unexpected diagnosis of non-ST elevation myocardial infarction in a seemingly innocuous presentation of chest pain. Perhaps best to remember the old aphorism, 'Uncommon manifestations of common disease are more common than common manifestations of uncommon diseases'.[2] Hence, ischaemic heart disease, which is very common, is likely to present in quite unexpected ways.

What processes are used to make these clinical decisions? Clinical judgement is dependent on practice, experience, knowledge and continuous critical analysis. However, there is also an implicit but often unstated assumption that accuracy is variable.[3] An alternative way of considering the underlying process of clinical judgement is to view this as the variable application of two somewhat conflicting approaches: intuition mainly based on Gestalt principles, and factual analysis.[4]

A key solution to the problem of variable accuracy in the clinical process was the incorporation of Bayes' theorem into solving key clinical conundrums. Bayes stated, 'The probability of any event is the ratio between the value at which an expectation depending on the happening of the event ought to be computed, and the value of the thing expected upon its happening'.[5] Effectively, this means that the diagnostic utility of a test is directly influenced by the prevalence of disease (ie the pre-test probability). An excellent example of this process in practice is the use of scoring systems in the diagnosis of pulmonary embolus, as detailed by Steven Doherty.[6] Pulmonary embolism is often a difficult disease to diagnose, with few definitive diagnostic symptoms or examination findings. The investigations are not without risk, yet missed disease is potentially lethal. The introduction of validated scoring systems based on Bayesian logic has revolutionised care through dramatically improved diagnostic accuracy.

So where does this leave us? I think that we are all Bayesians at heart, and we consciously or unconsciously map the predictive value of our item of history, examination or special test with disease prevalence. This is perhaps best displayed by the saying commonly known to medical students, 'When you hear hoof beats, think horses, not zebras'.[7] Notwithstanding that the most common hoofed animal varies across geographic locations, this saying emphasises that prevalence is a key determinant in the diagnostic process.

In summary, the diagnostic process as a conceptual method is fundamentally based on probability rather than absolute certainty.[8] Acknowledging this uncertainty helps inform the conversation with our patients to help reach a mutually agreed plan of action.

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