75-Year-Old Man With Fever, Cough, Myalgias, and Pruritus

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A 75-year-old man presented to the emergency department (ED) with a 5-day history of fever, cough, nasal congestion, sore throat, myalgias, headache, loose stools, and diffuse pruritus. His medical history was notable for coronary artery bypass graft surgery several years previously, hypertension, hyperlipidemia, chronic kidney disease, acid reflux, alcohol abuse, and gout. He had taken acetaminophen with modest improvement in his fever, myalgias, and headache. He was a lifelong nonsmoker. The patient had no sick contacts or recent travel history.

On initial presentation to the ED, his vital signs were normal with the exception of a blood pressure of 159/66 mm Hg. Examination of the eyes, ears, nose, throat, heart, lungs, abdomen, and skin yielded unremarkable results. Chest radiography and urinalysis revealed no abnormalities. The patient was discharged from the ED with a diagnosis of a viral syndrome and was instructed to follow-up with his primary care physician in 1 week.

Four days later, the patient returned to the ED with persistent symptoms. He remained hypertensive, and his physical examination findings were unchanged. Laboratory studies revealed the following results (reference ranges provided parenthetically): platelet count, 149×10^9/L ($150\text{-}450 \times 10^9$/L); potassium, 3.1 mmol/L (3.6-5.2 mmol/L); creatinine, 1.4 mg/dL (0.8-1.3 mg/dL; baseline creatinine, 1.5 mg/dL 9 months previously); erythrocyte sedimentation rate, 29 mm/h (0-22 mm/h); and C-reactive protein, 16.8 mg/L ($\leq$8.0 mg/L). Given his headache, computed tomography (CT) of the head and cervical spine were obtained and revealed no abnormalities. The patient's symptoms were again thought to be related to a prolonged viral syndrome. He was discharged to home with a plan for outpatient primary care follow-up.

Three days after his second ED visit, the patient was seen in his outpatient primary care clinic. He continued to complain of fevers, headaches, and diffuse myalgias. He again noted generalized pruritus and was now describing generalized fatigue. Viral syndrome was diagnosed again. He was encouraged to take oral diphenhydramine for his itching and to return to the clinic if his symptoms failed to improve.

One week later, the patient returned to the primary care clinic. Laboratory studies obtained before that visit revealed the following: potassium, 3.9 mmol/L; creatinine, 1.7 mg/dL; erythrocyte sedimentation rate, 57 mm/h; and creatinine kinase, 215 U/L (52-336 U/L). The patient complained of continued fevers, generalized weakness, and fatigue. He also reported new development of lower abdominal pain. His pruritus had improved considerably with the use of diphenhydramine. He was afebrile at the clinic; however, his blood pressure was substantially lower at 109/57 mm Hg. His abdominal examination revealed mild lower abdominal tenderness without peritoneal signs. The patient was advised to stop taking his antihypertensive medications. Computed tomography of the abdomen and pelvis was ordered and scheduled for the following week because it was late on a Friday afternoon at the time of the clinic visit.

Two days later, the patient presented to the ED with worsening abdominal pain and associated diarrhea. He continued to describe fatigue, fever, generalized weakness, and diffuse pruritus. His physical examination now revealed scleral icterus and a diffusely tender abdomen without peritoneal signs. Laboratory studies yielded the following notable results: aspartate aminotransferase, 154 U/L (8-48 U/L); alkaline phosphatase, 249 U/L (45-115 U/L); total bilirubin, 15.4 mg/dL (0.1-1.0 mg/dL); direct bilirubin, $\leq$1.2 mg/dL (0.0-0.3 mg/dL); and lipase, 48 U/L (10-73 U/L). Computed tomography of the abdomen and pelvis with intravenous contrast revealed a heterogeneous mass in the right hepatic lobe measuring 6.3 cm in largest dimension, with invasion into the central biliary tree.

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1. Which *one* of the following cognitive biases may have led to a failure to recognize obstructive cholestasis earlier in this patient?

a. Focusing illusion
b. Gambler's fallacy
c. Playing the odds
d. Base rate fallacy
e. Aggregate bias

Focusing illusion refers to a tendency to overemphasize one piece of information when making a decision. In medicine, this may be seen in overemphasis on a specific laboratory test at the expense of the clinical scenario when making a diagnosis.[1] The gambler's fallacy is the belief that current probabilities are affected by past events.[1] An example would be the belief that a pregnant woman who has had 3 boys is more likely to have a girl with her next pregnancy. Neither of these biases were likely in this case.

Playing the odds, which is the most likely explanation in this case, is a cognitive bias in which when one is faced with an ambiguous set of symptoms, a benign cause is chosen over a more serious one.[1] In this case, the diagnosis of a viral illness was made at multiple ED and office visits based on vague symptoms rather than earlier recognition of obstructive cholestasis.

The base rate fallacy occurs when the underlying likelihood of something is ignored given the current situation.[1] An example would be diagnosing carcinoid syndrome in a patient with abdominal pain and diarrhea because the symptoms fit, even though viral gastroenteritis is much more common. Finally, the aggregate bias refers to a physician's belief that aggregate data, such as clinical guidelines, do not apply to their patients because of perceived unique characteristics. Neither base rate fallacy nor aggregate bias were likely in this case.

The patient was admitted to an internal medicine service and underwent endoscopic retrograde cholangiopancreatography, which identified a malignant-appearing hilar biliary stricture. A biopsy specimen and brushings were obtained. The stricture was stented, and a biliary sphincterotomy was performed. The patient's abdominal pain improved after stenting, and he remained in the hospital. Two days later, the pathology report indicated inconclusive findings, and a CT-guided biopsy of the right hepatic lobe mass was performed. Immediately before the biopsy, the patient's vital signs were recorded as follows: temperature, 36.0°C; pulse rate, 73 beats/min; blood pressure, 160/73 mm Hg; and respirations, 18 breaths/min.

Two hours after the biopsy, the patient complained of chills and was confused. Vital signs at that time were recorded as follows: pulse rate, 102 beats/min; blood pressure, 143/59 mm Hg; and respirations, 24 breaths/min. The patient was evaluated, and his symptoms were attributed to adverse effects from the sedation he received at the time of his biopsy. An hour later, his vital signs were recorded as follows: pulse rate, 120 beats/min; blood pressure, 114/70 mm Hg; and respirations, 24 breaths/min. He was noted by nursing staff to be even more confused. The medical team was alerted to the patient's tachycardia and relative hypotension, and 1 L of intravenous normal saline was administered.

Six hours later (9 hours after his biopsy), the patient continued to be confused. His blood pressure was 95/56 mm Hg despite fluid resuscitation. The medical team was concerned about an abdominal hemorrhage. Computed tomography of the abdomen and pelvis revealed no evidence of abdominal bleeding. Laboratory studies were urgently obtained and revealed the following notable results: white blood cell count, 14.4×10^9/L ($3.5\text{-}10.5 \times 10^9$/L); and lactate, 6.3 mmol/L (0.6-2.3 mmol/L). Laboratory studies obtained earlier in the morning had yielded a white blood cell count of 10.4×10^9/L. Blood and urine cultures were obtained. Intravenous antibiotics including vancomycin and piperacillin-tazobactam were initiated. The patient was transferred to the intensive care unit (ICU) with septic shock 12 hours after the CT-guided liver biopsy.

2. Which *one* of these cognitive biases may have led to the overemphasis of the procedure on the patient's symptoms?

a. Availability heuristic
b. Base rate fallacy
c. Bandwagon effect
d. Hindsight bias
e. Recency bias

The availability heuristic results from the false notion that events or conditions are more likely if they can be recalled easily.[1] An example would be a physician who reads multiple case reports about melanoma and perceives that the risk of melanoma is increasing. The previously described base rate fallacy was not present in this case. The bandwagon effect describes how new drugs, devices, or procedures can achieve widespread popularity relatively quickly.[1] As a new product becomes more common, additional people are more likely to adopt it without question and less likely to critically assess it. Hindsight bias is also called the "knew it all along" bias and explains how people tend to see events as predictable after the fact. The availability heuristic, base rate fallacy, bandwagon effect, and hindsight bias were not present in this case. In this case, the recency bias best explains how the biopsy may have played an outsized role in the evaluation of the patient's symptoms.[1] This bias refers to the tendency to disproportionally weigh recent events or observations (in this case, the procedure) relative to alternative options.

The critical care team evaluated the patient on his arrival in the ICU. Within a short time, there were multiple admissions to the ICU. The patient continued to be confused. An electrolyte panel revealed the following results: sodium, 137 mmol/L (135-145 mmol/L); potassium, 3.0 mmol/L; chloride, 108 mmol/L (98-107 mmol/L); bicarbonate, 17 mmol/L (22-29 mmol/L); serum urea nitrogen, 21 mg/dL (8-24 mg/dL); creatinine, 1.8 mg/dL; and random glucose, 13 mg/dL (70-140 mg/dL). Intravenous vancomycin and piperacillin-tazobactam were continued. The ICU remained busy with more admissions. The hospital sepsis bundle was not initiated at this time.

3. Which one of the following psychological biases, which put the current patient at risk of suboptimal care, could have been displayed by the team in the busy ICU in this case?

a. Omission bias
b. System 1 thinking
c. Representativeness
d. Triage cueing
e. Yin-yang out

Omission bias is a propensity toward inaction in which decision makers inappropriately judge harms due to inaction as less severe than harms caused by action.[1] This bias is influenced by the concept of nonmaleficence or inflicting the least amount of harm possible to achieve the most favorable outcome for a patient. An example of this bias in medicine is failure to initiate warfarin therapy when it is indicated because of exaggerated fear of bleeding complications. System 1 thinking best fits the current scenario in a busy workplace. System 1 thinking is involuntary and extremely fast. It is based on our initial feelings, hunches, and biases.[2,3] Alternatively, system 2 thinking requires concentration and involves conscious effortful mental activity. The difference in time and effort between the 2 processes can be seen when solving 2 math problems: 5×2 (system 1) vs 37×16 (system 2). When time is short and stress is high, system 1 thinking is used to complete tasks quickly and efficiently. In the busy ICU environment with multiple admissions of critically ill patients, such reliance on system 1 may result in errors.

Representativeness is the tendency to focus on typical features of a disease and miss unusual presentations of a disease. Triage cueing is a bias in which the location of a patient may affect the diagnosis or treatment.[1] For example, if a patient self-refers himself to a cardiologist for dyspnea, the patient may be more likely to get a cardiac rather than pulmonary diagnosis. Yin-yang out leads to errors when new or evolving symptoms are ignored because of a previous exhaustive work-up.[1] For example, if a patient with chronic abdominal pain has an unrevealing evaluation, a clinician may be reassured by this work-up even if important new symptoms occur as a disease progresses.[1] Representativeness, triage cueing, and yin-yang out were unlikely to be present at this point in the case.

Several doses of intravenous dextrose were administered, which restored normoglycemia. Following the administration of dextrose, the patient's mental status markedly improved. A second liter of normal saline was administered overnight, yet the patient's blood pressure remained marginally low with mean arterial pressures ranging between 55 and 65 mm Hg. During unit rounds the following morning, a gradual decline in the patient's mean arterial pressure was noted, with values now ranging between 50 and 60 mm Hg. Blood cultures, obtained the evening before, returned positive for *Escherichia coli*, growing in multiple bottles.

4. In this case, the diagnosis of corrected hypoglycemia with improved mental status may have contributed to a delayed treatment of sepsis through which *one* of the following cognitive biases?

a. Search satisfying bias
b. Ascertainment bias
c. Framing effect
d. Unpacking principle
e. Bandwagon effect

Search satisfying bias is the tendency to call off a diagnostic search once something is found.[1] In this case, the team may have been reassured with the improvement in the patient's mental status after infusion of dextrose and did not search and treat as aggressively for other contributing conditions, such as sepsis. None of the other options are likely in this case. Ascertainment bias occurs when former expectations affect thinking.[1] Framing effect occurs when reasoning is affected by the way a problem is presented.[1] An example would be the different perception of risk if a procedure is described as having a 90% success rate vs a 10% failure rate. The unpacking principle can lead to error when there is a failure to elicit all relevant information from a patient.[1] The bandwagon effect, which was previously described as how new drugs, devices, or procedures can achieve widespread popularity, is also unlikely in this case.

The hospital sepsis protocol was initiated, and central venous access was obtained. The patient was resuscitated with fluids, and a vasopressor was initiated to maintain mean arterial pressure above 65 mm Hg. The patient's mental status continued to decline. His urinary output decreased markedly, eventually resulting in anuria. Serum lactate levels, which had improved after initial resuscitation to 4.1 mmol/L, now increased substantially to 7.8 mmol/L. The patient required escalating use of vasopressors to maintain adequate pressures.

5. Which *one* of the following quality improvement tools could be used in this ICU to organize root causes of delayed initiation of the sepsis bundle in this case?

a. Define, measure, analyze, improve, control (DMAIC)
b. Six-Sigma
c. Fishbone diagram
d. Lean
e. Run chart

The DMAIC model is part of the Six-Sigma improvement methodology.[4] Six-Sigma focuses on reducing errors and variability using DMAIC in a stepwise process. Neither DMAIC nor Six-Sigma would be useful to specifically organize root causes of a problem. Alternatively, a fishbone diagram (also called a cause-and-effect diagram or Ishikawa diagram) is used to organize the root causes of a quality problem.[4] A fishbone diagram is organized so that the "backbone" is the problem and the "ribs" are the individual root causes. Lean is a quality improvement strategy that seeks to eliminate waste.[4] A run chart graphically displays variation over time. Lean and run charts would not be useful to organize root causes of a problem.

In our patient, the pathologic features of the liver biopsy specimen were consistent with cholangiocarcinoma. A care conference was held, and interventions to relieve biliary obstruction from the hepatic mass, including endoscopic retrograde cholangiopancreatography, were discussed. The patient's family elected to pursue comfort care measures, and the patient died a few hours later, 6 days after admission to the hospital and 2 days after CT-guided liver biopsy.

DISCUSSION

The Accreditation Council for Graduate Medical Education recognizes 6 competencies for physicians, including medical knowledge, patient care, professionalism, interpersonal communication, practice-based learning and improvement (PBLI), and systems-based practice (SBP). Examining patient cases in which care could have gone better can reveal areas in need of PBLI or SBP.[5] Morbidity and mortality conferences are a venue where medical errors are candidly discussed at most medical institutions. The Mayo Clinic Internal Medicine Residency Program has developed an approach to morbidity and mortality conferences to highlight the need for personal or system improvements.[6] Recognition of cognitive biases in cases in which care was suboptimal can highlight the need for personal or system improvements in the realm of the PBLI and SBP competencies.

Classically, diagnostic error was treated as an intellectual failing, but faulty or inadequate knowledge is an uncommon cause of these errors.[7] Much attention has been given to the role of cognitive bias in clinical decision making. It has been realized that the mental shortcuts of system 1 are an essential part of a physician's daily practice. These strategies allow for efficient and relatively effortless decision making, but they are not infallible. One study involving internists found that cognitive bias contributed to 74% of diagnostic errors.[7] Half of all litigation brought against ED physicians is due to missed or delayed diagnoses.[1] It is therefore important to recognize the situations that are susceptible to cognitive bias and employ strategies to decrease the risk of a costly diagnostic mistake. Additionally, it is important to note that cognitive biases may occur during system 2 or analytic thinking as well and that not all system 1 thinking leads to diagnostic error.

System 1 and the mental shortcuts it employs are not perceptible; we experience it as an intuition for or aversion to a particular test/treatment/diagnosis. Because it operates so efficiently and effortlessly, we are particularly dependent on system 1 when we are stressed, tired, or busy. Fortunately, there are strategies that physicians can employ to avoid cognitive bias, including both system and individual approaches.[8] System-wide policies include improving presentation of data, reducing physician burden, and the use of technology and clinical decision support systems.[7] Individual strategies are largely based on the idea of metacognition. The first step is appreciating the potential for bias. Once this potential is understood, we can develop individual strategies to avoid particular pitfalls. Indeed, most experienced physicians intuitively develop such strategies to broaden their differential diagnoses. Strategies to mitigate cognitive error include development of insight through education, metacognition, cognitive forcing strategies, removal of time pressures, and feedback.[1]

Many EDs and ICUs have implemented the Sepsis Resuscitation Bundle, which coordinates care with nursing and pharmacy staff to ensure that evidence-based goals are achieved within 6 hours of the diagnosis of sepsis. The bundle also includes the diagnostic criteria for sepsis and identifies the current treatment recommendations and the clinical markers to follow. This policy is an example of a system approach to avoid cognitive bias.

In summary, cognitive bias has become increasingly recognized as a cause of diagnostic error. Physicians are at risk for cognitive bias when they are stressed, tired, or busy and when confronted with an area of medicine in which they have relatively little experience. There are system and individual strategies that can be employed to reduce this risk.[8]

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CORRECT ANSWERS: 1. c. 2. e. 3. b. 4. a. 5. c

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