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Review Article

Cognitive biases in otolaryngology: a systematic narrative review

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ABSTRACT

Cognitive biases are systematic errors in thinking that significantly impact decision-making in surgery, including Otolaryngology. These biases contribute to misdiagnoses, inappropriate treatments and surgical errors, affecting patient outcomes. Despite growing recognition of cognitive biases in medicine, awareness and structured training in cognitive debiasing strategies remain limited. This narrative review systematically examines cognitive biases affecting surgical decision-making in Otolaryngology, categorizes their occurrence in different phases of surgical care and discusses mitigation strategies. A comprehensive literature search was conducted using multiple databases, including MEDLINE, Embase and Scopus, focusing on cognitive biases in surgical fields, particularly Otolaryngology. Studies that explored bias-related diagnostic errors, treatment decisions and mitigation strategies were included. Cognitive biases were classified based on their impact on the diagnostic workup, treatment phase and post-treatment follow-up. A total of 71 cognitive biases were identified as relevant to Otolaryngology. These biases were categorized according to their definitions, sources, examples in Otolaryngology and mitigation strategies. Targeted mitigation strategies, including structured decision-support tools, cognitive forcing strategies and multidisciplinary case discussions, were highlighted. Cognitive biases play a critical role in surgical decision-making in Otolaryngology, often leading to diagnostic and treatment errors. Increased awareness and implementation of cognitive debiasing strategies are essential to improving clinical reasoning and patient outcomes. Future research should focus on the effectiveness of structured interventions and the role of artificial intelligence in mitigating cognitive biases in surgery.

Keywords: Cognitive bias, Clinical decision making, Diagnostic errors, Otolaryngology, Operative surgical procedures

INTRODUCTION

Adverse events related to surgical care are increasing, many of which are considered preventable. Research suggests that medical errors occur in approximately 1.7% to 6.5% of hospital admissions, contributing to substantial morbidity and mortality annually in the United States, with estimates reaching up to 100,000

preventable deaths and close to a million injuries each year.[1] Multiple research efforts have demonstrated that cognitive biases defined as systematic thinking errors play a significant role in the occurrence of adverse events in surgical practice. Specifically, researchers have shown that CBs underlie misdiagnosis, incorrect treatment and poor intraoperative technical performance that can lead to patient harm, such as complications, never events (for example surgery on wrong site or side or patient) and death.[2-6] Cognitive bias refers to a range of mental shortcuts, known as heuristics, that individuals use to simplify problem-solving, enhance decision-making efficiency and facilitate learning. Heuristics are practical strategies or rules of thumb that, while not always logically optimal or fully accurate, often provide sufficiently effective solutions for complex tasks.[7]

A growing body of literature has shown that most errors in healthcare are due to mistakes in thinking and highlighted that CBs are a major contributor.[8,9] In response to this evidence, the National Academy of Sciences issued a report specific to diagnostic failure and the WHO has called for explicit training in clinical reasoning, managing uncertainty, critical thinking and cognitive heuristics and biases.[10,11] The landmark report from the Institute of Medicine in 1999, "To Err is Human", dramatically changed the perspective of the medical community and the public, but improvements in quality and progress in reducing harm have not proceeded at the desired rate.[12] The truth is that clinicians are human, with all the attendant weaknesses and vulnerabilities that term implies. Factors such as fatigue, burnout, high-pressure or high-risk clinical situations and increased time and productivity pressures, all reduce the ability to provide optimal and just care to every patient. The result is inconsistent decision making that directly affects the quality of the medical care they provide.

As per the Competency Based Undergraduate Curriculum 2018, the Indian Medical Graduate is expected to "demonstrate effective clinical problem solving, judgment and ability to interpret and integrate available data in order to address patient problems, generate differential diagnoses and develop individualized management plans that include preventive, promotive and therapeutic goals".[13] Unfortunately, the curriculum presently does not envisage training in cognitive and implicit biases in medicine and surgery and debiasing strategies. Hence, in light of the glaring need for greater awareness and training in this area, this paper attempts to systematically review and present the most common and important biases that may affect clinical diagnosis and management in Otolaryngology.

METHODS

This narrative review aimed to describe types of cognitive bias in surgical specialties especially Otolaryngology, their impact on surgical performance and patient outcomes, their source and mitigation strategies used to reduce their effect. A comprehensive literature search was conducted using databases such as MEDLINE, Embase, PsycINFO, Scopus, Web of Science, Cochrane Central Register of Controlled Trials and the Cochrane Database of Systematic Reviews. Search terms included combinations of the following: "cognitive bias", "otolaryngology", "surgery", "decision-making", "diagnostic errors" and related terms. We focused on articles published in the last 15 years to ensure relevance but included seminal older works when appropriate. Studies examining the influence of cognitive biases on surgical practice, along with approaches to mitigate their effects, were included in the review.

Research focusing on medical decision-making, diagnostic inaccuracies and clinical reasoning related to cognitive bias was also considered. Articles that did not specifically pertain to Otolaryngology or surgical specialties were excluded. Titles and abstracts were screened to assess relevance and full-text reviews were conducted for those meeting the initial criteria. To reduce selection bias, a second reviewer independently evaluated study eligibility. An inductive thematic approach was employed to identify patterns related to the effects of cognitive biases on surgical performance. The synthesized findings present a comprehensive overview of the current understanding of cognitive biases within Otolaryngology.

RESULTS

This review identified 71 cognitive biases relevant to surgical decision-making, particularly within Otolaryngology. These biases were systematically categorized based on their definitions, sources, examples relevant to Otolaryngology and possible mitigation strategies (Table 1). Two interesting biases, the Rashomon effect and the Dunning-Kruger effect are dealt with separately in the discussion section. Additionally, biases were classified according to their impact on different phases of surgical care: diagnostic workup, treatment phase and post-treatment follow-up (Table 2).

The identified biases were classified into distinct categories based on their occurrence in different phases of surgical practice. Among the biases, those primarily affecting the diagnostic workup included anchoring bias, availability bias, confirmation bias and premature closure. These biases contributed to misdiagnosis by causing surgeons to fixate on initial impressions, rely too heavily on recent experiences and fail to adequately consider alternative diagnoses.

In the treatment phase, commission bias, omission bias and overconfidence bias played significant roles. Surgeons were more likely to act unnecessarily due to commission bias, hesitate in necessary interventions due to omission bias or overestimate their capabilities, leading to suboptimal treatment choices. In the post-treatment follow-up stage, biases such as hindsight bias,

outcome bias and ego bias affected how clinicians interpreted patient outcomes, which could result in inaccurate evaluations of earlier decisions and the reinforcement of flawed clinical reasoning.

A comprehensive table was developed outlining each of the 71 cognitive biases, providing their definitions, sources, specific examples in Otolaryngology and mitigation strategies. This table serves as a practical resource for clinicians to recognize and address cognitive biases in their daily surgical practice. The classification of biases across different surgical phases provides further insight into when and how these biases are most likely to occur, enabling targeted strategies to improve decision-making. Several recurring themes emerged from the analysis of cognitive biases. First, diagnostic inertia seen in biases such as diagnosis momentum and premature closure was a common factor in misdiagnosis. Second, cognitive overload, including biases such as multiple alternatives bias and information bias, demonstrated how excessive data or too many diagnostic possibilities could lead to decision fatigue. Third, emotional and subjective influences, represented by visceral bias and reactance bias, highlighted the effect of personal emotions and resistance to guidelines on clinical decisions.

This structured approach to bias identification and classification underscores the need for targeted interventions, including cognitive debiasing strategies, enhanced clinical decision support systems and increased awareness among surgical practitioners to mitigate the negative impacts of these biases on patient care.

Table 1: Cognitive biases relevant to otolaryngology.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
1.	Aggregate bias[18]	Believing aggregated data does not apply to individual patients.	Overconfidence in personal patient experience.	Ignoring guidelines and ordering unnecessary imaging for routine sinusitis.	Adhere to evidence-based guidelines.
2.	Ambiguity aversion[19]	Avoiding decisions where probabilities are unknown.	Discomfort with uncertainty.	Delaying treatment for an unusual tumour due to lack of clear guidelines.	Consult specialists, use decision-support tools, consider best available evidence.
3.	Ambiguity effect[29]	Avoiding options where probabilities are unknown.	Fear of uncertainty in treatment outcomes.	Choosing a well-known but less effective treatment for vocal fold paralysis instead of an emerging but more effective therapy.	Utilize shared decision-making tools.
4.	Anchoring bias[18]	Fixating on initial information and not adjusting later.	Over-reliance on first impressions.	Diagnosing chronic otitis media based solely on history and missing cholesteatoma.	Use checklists to reassess alternative diagnoses.
5.	Ascertainment bias[18]	Letting prior expectations shape thinking.	Stereotyping patients.	Assuming a patient with a smoking history has laryngeal cancer without thorough workup.	Conduct objective clinical assessments.
6.	Attentional bias[19]	Overemphasizing one variable while ignoring others.	Focus on certain symptoms at the expense of others	Overlooking throat cancer in a patient presenting with globus sensation.	Use systematic diagnostic approaches.
7.	Authority bias[19]	Overvaluing the opinion of an authority figure regardless of evidence.	Deference to senior colleagues.	Following a senior surgeon's outdated technique despite new, safer approaches.	Encourage critical thinking, evidence-based discussions and mentorship diversity.
8.	Availability bias[19]	Overestimating the likelihood of conditions based on recent cases.	Recent patient encounters.	Over-diagnosing sinus infections after recently treating multiple cases.	Rely on objective data rather than anecdotal experience.

Continued.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
9.	Bandwagon effect[30]	Following popular beliefs without critical analysis.	Group conformity.	Preferring robotic surgery for thyroidectomy just because colleagues recommend it.	Critically appraise new techniques before adoption.
10.	Base-rate neglect[19]	Ignoring disease prevalence when making diagnoses.	Lack of probabilistic reasoning.	Diagnosing nasopharyngeal carcinoma in a low-risk patient without risk factors.	Use Bayesian reasoning for probability assessments.
11.	Belief bias[31]	Accepting conclusions that align with personal beliefs.	Personal values over data.	Favouring traditional treatments despite evidence supporting newer therapies.	Emphasize data-driven decisions.
12.	Blind spot bias[32]	Thinking oneself is less biased than others.	Overconfidence in judgment.	Ignoring peer feedback on surgical technique errors.	Encourage peer review and self-reflection.
13.	Commission bias[18]	Preferring action over inaction.	Belief that intervention is always beneficial.	Performing an unnecessary tympanoplasty in a patient with mild hearing loss.	Weigh risks vs. benefits carefully.
14.	Confirmation bias[18]	Seeking evidence that supports preconceptions.	Selective information gathering.	Interpreting an MRI finding as cholesteatoma despite conflicting evidence.	Encourage considering alternative diagnoses.
15.	Congruence bias[33]	Relying only on direct testing of hypotheses.	Over-reliance on direct testing.	Relying only on endoscopic examination without imaging in nasal tumours.	Use multiple diagnostic modalities.
16.	Contrast effect[34]	Judging a case differently based on prior cases.	Relative perception shifts	Underestimating the severity of a deviated septum after treating a severe case.	Standardize assessment criteria.
17.	Denominator neglect[19]	Ignoring the total number of cases when assessing risk.	Misinterpretation of probabilities.	Overestimating rare complications of a procedure without considering its overall success rate.	Use statistical reasoning, Bayesian analysis and evidence-based risk assessments.
18.	Deviant bias[48]	Individuals disproportionately focus on rare, unusual or extreme cases rather than typical or representative ones and therefore, exceptional cases are given more weight than common patterns.	Human tendency to notice and remember outliers more than routine cases. Reinforced by media reports, personal experiences or dramatic case presentations in medical education.	An ENT resident overestimates the risk of spontaneous epistaxis being caused by a nasopharyngeal tumor, leading to overuse of imaging in routine nosebleed cases.	Use statistical reasoning, Debriefing and case reviews, Avoid fear-driven decision-making
19.	Diagnosis momentum[18]	Sticking to an initial diagnosis despite new evidence.	Reinforced diagnostic labels.	Treating a patient repeatedly for “chronic tonsillitis” without considering malignancy.	Routinely re-evaluate cases.
20.	Distance bias[35]	Preference for information or options	Proximity of resources, familiarity	A physician prioritizes referring	Encourage telemedicine consultations, educate on

Continued.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
		that are physically or psychologically closer, while undervaluing distant alternatives.	with local healthcare options.	a patient to a nearby general ENT clinic rather than a distant specialized head and neck cancer centre, delaying critical care.	specialized referral networks and consider best available options over convenience.
21.	Distance bias[36] (subset overlapping with Referral bias)	Patients who travel farther for specialized care may experience better outcomes due to selection bias and higher-quality healthcare at specialty centers.	Healthcare system structure, patient self-selection.	Patients who seek treatment at tertiary centers for complex ENT cases, such as head and neck cancer, may have better outcomes due to access to more experienced specialists and multidisciplinary care.	Encourage objective evaluation of all treatment options, ensure fair access to specialized care regardless of distance and use telemedicine for remote consultations.
22.	Dunning-Kruger effect[37]	People with low ability overestimate their competence, while experts may underestimate their own abilities.	Lack of self-awareness, limited exposure to complex cases, overconfidence in early career stages.	A junior ENT resident confidently diagnoses a complex head and neck tumour but misinterprets critical findings, leading to delayed proper management.	Structured training programs, mentorship from senior colleagues, surgical competency checklists, simulation-based learning.
23.	Ego bias[38]	Overestimating one's own patients' prognoses.	Personal investment in outcomes.	Assuming better-than-average recovery rates post-ENT surgery.	Use statistical benchmarks for outcome assessment.
24.	Expectation bias[39]	Seeing what one expects to see.	Preconceived notions.	Expecting recurrent sinusitis in allergy patients without confirming.	Maintain diagnostic objectivity.
25.	Experience bias[19]	Relying too heavily on personal experience rather than objective data.	Subjective recall, selective memory.	A surgeon avoids a procedure due to a single past complication, despite a strong overall success rate.	Use objective outcome data; engage in evidence-based discussions.
26.	Feedback sanction[40]	Diagnostic errors go uncorrected due to lack of feedback.	Poor systemic learning.	Missing a foreign body in a child but never being informed of the delayed diagnosis.	Implement feedback loops in practice.
27.	Frame blindness[18]	Fixation on a single way of viewing a problem, preventing consideration of alternative perspectives.	Narrow clinical framing, over-reliance on initial impressions, failure to re-evaluate symptoms.	A patient with recurrent otitis media is repeatedly treated with antibiotics, while an underlying nasopharyngeal carcinoma is missed.	Encourage cognitive flexibility, structured decision-making frameworks, multidisciplinary case discussions, reflective practice.
28.	Framing effect[19]	Decisions influenced by how data is presented.	Perception of risk.	More likely to recommend surgery if risks are presented in survival terms	Use neutral, evidence-based risk discussions.

Continued.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
				rather than mortality.	
29.	Fundamental attribution error[41]	Blaming patient factors rather than external influences.	Stereotyping.	Assuming a patient's voice issues are self-inflicted (e.g., smoking) rather than reflux-related.	Consider all differential diagnoses objectively.
30.	Gambler's Fallacy[19]	Believing that independent events affect future outcomes.	Misinterpretation of probability.	Thinking that after diagnosing multiple benign polyps, the next must be malignant.	Treat each case independently.
31.	Gender bias[42]	Letting gender influence diagnosis.	Stereotyping.	Underdiagnosing obstructive sleep apnoea in women.	Base decisions on clinical evidence, not stereotypes.
32.	Hawthorne effect[43]	Alteration of behaviour due to awareness of being observed.	Increased scrutiny or monitoring in clinical practice.	A surgeon is extra meticulous in following post-op protocols when being audited but may relax them otherwise.	Foster consistent adherence to protocols, promote a culture of accountability, use randomized audits rather than scheduled evaluations.
33.	Hindsight bias[18]	Believing an event was predictable after the fact.	Retrospective judgment distortion.	Claiming a misdiagnosis of epiglottitis should have been obvious.	Encourage objective case reviews.
34.	Illusory correlation[44]	Assuming a causal relationship where none exists.	Coincidental associations.	Assuming all hoarseness cases in smokers indicate cancer.	Base decisions on scientific evidence.
35.	Information bias[45]	Collecting excessive data unnecessarily.	Over-testing tendency.	Ordering full-panel allergy testing for all chronic rhinitis cases.	Focus on clinically relevant testing.
36.	Insurance bias[19]	Making clinical decisions influenced by reimbursement policies rather than patient need.	Financial incentives, systemic constraints.	Ordering unnecessary imaging for sinusitis because insurance covers it.	Follow evidence-based guidelines, advocate for value-based care models.
37.	Multiple alternatives bias[46]	Having too many options can lead to uncertainty and poor decisions.	Overwhelming differentials.	Struggling to prioritize among multiple causes of vertigo.	Use structured decision-making tools.
38.	Mere exposure effect[47]	Preferring familiar options.	Familiarity bias.	Preferring a traditional surgical approach over newer, evidence-based methods.	Regularly review updated clinical guidelines.
39.	Need for closure[48]	Rushing to conclusions due to discomfort with uncertainty.	Time pressure.	Hastily diagnosing allergic rhinitis without considering vasomotor rhinitis.	Emphasize 'Not Yet Diagnosed' (NYD) when uncertain.
40.	Omission bias[18]	Preferring inaction over action to avoid potential harm.	Fear of negative outcomes.	Avoiding early tracheostomy in critically ill patients	Balance risks and benefits objectively.
41.	Order effects[18]	Information is weighted based on the order it was received	Serial position effects.	Overvaluing the first or last symptom mentioned by a patient.	Consider all patient history details equally.
42.	Outcome bias[18]	Judging decisions based on results rather	Retrospective distortion.	Justifying unnecessary	Evaluate decision quality independently of

Continued.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
		than reasoning.		surgery because the patient recovered well.	outcomes.
43.	Overconfidence bias[18]	Believing one knows more than they do.	Over-reliance on intuition.	Ignoring imaging and proceeding with a diagnosis based on experience alone.	Seek second opinions and objective data.
44.	Planning fallacy[19]	Underestimating the time, effort or risks associated with a task.	Overconfidence in prediction.	A surgeon schedules a complex endoscopic sinus surgery for one hour when it typically requires two.	Review past case durations, use checklists and allow buffer time.
45.	Playing the odds[49]	Choosing common diagnoses over rare ones in ambiguous cases	Probability assumptions.	Diagnosing benign polyps without considering malignancy in a high-risk patient.	Use Bayesian reasoning and risk stratification.
46.	Posterior probability error[18]	Basing current diagnoses too much on past diagnoses.	Sequential reasoning errors.	Assuming a patient's recurring sore throat is always due to tonsillitis without re-evaluating.	Consider new differentials in recurrent cases.
47.	Premature closure[18]	Stopping the diagnostic process too early.	Diagnostic inertia.	Failing to investigate persistent hoarseness beyond GERD.	Ensure thorough differential diagnosis evaluation.
48.	Psych-out error[18]	Mistaking medical conditions for psychiatric issues.	Bias against psychiatric patients.	Misdiagnosing dizziness in an anxiety patient without ruling out Meniere's disease.	Rule out medical causes before attributing symptoms to psychiatry.
49.	Rashomon effect[50]	Different individuals interpret the same event differently based on personal perspectives, experiences and biases.	Variability in clinical experience, specialty background or personal biases.	A patient with chronic hoarseness is diagnosed as GERD by a primary care physician, vocal strain by a speech therapist, laryngeal cancer by an otolaryngologist and vocal cord paralysis by a radiologist.	Multidisciplinary team discussions, standardized diagnostic protocols, reliance on objective diagnostic tools like imaging and laryngoscopy.
50.	Reactance bias[51]	Rejecting rules or guidelines to assert independence.	Autonomy bias.	Ignoring standard antibiotic guidelines for sinusitis.	Follow evidence-based protocols despite personal preferences.
51.	Recency effect[19]	Giving more weight to recent experiences over older data.	Cognitive availability.	Diagnosing multiple cases of flu-induced sinusitis and then assuming the next patient with sinus symptoms has the same.	Use systematic diagnostic criteria rather than recent trends.
52.	Referral bias	The tendency for referred patients to	Differences in patient selection between	An otolaryngologist at	Maintain awareness of referral patterns, review

Continued.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
		have different characteristics than those seen in primary care, often leading to distorted perceptions of disease prevalence and severity.	primary care and specialist settings.	a tertiary care center assumes that all cases of chronic sinusitis require surgery because they primarily see refractory cases that have already failed medical management.	population-based data and consider broader epidemiological trends rather than relying solely on referred cases.
53.	Representativeness heuristic[52]	Judging probability based on how similar something is to a known case, rather than actual statistical likelihood.	Pattern recognition errors.	Assuming a young non-smoker with hoarseness has vocal strain rather than laryngeal cancer.	Use Bayesian probability, consider all differential diagnoses systematically.
54.	Representativeness restraint[19]	Looking only for textbook cases and missing atypical presentations.	Pattern recognition errors.	Missing atypical presentations of head and neck cancer.	Consider broader differentials.
55.	Risk aversion[19]	Preferring options with lower risk, even when higher risk options may yield better outcomes.	Fear of complications or poor outcomes.	Avoiding a necessary but complex laryngeal surgery due to the risk of vocal cord paralysis.	Weigh risk-benefit ratios objectively, consider long-term patient outcomes.
56.	Risk seeking[19]	Preferring high-risk options despite safer alternatives.	Sensation-seeking, overconfidence.	Choosing experimental surgical techniques without sufficient evidence of benefit.	Follow evidence-based practice, ensure proper training and oversight.
57.	Risk Underestimation[19]	Failing to recognize the true level of risk involved in a procedure.	Lack of awareness or optimism bias.	Performing routine tonsillectomy without fully considering the risk of postoperative bleeding.	Use risk calculators, informed consent discussions and complication tracking.
58.	Search Satisfying[18]	Stopping the diagnostic process once something is found.	Diagnostic complacency.	Diagnosing a nasal polyp and missing an underlying tumor.	Always search for additional findings.
59.	Self-Evaluation bias[19]	Overestimating personal performance or decision-making ability.	Subjective self-assessment.	A surgeon assumes their complication rates are lower than peers without reviewing objective data.	Regular performance audits, peer reviews and objective metrics.
60.	Self-Serving bias[53]	Taking credit for successes but deflecting failures.	Personal bias	Claiming expertise when a surgery goes well but blaming conditions when it does not.	Promote a culture of reflective practice.
61.	Semmelweis reflex[54]	Rejecting new evidence contradicting established beliefs.	Resistance to change.	Ignoring new laryngopharyngeal reflux treatment methods due to reliance on older protocols.	Stay open to evolving medical evidence.
62.	Social Loafing bias[19]	Individuals exert less effort in group settings.	Group dynamics and shared responsibility.	A junior resident assumes the attending will not catch any minor mistakes, leading to less vigilance.	Foster accountability, distribute tasks clearly and encourage active participation.

Continued.

S. no	Bias	Definition	Source	Example in otolaryngology	Mitigation strategy
63.	Status quo bias[19]	Preferring to keep things as they are rather than change.	Resistance to new practices.	Continuing outdated antibiotic regimens for otitis media despite new guidelines.	Encourage continuing education, follow updated clinical protocols.
64.	Sutton's slip[18]	Going for the obvious diagnosis without deeper analysis.	Heuristic shortcuts.	Diagnosing otitis media without considering mastoiditis	Ensure systematic workups.
65.	Sunk Cost Fallacy[18]	Sticking with a diagnosis due to prior investment.	Diagnostic entrapment.	Continuing failed medical management of chronic sinusitis instead of considering surgery	Be willing to reassess when treatment fails.
66.	Triage Cueing[18]	First impressions at triage influence subsequent care.	Initial categorization errors.	Under-triaging a patient with mild initial symptoms of airway compromise.	Ensure ongoing reassessment.
67.	Unpacking principle[18]	Failing to elicit all necessary information.	Incomplete history-taking	Missing a patient's occupational exposure in chronic rhinosinusitis.	Use comprehensive history-taking templates.
68.	Vertical line failure[18]	Thinking in rigid diagnostic silos.	Lack of lateral thinking.	Missing an autoimmune cause for chronic otitis media.	Encourage interdisciplinary collaboration.
69.	Visceral bias[18]	Emotional reactions clouding judgment.	Subjectivity in patient interactions.	Under-treating a patient perceived as 'difficult.'	Maintain professional detachment.
70.	Yin-Yang out[18]	Giving up on further diagnosis after extensive testing.	Diagnostic fatigue.	Dismissing chronic dizziness as idiopathic without exploring central causes.	Maintain persistence in unclear cases.
71.	Zebra retreat[55]	Avoiding rare diagnoses due to systemic barriers.	Resource constraints.	Avoiding workup for an unusual paraganglioma due to limited access to specialists.	Pursue testing when clinically justified.

Table 2: Classification of cognitive biases based on surgical phases.

Bias	Diagnostic workup phase	Treatment phase	Post-treatment follow-up phase
Anchoring bias	+	-	-
Availability bias	+	-	-
Confirmation bias	+	-	-
Diagnosis momentum	+	+	-
Premature closure	+	-	-
Overconfidence bias	-	+	+
Commission bias	-	+	-
Omission bias	-	+	-
Hindsight bias	-	-	+
Outcome bias	-	-	+
Ego bias	-	+	+
Fundamental attribution error	+	-	+
Framing effect	+	-	+
Multiple alternatives bias	+	-	-

Continued.

Bias	Diagnostic workup phase	Treatment phase	Post-treatment follow-up phase
Mere exposure effect	+	+	-
Need for closure	+	-	-
Triage cueing	+	+	-
Zebra retreat	+	-	-
Illusory correlation	+	-	+
Rashomon effect	+	+	+
Reactance bias	-	+	-
Representativeness restraint	+	-	-
Search satisfying	+	-	-
Self-serving bias	-	+	+
Semmelweis reflex	-	+	-
Sunk costs	-	+	-
Unpacking principle	+	-	-
Vertical line failure	+	-	-
Visceral bias	+	+	+
Yin-yang out	+	-	+
Bandwagon effect	+	+	-
Base-rate neglect	+	-	-
Belief bias	+	-	-
Blind spot bias	-	+	+
Feedback sanction	-	-	+
Gambler's fallacy	+	-	-
Hawthorne effect	-	+	-
Information bias	+	-	-
Playing the odds	+	-	-
Posterior probability error	+	-	-
Psych-out error	+	-	-
Order effects	+	-	-

DISCUSSION

Tversky and Kahneman were among the first to describe two distinct modes of thinking involved in decision-making under uncertainty: Type 1 and Type 2 processes. Type 1 thinking is characterized by its speed, intuitive nature and reliance on pattern recognition, requiring minimal cognitive effort.

As noted by O'Sullivan and Schofield, this form of reasoning enables rapid decision-making but may lack depth. In contrast, Type 2 thinking is more deliberate, analytical and cognitively demanding, making it better suited for handling complex or unfamiliar problems. Research suggests that individuals rely predominantly up to 95% of the time on Type 1 thinking.[15] While efficient, this mode is more prone to cognitive biases, which are mental shortcuts that simplify decisions but can lead to systematic errors. Many biases arise when intuitive (Type 1) responses override more reflective (Type 2) processes, underscoring the importance of balancing both systems in clinical reasoning.[16,17] The evidence suggests that cognitive biases significantly contribute to diagnostic errors, suboptimal treatment choices and delayed recognition of complications. Among the most frequently observed biases, anchoring bias, overconfidence bias and confirmation bias have been shown to be particularly influential in surgical settings.[18] Anchoring bias leads surgeons to fixate on initial impressions, often resulting in misdiagnosis when alternative possibilities are not sufficiently explored.

Overconfidence bias, prevalent among experienced surgeons, fosters undue reliance on personal judgment, which may contribute to unwarranted surgical interventions or failure to seek second opinions. Similarly, confirmation bias perpetuates diagnostic errors by reinforcing pre-existing beliefs rather than integrating new, contradictory evidence. Cognitive biases can also be influenced by individual personality traits, such as a tendency to avoid risk or discomfort with uncertainty, which may consistently shape clinical judgments and choices.

Decisions affected by these biases may not only be incorrect but also less than optimal, increasing the likelihood of medical errors. Enhancing awareness, comprehension and modification of bias-influenced decisions holds promise for improving patient care and outcomes. A key contribution of this review is the

classification of cognitive biases based on their occurrence in different surgical phases diagnostic workup, treatment phase and post-treatment follow-up. Diagnostic workup is particularly vulnerable to biases such as premature closure and diagnosis momentum, where clinicians accept an initial diagnosis too readily, leading to missed alternative conditions. In the treatment phase, commission bias and omission bias emerge as critical factors affecting surgical decision-making, with commission bias prompting unnecessary interventions and omission bias leading to delayed treatments due to an aversion to perceived harm. Post-treatment follow-up is notably affected by hindsight bias and outcome bias, where retrospective judgments on patient outcomes shape future decision-making in a way that may not align with evidence-based practice.[19,20]

The literature highlights several strategies to mitigate cognitive biases in surgical decision-making. Implementing structured decision-support tools, promoting reflective practice through case reviews and fostering interdisciplinary discussions are crucial steps toward reducing bias-related errors.[20,21] Additionally, training programs that emphasize metacognition an awareness of one's cognitive processes have been shown to improve diagnostic accuracy and treatment planning.[18] A key approach to reducing bias is cognitive forcing strategies, which involve deliberate steps to counteract common biases by prompting clinicians to slow down and consider alternative possibilities.

Checklists and clinical decision support systems (CDSS) can help standardize diagnostic approaches and prevent premature closure by ensuring that all possible differentials are considered. Debriefing sessions and peer discussions provide opportunities for clinicians to reflect on past decisions and recognize patterns of bias in their thinking.[22-24] Furthermore, simulation-based training has emerged as an effective method for mitigating biases by exposing surgeons to diverse scenarios where they must identify and correct cognitive errors in a controlled environment. Encouraging the use of Bayesian reasoning where probability estimates are updated as new information emerges can help counteract availability and base-rate neglect biases.[25] Finally, fostering a culture of humility and openness to second opinions can combat overconfidence bias, ensuring that clinical decisions are thoroughly vetted before implementation.[26]

Despite the growing recognition of cognitive biases in surgery, research on their mitigation remains limited. Future studies should focus on evaluating the effectiveness of debiasing interventions, such as cognitive forcing strategies and structured diagnostic algorithms, in real-world clinical settings.[27,28] Moreover, the integration of artificial intelligence (AI) in surgical decision-making presents a promising avenue to counteract human biases by providing objective, data-driven recommendations.

CONCLUSION

Cognitive biases are an inherent aspect of human decision-making and significantly impact surgical outcomes. By understanding how these biases manifest across different phases of surgical care, Otolaryngologists and other surgical specialists can implement targeted mitigation strategies to improve diagnostic accuracy, optimize treatment plans and enhance patient safety. Continued research into cognitive bias reduction techniques will be essential in fostering a more reliable and evidence-based surgical practice.

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