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Metaphor and Anesthesia

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METAPHOR is commonly considered a poetic device and hence irrelevant to the highly technical world of anesthesia, in which practical matters like flowmeters and pulse oximeters prevail. The possibility that literary theory could have any conceivable benefit to the clinician or scientist has "fueled impassioned debate since the Victorian era."¹ In general, such notions are now met, at best, with a benign nod to the fringe element of medicine.

Metaphors are profoundly important to the practice of anesthesia. This article examines the questions of how and why metaphors are involved with anesthesia. First, metaphor is defined and current theories on how metaphors shape our language, behavior, culture, and thought processes are reviewed. Included are definitions of related tropes (figures of speech) whose roles mimic or complement metaphor. Second, the relationships between metaphor and anesthesia are explored. Third, the interaction between science and metaphor and the particular implications for anesthesia research are considered. The alteration in the state of being that defines the anesthetized state is, by nature, intangible, and hence may require metaphor for comprehension. Fourth, a brief exploration of some diverse areas of anesthesia practice, such as subspecialties and economics, highlights the ubiquity of metaphors in our work as anesthesiologists.

An examination of the metaphors in anesthesia can enhance the understanding of our specialty by offering a different perspective. It also raises the questions of

why metaphors are pervasive in medicine and whether such metaphors are useful, harmful, or both. The moral and philosophical implications of metaphor in anesthesia, however, can be debated only when critical attention is paid to the manifestations of metaphor in anesthesia practice and research.

Metaphor: What Is It?

Definition and Classification of Metaphor

The word metaphor is derived from the Greek, *metapherein*, to transfer, and is defined as "the application of a word or phrase to an object or concept it does not literally denote, suggesting comparison to that object or concept."² For example, the phrase, "metaphor is a tool," is a metaphor. A metaphor, "A is B," confers properties of one concept or domain (B, the vehicle) onto another (A, the tenor).³ Metaphor involves a process using cognitive, affective, and somatic ways of knowing to discover the correspondences between A and B. Although metaphors are asymmetric analogies (*i.e.*, B onto A), there is still some mapping in the reverse direction. The correspondences that are made are selective and in fact unknown until the two concepts are related metaphorically. At that point, metaphors create meaning.⁴ Ricoeur's pithy epigram summarizes this aspect: "The metaphor is not the enigma but the solution of the enigma."⁵

Theories and debate about metaphor have flourished since Aristotle praised the masterful use of metaphor as a "sign of genius, since a good metaphor implies an intuitive perception of the similarity in dissimilars."⁶ Not all critical thinkers have been enamored of metaphor. Plato abhorred it; Hobbes, Locke and other Enlightenment philosophers felt the rhetorical uses of metaphor were dangerous and antithetical to the search for truth.^{7,8} Nonetheless, many researchers in the fields of philosophy of science, linguistics, psychoanalytic theory, as well as modern literary critique theory view the study of metaphor as pertinent and important.⁹⁻¹⁹ Currently, the apprehension of metaphor is used to

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explain seemingly diverse cognitive processes. Metaphors are much more than literary tropes.

For example, the use of a *symbol* as a representation can be viewed as a metaphoric process that presents the vehicle but only implies the tenor.⁷ Symbols range from polysemous representations of complex states or experiences (*e.g.*, shaking the hand of a patient can symbolize a sense of humanity, the end of the interview, *etc.*), to simple signs (signals, icons, logotypes, or other graphic notations). Symbols are, in effect, "the embodiment or enactment of metaphor."⁴ For instance, we say that a red light "means" stop. The word "means" is actually a metaphoric transformation: seeing a color in a certain shape is translated into movement (braking, decelerating). Because the metaphoric aspect of this representation becomes hidden within the system, the system may come to be viewed as objective "truth." Literal speech and the alphabet are examples of forgotten, conventionalized metaphor. By uncovering the metaphoric nature of the initial transformation, new insight into the limitations of the system and associated symbols is possible.

Some current definitions of metaphor and its roles are quite expansive. In their book *Metaphors We Live By*, Lakoff and Johnson argue that "metaphor is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature."⁸ Metaphors can be considered tools for understanding, categorizing and working with new experiences.⁴ Verbrugge defines the cognitive process of metaphor: "Language can induce or express metaphoric perception or action, but the linguistic forms are not themselves metaphoric. Metaphor is better conceived to be a type of dynamic process in living systems—a process that can alter perception, thought, or action in particular ways, but does not necessarily have language as a catalyst or consequence. In short, metaphoric processes are a class of biological events, a class not limited to literary contexts, not limited to linguistic behavior, and perhaps not limited to humans."²⁰ In other words, metaphor is the "aha!" process itself, the formation of a new link or connection between two previously unlinked concepts.

Metaphors may be classified as: *orientational* (or spatial), *ontological* (or conceptual), and *structural*. An orientational metaphor is based on human experience, on how we function day to day. For in-

stance, the concept of up-down is fundamental to the way we live, that is, on the surface of a planet with a gravitational field. Similarly, our conception of front-back, in-out, and so on, is based on our experience, on the developmental understanding of self *versus* nonself. An example of a metaphor, intrinsic to our language, based on the up-down concept is "wake up!" Here, awake is up, and by implication, asleep is down. An ontological metaphor transforms a nonentity, such as a state of being, or an imperfectly bounded entity into a substance or a bounded entity. For example, the phrase, "he's out of his mind," implies the metaphor, "the mind is a container." A structural metaphor uses complex or multiple aspects of one concept to structure another concept. For example, the metaphor, "the mind is a machine," allows one to impart many (but not all) aspects of machinery and technology onto the concept of the mind. Hence the mind can be "rusty," "revved up," "not running on all cylinders," or have "a screw loose." Linguistic theory contends that metaphors are not random, and that multiple metaphors on a single topic tend to demonstrate coherence among images.⁸ Because different metaphors that refer to the same topic may reveal different aspects of that topic, metaphors help us understand multifaceted, difficult concepts. In fact, metaphoric language increases the more complex or unknowable the topic.²¹

Tropes Related to Metaphor

Several other tropes that are closely linked to metaphor need some clarification: *metonymy*, *synecdoche*, *simile*, *analogy*, and *synesthesia*. Metonymy is a "figure in which one word is substituted for another on the basis of some material, causal or conceptual relation."⁷ There is a relationship, often referred to as contiguity, between the two words or phrases. Synecdoche can be defined as a subset of metonymy in which a part is substituted for a whole, or a species for a genus, or *vice versa*. Frequently, metonymy and synecdoche are indistinguishable, so I will use the more encompassing term. Metonymy differs from metaphor in that metonymy is more directly referential. For example, in the directive "Look it up in Miller!" the editor is substituted for that which he edited. This is a metonymy; Dr. Miller would most likely not appreciate a literal reading of the phrase. It is not a metaphor because there are no attributes of man and book that are being compared.

In many ways, metonymy is a verbal shorthand and is pervasive in everyday and medical parlance. "I'm doing a carotid tomorrow" or "she intubated the patient" are metonymic phrases. As these examples demonstrate, however, metonymy is often more than merely referential. The choice of words influences the import of the sentence. What customer would feel welcome in a restaurant if he heard his waiter say: "The ham sandwich wants his check"?⁸

Simile is a comparison using a connecting word or words (most commonly "like" or "as") to reveal an unexpected likeness between two different things.⁷ "The patient's skin is like leather" is a simile. Many consider simile and metaphor to be two versions of the same figure, for instance, that metaphor is a compressed simile. Aristotle gave simile a less exalted role than metaphor: "The simile . . . is a metaphor, differing from it only in the way it is put; and just because it is longer it is less attractive."²² Metaphor has more energy, whereas simile tends to soften the comparison.²³ In the example given earlier, for instance, the use of the word "like" makes allowances in the phrase itself; there are probably some aspects or parts of the skin that are *not* like leather. But the metaphor, "the patient's skin is leather," implies that not only is all of the skin leather, but that perhaps even some other aspects of the patient could be considered bovine. Part of the reason for this effect is that the words "skin" and "leather" are physically closer together in the metaphor. One of the metaphors that we live by, "being closer is exerting a stronger effect," is reflected in our language as well: the closer two words are in a sentence, the more effect they will have on each other.⁸ Nonetheless, simile is a powerful trope and, like metaphor, simile maps attributes of one domain onto another. Hence, similes are understood in a similar, or even identical, manner to metaphors, and are studied in nonliterary contexts as metaphors.¹³

Analogy is also a form of metaphor, a proportional metaphor, and introduces more elements: "A is to B what C is to D."⁵ "The laryngoscope is to the anesthesiologist what the flashlight is to the spelunker" is an analogy that compares laryngoscopy to the exploration of unseen worlds.

Lastly, *synesthesia* is a specific type of metaphoric transformation: one sense modality is described in terms of another.⁷ For example, "moist rales" is an auscultatory finding with a nonaural sensory mode descriptor: touch. Synesthesia is one of the basic methods of categorization and is demonstrable in infant behavior

(e.g., the calming effect of a mother's voice on a hungry infant before actual feeding).^{4,24}

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Perception of Anesthesia: "Under Anesthesia"

The phrase, "under anesthesia," reflects an entire system of metaphors about anesthesia. It is both an orientational metaphor (anesthesia is down) and an ontological metaphor (anesthesia is a substance or entity that one can be underneath). The metaphor is pervasive in concepts concerning anesthesia. Not only does it affect how anesthesiologists view their work, it also affects how the public views anesthesia.

Why is anesthesia "down?" This metaphor is based on human experience: conscious is up; unconscious is down. People sleep "lying down," and "stand up" when they awaken. You "fall" asleep; you "sink" into a coma. Up-down metaphors are deeply rooted in our language and perceptions. In general, up is equated with good, and down with bad. Health and life are up; sickness and death are down. "She's in top shape." "He came down with a cold." "She dropped dead." Having control is up; being subject to control is down. "I have control over him." "He's underprivileged." Happy is up; sad is down. "Flowers boost my spirits." "I'm feeling low." High status is up; low status is down. "She's climbing the corporate ladder." "She's at the bottom of the heap." Virtue is up; depravity is down. "He has high standards." "He's underhanded." To be up, then, is to be awake, healthy, in control, happy, important, and virtuous.⁸ Conversely, to be down, as in "under anesthesia," is associated with negative and undesirable images. Just from the intrinsic semantics of our language, people will fear anesthesia.

Cultural and religious beliefs and iconography are also part of the up-down metaphoric system. Heaven is up; hell is down. The further down you go into the inferno, the worse it gets. Test yourself: think of the metaphor, "education is a stairway." You envision "education" as going "up" the stairway, not down. Hence, advertisements for anesthetics graphically represent the emergence from anesthesia with images of vertical, rising people (fig. 1).

This orientational metaphor also reinforces the concept of anesthesia as sleep or a form of death, perhaps suspended animation (suspended betwixt life and death). Indeed, some authors have recommended the anesthesiologist as *the* logical specialist to perform ac-



Fig. 1. A vertically rising person is a metaphor for emergence from general anesthesia. Reproduced with permission from Zeneca, Inc.

tive euthanasia,²⁵ whereas others have recognized the inherent dangers of such an association.^{26,27} In that one of the metaphoric roles of the anesthesiologist is as a guide to the patient through the perioperative period, it behooves us to ponder the implications of becoming the guide to death for the dying. Usually the hospitalized patient envisions the physician "as the sole barrier standing between himself and the Angel of Death,"²⁸ not as the "Angel of Death" *per se*.

The preponderance of "down is bad" metaphors is a potential disadvantage to invoking the sleep metaphor. The anesthesiologist may say to the patient just before induction of general anesthesia: "Now you're going to sleep," or "Have a pleasant dream." These phrases are spoken with good reason: to explain the unknown (anesthesia) using a familiar experience (sleep) in an attempt to comfort the patient. The anesthesiologist, however, needs to be aware that invoking this metaphor may not be completely reassuring to the patient. The sleep metaphor describes only certain aspects of anesthesia. Patients know they cannot undergo painless surgery while merely asleep, nor will they be able to rouse themselves unassisted during an anesthetic. Anesthesia is even further "down" than sleep. The prototypical patient counts down (or backward) from one hundred during induction of anesthesia, but the insomniac counts increasing numbers of sheep while trying to get *to* sleep. Far worse, the anesthesiologist can evoke images of death during induction. "I'm putting you to sleep now" can sound like dear old Fido's final trip to the veterinarian.

Not all of the metaphors for an altered state of consciousness are up-down oriented. Inside-outside (also known as container) metaphors also exist. For example, in the phrases, "he's out of it" or "he's out," dysfunction is being outside of the container, being out in the unknown. The ramifications of these metaphors are more limited because in many container metaphors, it is better to be outside. For instance: "she's still in critical condition; she's in a coma." Although one might enjoy being on the *inside* if the container holds love or luck, one would be better off *outside* if the container holds danger or trouble. However, the orientational metaphor usually associated with the state of anesthesia is up-down, a more cohesive system of metaphors.

This metaphoric system also pervades the practice and theory of anesthesia. Anesthesiologists discuss "depth of anesthesia" and "deep" *versus* "light" levels of anesthesia. The classic 1937 table of Guedel's stages of ether anesthesia configures the stages as rows across the page (figure 2).²⁹ The first stage, or lightest level, is at the top of the figure; the fourth stage, "respiratory paralysis," spans the bottom of the figure. In the "deeper" levels of anesthesia, the cardiorespiratory and neurologic systems are "depressed." During emergence, the patient "wakes up." It is difficult to speak of anesthesia without acknowledging the impact of the up-down metaphor attached to the simple phrase, "under anesthesia."

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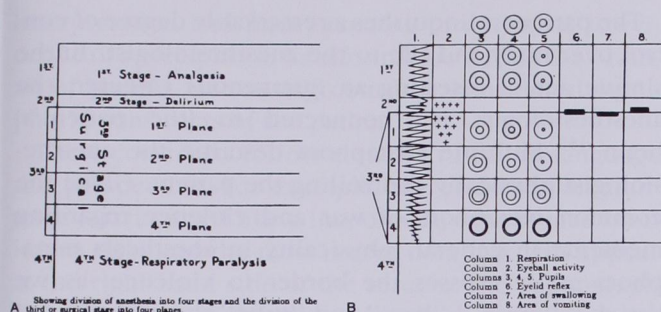


Fig. 2. The stages and planes of ether anesthesia provide a framework for the metaphor of "depth of anesthesia." Reproduced with permission.²⁹

Perception of Patients: The Patient as Object

Metaphoric thinking is encouraged in infancy during interactions with adults and develops in early childhood.^{24,30} Throughout life, metaphors become so ingrained in our perceptual and conceptual systems that they invisibly affect and even direct our actions.³¹ By influencing attitudes, metaphors and language also determine aspects of behavior, particularly patient care.³² Sontag eloquently argues that the impact of metaphors associated with disease, such as "cancer treatment is war" or "AIDS is a plague," is devastating for the patient.³³ Diseases, and the patients who have them, are given moral meanings *via* metaphor.³⁴⁻³⁹ For instance, the cancer patient is a "victim" and the AIDS patient is "contaminated." However, because we live in a world of symbols, we cannot strip all metaphor from disease.^{40,41} But by revealing and discussing metaphors associated with patients and disease, perhaps more humanistic patient care will result.⁴² Most of the current metaphors about patients limit our ability to view patients as little more than "the sum of their organs, diseases, or economic value . . . [and] we are all too often forced, inadvertently, into useless, harmful, or insensitive ways of thinking."⁴³

Anesthesiologists frequently use metonymy to refer to their patients. The patient is the surgery ("The CABG is still on bypass"), the part of the body to be operated on ("The hip needs an ICU bed"), or the disease ("The hernia ate breakfast"). This is verbal shorthand and is not usually intended in a pejorative sense. This type of metonymy is particularly prevalent in situations of high stress and limited continuity of care, such as anesthesia, emergency medicine, internship, and residency training. Owing to a lack of history with the patient, there is limited value attributed to remembering the patient's name. The

name becomes just another icon for the patient and gives no further information about "the case."

Much of the anesthetic jargon explored and deplored by Eger and others is metonymic in nature.^{44,45} A part of the patient's body is expressed as the entire patient. Thus a whole patient is "a difficult intubation" or "tough to ventilate." Although this compressed or elliptical manner of speaking may be considered imprecise, only rarely is it misunderstood.

Metonymy is primarily a referential process, but it also provides understanding beyond mere substitution. For example, the phrase, "she's a brain" in everyday usage gives "she" attributes of a "brain," such as intelligence. However, if the anatomic part is merely a substitute for the whole person, a sense of dehumanization is perceived. In the phrase, "the blonde is cute," the person is only seen as a physical attribute. In fact, metonymic uses of the parts of the body for the whole in everyday speech are usually judgmental. An exception is the substitution of the face for the whole body, as in a photograph.⁸ I would be considered odd if I said "Here are my kids" and showed a picture of their knees, but I would not be strange if the picture was of their faces.

By using metonymic references for patients, even without a conscious intent to denigrate, the anesthesiologist can be perceived (especially by one outside of the "club") as uncaring. The effect of such references is dehumanization of the patient.^{12,39} As a family member, you would protest: "Hey, that's no TURP, that's my father!" A similar, though less intense, feeling of anonymity and depersonalization occurs when the surgeon yells, "Anesthesia, raise the table!"

Metonymic references to patients can incite even more damage. Metonymy facilitates placing blame for any anesthetic difficulty on the patient. For instance, it becomes the patient's fault that a problem exists because he becomes the problem; he not only has a difficult airway, "He *is* a difficult airway." The anesthesiologist thereby distances himself or herself from the patient as a whole and from the consequences of anesthetizing the patient. Clearly, some degree of separation between physician and patient is normal and natural. Should that separation widen too far, however, the quality of medical care deteriorates.^{46,47} The traditional biomedical model encourages objectification of the patient and even transubstantiates the Cartesian mind-body duality into mind (the physician) and body (the patient).³²

Table 1. Metaphors of Anesthetic Practice: The Patient

The patient is an object to be actively controlled.
Invasive monitoring
Arterial stick
Crash induction
A flail
Blow (or mask) the patient down
Tube the patient
Snow the patient
Bag the patient
Push drugs into the patient
Patient is resistant to the effects of drugs
Block the patient
Knock out the patient
Gas the patient
The patient is a container or substance.
Tank up the patient
Fill up the patient
Pour fluids into the patient
Patient is dry (or wet)
Insert an iv line
Drop a nasogastric tube into the patient
Patient is a full stomach
Suck out the patient
The patient is a machine or machine extension.
Train wreck
Patient is on the ventilator
Blow in the good gas, blow out the bad gas
Hooked up to the monitors
Line up the patient
Patient is on cruise control

Table 1 lists some of the metaphors commonly used by anesthesiologists in reference to patients and actions done to patients (some metaphors fit into more than one category). The first set, "the patient is an object to be actively controlled" is a corollary of the "medicine is war" metaphor.^{43,48,49,*} This pervasive metaphor latches itself to physicians ("surgeon general," "house officers"), diseases ("invasive" or "infiltrating" tumor), and therapy ("magic bullet," "therapeutic armamentarium"). Because war is violent, medicine is also violent. In adding this property to medicine, however, not only do death and disease become the enemy to be conquered, but the patient and physician are hurt as well. The patient was "flogged" and the admitting physician "got hammered"; each are victimized by the other.

* Caldicott C: What's in a Word?: An Analysis of Medical Metaphors. Annual meeting of the Society for Health and Human Values, Pittsburgh, Pennsylvania, October 8, 1994.

The patient relinquishes a remarkable degree of control over body and life to the anesthesiologist. In the simple act of inserting an intravenous catheter, the anesthesiologist is "connected to [the patient's] brain."⁵⁰ Multiple metaphors describe the anesthesiologist physically controlling the patient. Given the common metaphors of war and violence regarding medicine in general, physicality in anesthesia metaphors easily crosses the border to violence, as we "stick," "crash," "bag," and "tube" the patient.

What, then, is the nature of the patient as object? In general, the patient is a passive recipient. The second set of metaphors in table 1 are largely based on the conceit, "the patient is a container." Because of the imbedded, hidden metonym of the "patient is vasculature," this container metaphor compares intravenous fluid to ingested fluid and the patient to a container for liquid. The metaphor refers to pre-Harvey medical theory, wherein the body was described as a vessel for the four humors. Hence, one can "pour fluids into" the patient.

As noted in the third section of table 1, the patient is also likened to a machine. This analogy dates back to Descartes, who revolutionized medical theory by splitting the concept of the mind from the body and comparing the body to a machine. Body-machine metaphors are now prevalent and intrinsic to our perception of the body.^{51,52} For instance, the heart is a "pump" and the kidneys are "filters." In its most typical manifestation in anesthesia practice, the patient is an extension of a machine, quite literally, the anesthesia machine.

This metaphor is given its most extensive form in the familiar airplane analogy.⁵³ The anesthesiologist is the pilot, the anesthesia machine and monitors are the cockpit, and the anesthetic course is the flight (albeit topsy-turvy, as the induction is takeoff and emergence is landing). By default, the patient is the airplane. This conceit, although potentially dehumanizing, has led to a new way to improve crisis management training and hence patient safety: the anesthesia simulator.⁵⁴ In an ironic twist, the simulator "patient" is a machine, constructed to be as "lifelike" and "human" as possible.

Perception of Patients: The Virtual Patient

The anesthesiologist is vigilant not only of the patient and what is happening to the patient, but also of the "virtual patient," the patient constructed *via* physiologic monitoring. The patient is thus represented by symbols, numeric and graphic. In the sense that the

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interpretation and understanding of a symbol is evidence of a metaphoric transformation within the brain, all of patient monitoring could be considered metaphoric constructs of the patient.

These constructs follow certain "rules" of language and perspective. For example, the electrocardiogram trace is structured like a line of text; time is read from left to right and the most recent complex will appear at the right hand side of the screen. The capnograph follows the same structure as well as the convention (*i.e.*, metaphor), "up is more." The greater the concentration of carbon dioxide, the higher the trace on the graph. The use of this common metaphor by engineers who design equipment displays facilitates interpretation of the signal.

Much of monitoring relies on synesthesia. Invasive monitoring waveforms are visual representations of touch (pressure) sensory input. In fact, much of the data about the patient are transformed into a visual representation. When something is amiss, we may corroborate our impressions by returning to the original sensory mode (*e.g.*, to check whether the patient's temperature is really 42°C and needs further attention, we touch the patient's skin).

A notable exception to the purely visual sensory mode is pulse oximetry. Although there is a visual display, anesthesiologists quickly develop a Pavlovian conditioning to the auditory signal. Here, visual information, the color of deoxygenated hemoglobin, is transformed into the changing pitch of the pulse tone. In a version of the "down is bad" ontological metaphor, the lower the pitch, the more ominous the message. The vigilant anesthesiologist springs into action and will hopefully once again hear the sweet sound of adequate oxygenation.

The time-based graphic anesthesia record (the Cushing/Codman record) was introduced in the late 1800's and allowed for pattern and trend recognition.⁵⁵ In the anesthesia record, the abscissa is a metaphor for time and the ordinate is a metaphor for magnitude or quantity. In addition, the anesthesia record is a metonym for the patient. Hence, when the graphic notations for heart rate and blood pressure are as unvarying as "railroad tracks," the implication is that the vital signs *and* the patient are "stable." The linking of plotted variables to resemble a single topographic surface in an automated recordkeeping system has been likened to an "expression" of the patient's well-being.⁵⁶ Recent work on improving graphic representation of information-rich data, such as mechanical ventilator data in the intensive care unit, uses the concept of "metaphor

graphic approach." Multiple line graphs are replaced with "volume rectangles" in a presentation that "is far more metaphoric" and enhances pattern recognition.⁵⁷ Furthermore, the time needed to detect changes in displayed physiologic parameters is dependent on the type of display mode.⁵⁸

The anesthesiologist simultaneously perceives the patient in metonymic and metaphoric terms. The anesthetized patient lying on the operating room table is surely the same patient as the preinduction awake patient just previously lying there. The anesthetized patient is thus a metonym for the awake patient. But the profound change in the patient's status that has occurred since induction of general anesthesia, the very ability to perform painful and invasive procedures on that patient, is just as surely evidence of a metaphoric transformation of the perception of that person.

Metaphor and Anesthesia Research

Science and Research

Metaphoric thinking is part of the process of scientific theory development. "Metaphors (unless reified, concretized, treated as if they were visible, measurable, audible, touchable reality—as if they were substance, not function) are indispensable for scientific generativity. They are part of the hierarchy of abstraction needed for all theory formation."¹⁵ Although a metaphor may not be prerequisite to formulate the object of scientific research, it can "direct the inquiry towards the query. . . . Metaphor serves to orientate the science and is crucial in erecting the theory. To move into strata where we must employ metaphor is to acknowledge not only our search, but also to recognize that new theory is beckoning."⁵⁹ Furthermore, metaphoric thinking enhances pattern recognition.⁶⁰ A classic example of the effect of metaphoric thinking on scientific insight is the dream image of a snake eating its own tail that led the chemist Kekulé not only to discover the ring structure of benzene, but also to revolutionize the iconic nomenclature (itself a metaphor) of chemical notation.²⁰ Tauber attributes multiple discoveries in the field of immunology to the metaphor of immunology as a study of the "self," a study of the individual's Darwinian struggle to define and express self identity.⁵⁹ Permutt's metaphor of a "vascular waterfall" has enhanced comprehension of the physiology of blood flow and also airway mechanics.⁶¹

In fact, philosophers of science attribute much of the critical thinking in scientific research to a metaphoric

form of cognition. People who are "extremely creative in science are characterized by two related skills, a sensitivity to dissonances and anomalies and the ability to link them in some novel fashion."⁶² The metaphoric linking of dissimilars transcends the dissonance and leads to creativity. Metaphors enhance understanding by transforming the inchoate to the tangible, to the graspable. The more abstract or complex the concept, the more likely that metaphors will be necessary.³ Moreover, metaphors help us communicate about intellectual concepts.⁵²

Scientific models, especially theoretical models, are analogous to extended networks of metaphors.⁶³ In scientific models, a primary system (e.g., propagation of sound) is explained by a secondary system (e.g., wave motion).^{64,65} These systems are analogous to the tenor and vehicle of the metaphor. To conceive of theories as metaphors emphasizes the interaction between the two systems and results in new perceptions about those systems. "Nonscientists tend to think that science works by deduction," states economist Brian Arthur about the new theories of complexity, "but actually science works mainly by metaphor."¹⁰

A narrow metaphor, though, can constrain understanding of an abstraction by reducing and circumscribing it.^{20,49} "Formal scientific theories are attempts to consistently extend a set of ontological and structural metaphors. . . . [But to] operate only in terms of a consistent set of metaphors is to hide many aspects of reality."⁸ In other words, diverse and perhaps conflicting metaphors may be required to explore the multiple facets of anesthesia.

Attempts to Define Anesthesia: The Role of Metaphor

Anesthesia research is diverse and interdisciplinary. This discussion is limited to the basic but thorny questions of what is anesthesia and how do anesthetics work. The state of being termed "anesthetized" is an interior state, without reference to external objects (unlike, for example, being afraid of something). Such interior states resist easy definition and description.⁶⁶ Because of the intrinsically recondite nature of the brain, metaphors may be particularly suitable for such anesthesia research.

First one needs to define anesthesia. Just as with the limitations of the dictionary definition of metaphor, the definition of the anesthetized state is far more complex than that indicated by the lexical entry, "general or localized insensibility, induced by drugs or other

intervention and used in surgery or other painful procedures."² Such a definition stems from the monovalent "under anesthesia" historical metaphor described earlier, in which anesthesia has a depth with progressively deeper stages.

Current research indicates that anesthesia is multifaceted and contains a wide spectrum of pharmacologic actions. Depending on what definition or theory one follows, these components can include some or all of the following: unconsciousness, analgesia, anxiolysis, amnesia, absence of movement in response to noxious stimuli, and the control of cardiovascular, sudomotor, or other hormonal responses.⁶⁷ Some of these effects may be considered desirable supplements rather than components of anesthesia.⁶⁸ Not all of the effects may need to occur simultaneously or occur at all for any given anesthetic. Some drugs usually considered to be complete anesthetics, such as isoflurane, may not produce clinically desired effects at tolerable doses without concomitant drugs.^{69,70} In light of the new functional definitions of anesthesia, Kissen writes, "the very meaning of the depth of anesthesia disappears."⁷¹

Not only has the "under anesthesia" metaphor hindered our ability to adequately define anesthesia, but it has also affected our search for an understanding of how anesthetics work. The metaphor supports an uncomplicated, unitary theory of anesthetic action. The Meyer-Overton correlation, in which anesthetic potency is directly correlated to its lipid/water partition coefficient, led to a "simple unifying idea" of anesthetic action, *i.e.*, anesthetics act by perturbing lipid bilayers. This correlation is no longer believed to be germane to an understanding of the anesthetized state.⁷² Similarly, pressure reversal of general anesthesia, a potentially simple framework for investigating the effect of anesthetics, is now believed to be more incidental than fundamental to an understanding of anesthesia.^{73,74}

A single site or mechanism of action of anesthetics cannot be pinpointed.⁷⁵ Potential sites of anesthetic action include synapses and axons. Presynaptic and postsynaptic effects have been inferred. Anesthetics may affect inhibitory or excitatory neurons. Anesthetic effects on voltage-gated and ligand-gated ion channels are probable target sites of anesthetic action, but others such as pumps and second-messenger modulated receptors and channels are possible sites as well. Recent attempts to invoke a unified mechanism of action even at a single receptor-type demand increased complexity than previously postulated.^{76,77} The diverse effects of anesthetic agents, even within the confines of a re-

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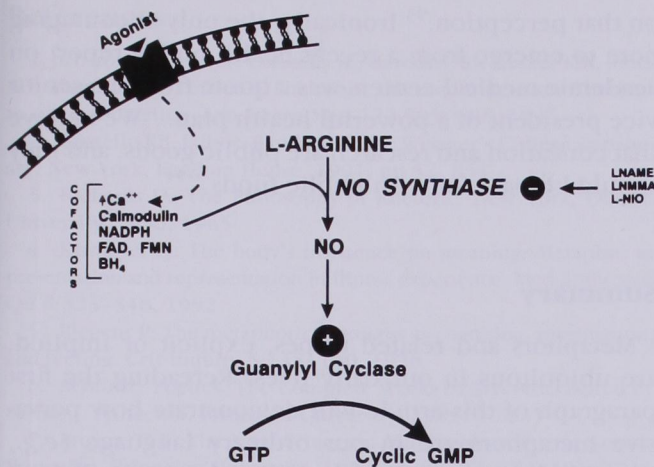


Fig. 3. The "pathway" leading to production of cyclic guanosine monophosphate is a journey metaphor. Reproduced with permission.⁸²

stricted and isolated system, imply "a multisite agent-specific mechanism of anesthesia, in which each agent acts by a unique spectrum of effects."⁷⁸ Furthermore, intravenous and inhaled anesthetics may have profoundly different mechanisms of action.^{79,80} Perhaps this complexity is why a reliable "depth of anesthesia" monitor and an "ideal" anesthetic drug have not been discovered.

This is the challenge: what metaphors are compatible with current theories of anesthetic action? One category of metaphors, the body is a machine, is implicit in phrasing the question as, "What is the *mechanism* of anesthetic action?" A machine metaphor implies on-off states, control elements, multiple parts, and the potential for malfunction. Lock-and-key analogies for receptor pharmacology are mechanistic metaphors used to visualize how anesthetics work. The complexity of the molecular and neural network environments, however, demand a complexity to the machine metaphor that limits the metaphor's ability to fully elucidate how anesthetics work. Nonetheless, machine metaphors do lend insight into mechanisms and control of such mechanisms. For instance, anesthesiologists have been likened to controllers who disconnect or modify "the actions of a patient's regulating 'computer' from its control of the body's function" and who interfere "with the mechanisms controlling consciousness."⁸¹

Another possible metaphor involves topography and time: anesthesia is a journey. Journey metaphors imply sequence (beginning, middle, and end) and the potential for variety or risk. The terrain and mode of

transport can differ. Tasks and environmental conditions vary. This metaphor accounts for more of the variety of response to a drug given differing and sometimes unknown conditions, although, like the machine metaphor, it evokes relatively concrete images. It is implied in the search for "sites" of anesthetic action. It is compatible with a topology of unique surfaces for various anesthetic effects on different sites. Journey metaphors are invoked whenever a "pathway" is drawn. In figure 3, the journey starts with a lock-and-key analogy, and continues via a series of arrows to the goal: formation of a cyclic guanosine monophosphate molecule.⁸²

New metaphors may need to be developed to help us completely understand how anesthetics work. The following metaphor is but one candidate to help define the issue and is offered as food for thought. The anesthetized state is a trope: either metonymy or metaphor. If anesthesia is metonymy, then the configurational changes that result from the binding of an anesthetic molecule are directly referential to the original conformation. If anesthesia is metaphor, then a dissimilar state is induced that can only be related to the original unanesthetized state by finding similarities in what would appear initially as dissonant states.

In sum, metaphor and science are inextricably linked. Critical examination of different metaphors used in various areas of investigation and development of novel metaphors may further our understanding of anesthesia research goals and theories.

Special Applications of Metaphor to Clinical Practice

Anesthesia Subspecialties

Each subspecialty has unique metaphors, such as the fantasy space journey of the pediatric patient during inhalational induction. Examination of these metaphors could yield insight into our heterogeneous field. For instance, pain management inherits vast metaphoric systems due to the varied historical and cultural meanings not only of pain, but also of drugs to alleviate pain.^{31,83-90} In attempts to verbalize pain with coherent language, patients use metaphors or similes ("it feels like a knife sticking in my back").⁶⁶ Insensitivity to pain during surgery, that is, anesthesia, became accepted within a generation of its discovery in the United States, despite the paternalistic view of some surgeons who continued to believe that intraoperative pain was

necessary.⁹¹ However, the diversity of deeply held beliefs and metaphors about pain and its alleviation continue to contribute to the complexity of caring for the patient in pain, whether that pain is postoperative, obstetric, traumatic, or chronic.

Economics of Anesthesia: "Time is Money"

Metaphors may become so ingrained in our thinking and lives that they lose all "figurative reminiscence"—and are taken as literal truth, as reality.⁵² "Time is a valuable resource" is just such a metaphor.⁸ "You're wasting my time" and "The chairman of my department wonders how I spend my academic time" are two of the myriad examples of this metaphor. Anesthesiologists have traditionally valued the "time is money" metaphor: in the "fee-for-service" world, we bill for our operating room time in 15-min quanta. Hence, it is particularly difficult for anesthesiologists to shift gears in the current health care reform climate—the "time is money" metaphor is being replaced by the "medicine is a marketplace" and the "marketplace is a competition" metaphors. Such metaphors can help elucidate aspects of anesthesia practice, such as realizing that the surgeon is also a customer of the anesthesiologist.† However, some economic terms can dehumanize: "capitation" (a metonym itself, from capit or caput, head), "captured lives" and "surgical volume" are three examples. The "time is money" metaphor is replaced by "power is money" in current discussions about anesthesia care. For example, "[i]n a fully capitated environment, anesthesiologists should only accept capitation if the surgeons are also capitated."‡ Anesthesiologists may hope to "assume a gatekeeper function" in intensive care and other nonoperating room settings.§

Researchers and educators in academic centers are justifiably concerned about the current and potential effects of "market forces."⁹² Language and terminology shape our perception of reality and our actions based

on that perception.⁹³ Ironically, the only encouraging note to emerge from a recent health policy report on academic medical centers was a quote from the senior vice president of a powerful health plan: "We believe that education and research are public goods, and they should be paid for with public funds."⁹⁴

Summary

Metaphors and related tropes, explicit or implied, are ubiquitous in our daily lives. Rereading the first paragraph of this article will demonstrate how pervasive metaphors are in our ordinary language (e.g., "world of anesthesia," a "fueled" debate, "medicine" has a "fringe element"). Metaphors are not merely ornamental; metaphoric thinking is integral to how we perceive our environment and process our experiences. Anesthesia patient care, monitoring, research, subspecialties such as pain management, and the economics of anesthesia care are examples of areas replete with metaphors. Because language affects our perceptions, phrases such as "under anesthesia," which evoke vast metaphoric relationships, have profound implications.

Some metaphors can be harmful or pointless. For instance, metonymic references to patients and other jargon provide a verbal shorthand, but may be unintentionally hurtful. Metaphors, such as those in scientific theories, can hide truths as well as reveal them. Unlike literary metaphors, scientific metaphors need to be consistent with observation and measurement. Although we need not return to Lockean distrust of tropes, over-adorned or flowery phrases are usually inconsequential or self-mocking.

We are a species that can think metaphorically; it would be artificial, and indeed impossible to ban metaphors from the practice of anesthesia. Instead, we must recognize that metaphors exist in anesthesia and acknowledge their implications. Metaphors are powerful tools. By transforming the intangible to the tangible, metaphors may enhance and direct our understanding of anesthesia. Elucidating the metaphors that underlie difficult and multifaceted concepts can help clarify those concepts. Furthermore, creativity, whether it be in patient care issues or research, may be enhanced by a conscious effort to conceive new metaphors or combine existing ones in novel ways.

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