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Recent History of Publication-Based Academic Interest in General Anesthetics

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ABSTRACT

Purpose: The aim of this study was to determine how interest in various general anesthetics among the authors of academic publications changed over the past 50 years.

Methods: Publication-based academic interest were analyzed using specific scientometric indices: popularity index (PI), top journal selectivity index (TJSI), and index of change (IC). Terms used for searches were the names of drugs belonging to two pharmacological classes of general anesthetics – inhaled and intravenous. Only those that had a PI value > 2.0 during at least one of the 10 five-year periods, from 1967 to 2016, were selected.

Results: The PI, an index of comparative popularity, reflects a consistent decline in academic interest over time in both classes of general anesthetics. Over the past 25 years, the PI of inhaled anesthetics decreased by 52 %, and that of intravenous anesthetics fell by 32%. At the same time, the PI of anesthesia management increased by 167%. Among individual anesthetics, the most impressive change was a profound decline in halothane's PI, from 22.9 in 1972–1976 to 0.5 in 2012–2016. The interest in halothane was gradually supplanted by that in new agents, initially by enflurane, followed by isoflurane and finally, sevoflurane. The next meaningful change was the gradual rise in sevoflurane's PI to surpass that of isoflurane. The most dramatic change among the PIs of intravenous anesthetics was associated with the introduction of propofol: an increase from 1.8 to its maximum of 13.6.

Conclusions: The study revealed a constant decline over time in academic interest in the pharmacological basis of general anesthesia relative to all fields of anesthesia combined.

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Introduction

One of the many facets of the history of general anesthesia is publication-based academic interest in the field of general anesthetics. **It belongs to scientometrics which is the study on the quantitative aspects of the process of science as a communication system.** Scientific output (publications) can be measured using specific scientometric indices.^{1–8} Such an approach allows the presentation of the quantitative history of changes in academic interest associated with two classes of general anesthetics: inhaled and intravenous.

The aim of this study was to determine how interest in various general anesthetics among the authors of academic publications has changed over the past 50 years.

Methods

Publication-based academic interest in general anesthetics was assessed using three indices: popularity index (PI), index of change (IC), and top journal selectivity index (TJSI). The PI is the percentage of articles on a specific topic relative to all articles in the related field published over the same 5-year period.⁵ The PI includes all types of articles in all journals covered by the National Library of Medicine's PubMed database. The PI allows the measurement of comparative popularity, for example, the popularity of a drug (such as sevoflurane) among the authors of publications in a related field (such as general anesthesia). If the PI on a specific topic increases compared to its related field, it means that the topic's comparative popularity is growing.

The IC is the change (expressed in percent) in the number of publications on a topic during a 5-year period compared with the previous 5-year period.⁵ It reflects the degree of change in interest in that topic irrespective of changes in the related field.

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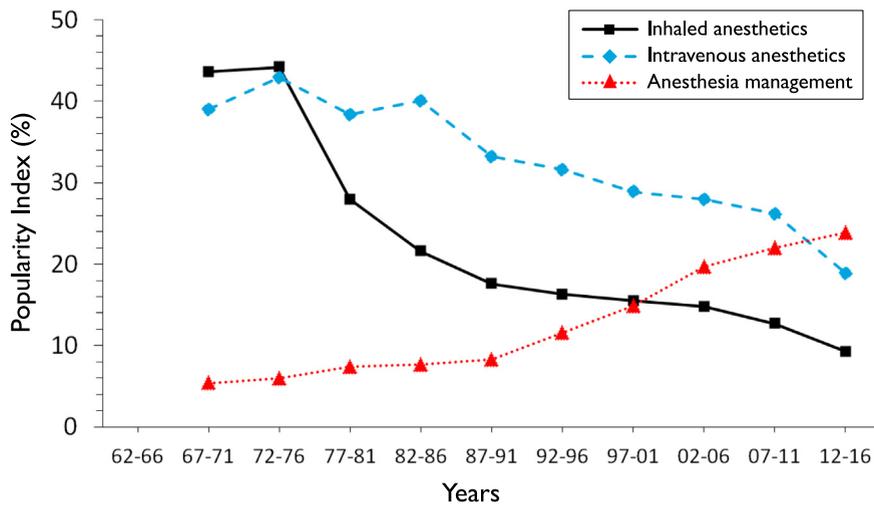


Fig. 1. Time courses of PI reflecting the publication-based academic interest for two classes of general anesthetics. The PI reflects the number of articles on each class of anesthetics, presented as a percentage of all articles in the fields of anesthesia over a 5-year period. For comparison, the PI for anesthesia management is also presented.

The TJSI is the ratio (expressed in percent) of the number of articles on a particular topic in the top 20 journals relative to the number of articles on the same topic in all (>5000) biomedical journals covered by PubMed over a 5-year period.^{1,3} To determine the TJSI, the top 20 journals are selected based on two factors: (1) their rank sorted by impact factor, as indicated by Journal Citation Reports, and (2) the journal's specialty area, which in our case included anesthesiology, pain, surgery, and pharmacology (10 journals) and general biomedical journals (also 10 journals), as follows: *Anesthesiology*, *Annals of Internal Medicine*, *Annals of Surgery*, *British Journal of Anaesthesia*, *British Journal of Surgery*, *British Medical Journal*, *Journal of American College of Surgeons*, *Journal of American Medical Association*, *Journal of Clinical Investigation*, *Journal of Clinical Pharmacology and Therapeutics*, *Journal of Pharmacology and Experimental Therapeutics*, *The Lancet*, *Nature*, *Nature Medicine*, *Nature Reviews Drug Discovery*, *New England Journal of Medicine*, *Pain*, *Proceedings of the National Academy of Science of the United States of America*, *Science*, and *Trends in Pharmacological Sciences*. The TJSI represents the level of interest in select top journals and indicates when the “excitement” regarding a topic begins to spread into neighboring areas. This index can be considered as an indication of expectations at the time of article publication; it is usually the first among scientometric indices to indicate promising development.

The values for the above indices were calculated using data from the National Library of Medicine’s PubMed Web site (<http://www.ncbi.nih.gov/pubmed>). It is the largest and most authoritative source of biomedical publications, comprising more than 27 million citations from the biomedical literature that are carefully classified, and, most

importantly, has a controlled vocabulary for indexing (Medical Subject Headings or MeSH terms).

Terms included in our searches were the names of drugs belonging to two classes of general anesthetics—inhaled and intravenous—as they were listed in *Goodman and Gilman’s Pharmacological Basis of Therapeutics*⁹ and *Martindale’s Complete Drug Reference*.¹⁰ Drugs used to augment a specific component of anesthesia (anesthetic adjuvants), such as opioids, alpha-2 adrenergic agonists, benzodiazepines, and neuromuscular blocking agents, were not assessed. The only exception was midazolam because it was produced primarily for use in anesthesia.¹¹ The scientometrics of adjuvant anesthetics was reviewed previously.⁵

Only anesthetics introduced after 1960 were included. Exceptions (see asterisks below) were made for two agents—halothane and thiopental—to use them as the supplanted agents for comparisons of inhaled and intravenous anesthetics, respectively. The terms for the searches were selected from various sources^{12–15}; they included the following: “carboetomidate,” “desflurane,” “enflurane,” “etomidate,” “fospropofol,” “halothane,”* “isoflurane,” “ketamine,” “methoxycarbonyletomidate,” “methohexital,” “midazolam,” “propofol,” “remimazolam,” “sevoflurane,” and “thiopental.”* The following PubMed “MeSH” terms were also included: “Anesthetics, Inhalation” and “Anesthetics, Intravenous.” For the sake of comparison with these two terms, we also included a term not primarily associated with anesthetic agents: “anesthesia management.”

Articles related to the above terms were counted using the PubMed site. An individual term was entered in the search box together with the general anesthesia MeSH terms: “AND (“Anesthesia,

Table 1

Comparisons of the number of articles on intravenous anesthetics, inhaled anesthetics, and anesthesia management over the past 50 years: 1967–1991 vs 1992–2016.

Years	Anesthesia		Inhaled anesthetics				Intravenous anesthetics				Anesthesia management			
	Articles ^a		Articles ^a		Popularity ^b index		Articles ^a		Popularity ^b index		Articles ^a		Popularity ^b index	
	Number ^c	Change ^d	Number ^c	Change ^d	Value ^e	Change ^d	Number ^c	Change ^d	Value ^e	Change ^d	Number ^c	Change ^d	Value ^e	Change ^d
1967–1991	60,587	-	16,481	-	27.2	-	22,306	-	37.8	-	4,462	-	7.3	-
1992–2016	173,382	+187%	22,592	+37%	13.0	-52%	44,255	+93%	25.5	-32%	33,746	+656%	19.5	+167%

^a Articles published in the journals covered by PubMed over 25-year period.

^b Comparative topic popularity; percent of articles in a category (“Anesthetics, Inhalation” or “Anesthetics, Intravenous” PubMed’s MeSH terms) among articles covering all fields of anesthesia (“Anesthesia” PubMed MeSH term).

^c Number of articles in a related category published during indicated period.

^d Percentile change compared to the previous 25-year period.

^e Value of popularity index for a related category during indicated period.

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