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The Top 100: A Review of the Most Cited Articles in Surgery☆

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ABSTRACT

Introduction: We performed a study of the top 100 most cited articles in the five general surgery journals with the highest impact according to Journal Citation Report.
Methods: We selected the five journals with the highest impact in 2015: Annals of Surgery, British Journal of Surgery, JAMA Surgery, Surgery, and Journal of the American College of Surgeons. In January 2017, using the Web of Science application, we performed a search of all articles published by these journals and identified the 100 most cited articles (top 100). We evaluated the number of citations, year of publication, type of article, country and hospital of the article, area of interest and number of authors.
Results: The median number of citations per top 100 paper was 490. Twenty percent of the top 100 papers have been published since 2000. Overall, 70% are original papers, 8% randomized control trials, 11% reviews, 1% meta-analyses and 11% other subtypes. There are 13% proceedings papers. Sixty-one percent are from the US. The most frequently discussed topic is hepato-pancreato-biliary surgery (33%).
Conclusions: The top 100 most cited articles tend to be original articles describing studies carried out in the US, reporting significant surgical breakthroughs. Hepato-pancreato-biliary surgery is the most common subject area. Annals of Surgery had twice as many citations as the other journals studied. The archetypal article of the Top15 most cited is an original paper published in the twentieth century, with an average of 2000 citations.

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Los top 100. Revisión de los artículos más citados en cirugía

Palabras clave:
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RESUMEN

Introducción: Llevamos a cabo un estudio de los 100 artículos más citados en las 5 revistas quirúrgicas con mayor factor de impacto según Journal Citation Report.
Métodos: Seleccionamos las 5 revistas con mayor factor de impacto según JCR en el año 2015 (Annals of Surgery, British Journal of Surgery, JAMA Surgery, Surgery, and Journal of the American College of Surgeons). Realizamos una búsqueda de todos los artículos publicados en estas cinco revistas a fecha de enero de 2017 y seleccionamos los 100 artículos más citados según Web of Science. Evaluamos número de citaciones, año de publicación, tipo de artículo, país y hospital de procedencia, área de interés y número de autores.
Resultados: La mediana del número de citaciones del top 100 de citaciones es de 490. El 20% se han publicado desde el año 2000. De forma general, el 70% son originales, el 8% ensayos aleatorizados, 11% revisiones, 1% metaanálisis y el 11% otro tipo de estudios. Más del 60% provienen de EE. UU. y el área hepatopancreatobiliar es la más frecuentemente abordada (33%).
Conclusiones: El artículo incluido en el top 100 de artículos más citados en cirugía tiende a ser un artículo original sobre el área hepatobiliopancreática y procedente de EE. UU. La revista *Annals of Surgery* tiene el doble de citaciones que el resto de revistas estudiadas.

Introduction

The number of citations of a scientific article is a very popular method to determine the impact of a researcher or a publication in the scientific community, together with other indicators such as the impact factor.[1–8] While it is not an infallible method for determining scientific quality, it is considered an indirect indicator of the merit of an article, journal or researcher.[1,2,4,5]

A series of articles has been recently published on ''classic citations'' (the most cited articles) in various medical and surgical specialties, in an attempt at defining the characteristics that a publication should meet to be included on the list.[1–5,7,9] In the field of surgery, bibliometric studies are very limited, so the objective of our study was to determine the characteristics of the most cited articles in the journals with the greatest impact factor in surgery.

Methods

Our study analyzed the five scientific publications with the highest impact factor (IF) in the field of surgery in 2015, according to the *Journal Citation Report*® (https://jcr.incites.thomsonreuters.com/JCRJournalHomeAction.action):

- Annals of Surgery (IF: 8.569)
- British Journal of Surgery (BJS) (IF: 5.596)
- JAMA Surgery (IF 5.661; from 1920 to 2013, Archives of Surgery IF: 4.297)
- Journal of the American College of Surgeons (JACS) (from 1905 to 1994 Surgery, Gynecology and Obstetrics) (IF: 4.257)
- Surgery (IF: 3.309)

A search was made of all the articles published in these 5 journals from their beginnings until January 2017 using the Thompson-Reuters ISI Web of Science (WEB), and the 100 most cited articles were chosen using the ''times cited'' category of the application (top 100).

For each scientific article, the following were evaluated: publication, title, number of citations, year and month of publication, hospital, center and/or university where the study was designed, country (in multicenter studies, the country of the first author was selected), name of the first author, number of authors, type of article (original, randomized controlled trial [RCT], review, meta-analysis and other [case report, scientific letter and surgical technique]), area of interest, and whether originating from a scientific society.

The area of interest was divided into 16 groups:

- Hepato-pancreato-biliary (HPB) and spleen
- Colorectal
- Esophagogastric
- Endocrine and metabolic surgery
- Oncologic surgery, including melanoma, breast cancer, gastrointestinal stromal tumors and sarcomas
- Abdominal wall surgery
- Pediatric surgery
- Vascular surgery
- Sepsis
- Transplants
- Morbidity
- Quality
- Innovative technology
- Nutrition
- Trauma
- Other

We also determined the percentage of the total number of citations obtained by the 20 and 50 most cited articles (top 20 and top 50, respectively).

After obtaining the data referring to the 5 mentioned publications, the 15 most cited articles of the 500 total articles were selected for study.

Results

A total of 203,857 articles were reviewed. The number of articles published per journal varied from one to the next because some journals have been in operation longer than others. The top 100 most cited articles of *Annals of Surgery* obtained the highest total number of citations (78,691 citations). Next, the top 100 of the *British Journal of Surgery* (BJS) accounted for 45,860 citations, the top 100 of *Archives of Surgery + JAMASurg*. (AS/JS) represented 42,608 citations and the top 100 of *Surgery* had 41,445 citations. In the last position, the top 100 of *JACS* obtained 36,421 citations (Table 1).

If we limit the results to the 20 most cited articles per journal (top 20), these represented 34.8% of the total citations obtained by the top 100; likewise, the top 50 represented 65.5% of the total number of citations.

As for the timeframe, the articles published in this millennium (2000–2017) represented, on average, 20% of the top 100 citations (Table 1).

Focusing on the article type, 70% were original articles (range 54%–80%), 11% review articles (range 3%–27%), 8% RCT (range 4%–16%), 1% meta-analyses (range 0%–3%) and the remaining 10% were classified in the ''other'' group (range 6%–15%).

Regarding the distribution by country of origin of the publication, 61% came from the US. If we omit the BJS, where 85% of its top 100 comes from Europe (mainly the UK), the US origin increases to between 73% and 81% (Table 1). If we refer to the top 15 articles (Table 2), 9 were from the US.

Table 1 – Top 100 Most Cited Articles From the 5 Surgery Journals With the Highest Impact Factors.

Journals	Ann Surg	Br J Surg	Arch Surg + JAMA Surg	J Am Coll Surg + SGO	Surgery	Mean
IF 2015	8.569	5.596	4.297 (Arch Surg 2013) 5.661 (JAMA Surg 2015)	4.257	3.309	
First publication	January 1885	July 1913	July 1920	1905	January 1937	
Total *n* of papers	31,750	43,197	23 827	28 998	24 792	
Average citations per article in the top 100	787 (480–6202)	459 (273–4969)	426 (245–2765)	364 (238–997)	414 (262–2220)	490
Top 100 citations	78,691	45,860	42 608	36 421	41 445	
Top 20 citations	36.2%	38.6%	31.6%	32.5%	35.4%	34.8%
Top 50 citations	65%	65.5%	67.6%	62.8%	64.9%	65.5%
Best years (number of publications)	1995; 1999; 2004 (7)	1994 (7)	2003 (5)	1995; 2000 (5)	1988; 1992 (5)	
Articles 2000–2017	27%	21%	20%	17%	17%	20%
Type of article	73% original 16% RCT 3% reviews 2% meta-analyses 6% other	54% original 6% RCT 27% reviews 3% meta-analyses 10% other	80% original 4% RCT 8% reviews 1% meta-analyses 7% other	73% original 9% RCT 3% reviews 0% meta-analyses 15% other	67% original 5% RCT 15% reviews 1% meta-analyses 12% other	70% original 8% RCT 11% reviews 1% meta-analyses 10% other
Scientific society	35%	0%	13%	8%	9%	13%
Country/region	73% US 20% Europe 3% Asia 3% Canada 1% Brazil	6% US 85% Europe 5% Asia 2% Canada 1% Africa 1% New Zealand	74% US 17% Europe 5 Asia 4% Canada	81% US 11% Europe 4% Asia 1% Canada 1% Africa 1% Australia 1 South America	74% US 17% Europe 4% Asia 3% Canada 1% Africa 1% Australia	61% US 30% Europe 4% Asia 5% Other
Area of interest	HPB (37%) Other (12%) Oncologic surgery (8%)	Colon (33%) HPB (15%) EG (14%)	HPB (25%) Other (19%) Colon, vascular and trauma (8%)	HPB (31%) Other (20%) Colon (9%)	HPB (38%) Other (14%) Sepsis and oncologic surgery (7%)	HPB 33% Other 16% Colon 12%
Number of authors	6.5 (1–22)	3.9 (1–10)	4.7 (1–18)	5.1 (1–20)	5.4 (1–49)	5.1
Best top 100 hospital	Johns Hopkins	St Mark's	MGH	MSKCC	Mayo Clinic	

RCT: randomized controlled trial; EG: esophagogastric surgery; HPB: hepato-pancreato-biliary; MGH: Massachusetts General Hospital; MSKCC: Memorial Sloan Kettering Cancer Center; SGO: Surgery, Gynecology and Obstetrics.

Table 2 – Top 15 Articles of the 100 Most Cited Articles in the 5 Journals With the Highest Impact Factors in Surgery.

	Reference	Title	N of citations	Year	Country	Hospital/University	N of authors	Type of article	Area of interest	Scientific society	First author
1	Ann Surg. 2004;240(2):205–13	Classification of surgical complications – A new proposal with evaluation in a cohort of 6336 patients and results of a survey	6202	2004	Switzerland	Univ Zurich Hospital	3	Original	Morbidity	No	Dindo D
2	Br J Surg. 1973;60(8):646–9	Transection of esophagus for bleeding esophageal varices	4969	1973	UK	King's College Hospital and Medical School	5	Original	EG	No	Pugh RN
3	Arch Surg. 1992;127(4):392–9	Technical details of intraoperative lymphatic mapping for early stage melanoma	2765	1992	US	John Wayne Institute for Cancer Treatment and Research	8	Original	Oncologic surgery	No	Morton DL
4	Surgery. 2005 Jul;138(1):8–13	Postoperative pancreatic fistula: An international study group (ISGPF) definition	2220	2005	Italy (MC)	University of Verona	10	Guideline	HPB	No	Bassi C
5	Ann Surg. 1999;230(3):309–18	Clinical score for predicting recurrence after hepatic resection for metastatic colorectal cancer – Analysis of 1001 consecutive cases	1846	1999	US	Memorial Sloan Kettering Cancer Center	5	Original	HPB	ASA	Fong Y
6	Arch Surg. 1993;128(5):586–90	A clinically based classification system for acute pancreatitis. Summary of the International Symposium on acute pancreatitis, Atlanta, GA, September 11 through 13, 1992	1818	1993	US	Emory University	1	Original	HPB	No	Bradley EL
7	Ann Surg. 1994;220(3):391–8	Lymphatic mapping and sentinel lymphadenectomy for breast-cancer	1744	1994	US	Johns Hopkins Med Inst	4	Original	Oncologic surgery	ASA	Giuliano AE
8	Ann Surg. 1970;172(5):902–8	Thickness, cross-sectional areas and depth of invasion in prognosis of cutaneous melanoma	1706	1970	US	George Washington University	1	Original	Oncologic surgery	No	Breslow
9	Ann Surg. 2009;250(2):187–96	The Clavien-Dindo Classification of Surgical Complications Five-Year Experience	1580	2009	Switzerland	Univ. Zurich Hospital	15	Original	Morbidity	No	Clavien PA
10	Br J Surg. 1982;69(10):613–6	The mesorectum in rectal-cancer surgery – The clue to pelvic recurrence	1404	1982	United Kingdom	Basingstoke District Hospital	3	Surgical technique	Colorectal	No	Heald RJ
11	Ann Surg. 2000;231(1):51–8	Two hundred gastrointestinal stromal tumors – Recurrence patterns and prognostic factors for survival	1400	2000	US	Memorial Sloan Kettering Cancer Center	6	Original	Oncologic surgery	ACS	DeMatteo RP
12	Ann Surg. 1997;226(3):248–57	Six hundred fifty consecutive pancreaticoduodenectomies in the 1990s – Pathology, complications, and outcomes	1306	1997	US	Johns Hopkins Med Inst.	13	Original	HPB	ASA	Yeo CJ
13	Ann Surg. 1995;222(3):339–50	Who would have thought it – An operation proves to be the most effective therapy for adult-onset diabetes-mellitus	1299	1995	US	E. Carolina University	10	Original	Endocrine-metabolic surgery	ASA	Pories WJ

Table 2 (*Continued*)

	Reference	Title	N of citations	Year	Country	Hospital/University	N of authors	Type of article	Area of interest	Scientific society	First author
14	Ann Surg. 1978;187(1):1–7	Neonatal necrotizing enterocolitis – Therapeutic decisions based upon clinical staging	1228	1978	US	St Louis Children's Hospital	7	Original	Pediatric surgery	No	Bell MJ
15	Arch Surg. 1970;101(4):478–83	Intestinal mucosal lesion in low flow states .1. A morphological, hemodynamic, and metabolic reappraisal	1228	1970	Canada	McGill University Surgical Clinic, Montreal General Hospital	5	Original	Other	No	Chiu, CJ

ACS: American College of Surgeons; ASA: American Surgical Association; EG: esophagogastric; HPB: hepato-pancreato-biliary; MC: multicenter.

The average number of authors varied between 4 and 7, with a progressive increase in recent years. Regarding the area of interest, 33% of the top 100 focus on the HPB area.

Out of the top 100 articles, 13% were published by a scientific society; this was especially true in *Annals of Surgery*, where this percentage rose to 35%.

Table 2 summarizes the characteristics of the 15 most cited articles in the five journals with the highest impact factor. The average number of citations per article was 2181 (range 1228–6202). Nine of these articles were published in *Annals of Surgery*, three in *AS/JS*, two in *BJS* (the second most cited) and one in *Surgery*.

Discussion

The number of times an article is cited as a bibliographic reference in other articles is commonly used as a measure of the impact of scientific journals and as a way to validate the contributions made by the authors.[1,4,6,9]

There is a belief that articles with more citations are always the oldest due to the time factor, but 20% of the top 100 papers that we identified were published after the year 2000. This tendency may reflect the phenomenon of "obliteration by incorporation", which suggests that, once their ideas have already been generally accepted, the most classic articles are no longer cited.[1–6] However, other authors argue that the number of citations of an article reflects the duration of its academic life, and especially the IF of the journal in which it was published.[4,9]

Pagadulu et al. in 2002 and Long et al. in 2014 conducted bibliometric studies similar to ours. Pagadulu et al. studied the top 100 citations in the period between 1945 and 1995,[1] while Long et al. evaluated the 35 articles cited more than 1000 times in any field of surgery.[9] Half of the articles in the study by Long et al. corresponded to traumatology and neurosurgery.

We have identified a series of possible biases in our study of the top 100 citations. The most important source of bias was the fact that journals do not have the same period of time in their publications and, therefore, do not have the same number of articles. This makes it difficult to conduct a comparative statistical analysis among them. In addition, it is also difficult to determine the total number of articles per medical center, since hospitals and/or universities do not always use the same name over time.

Our study did not include surgical articles not published in non-surgical journals, and we only analyzed the 5 journals with the highest IF in the field of surgery, so journals devoted to specific areas of surgery were excluded from our study. According to Paladugu et al., only 12 articles from their top 100 most cited articles in general surgery were not published in the five journals studied in our article, and none of the articles was at the top of the ranking.[1] But, it is likely that the appearance and development of powerful journals in very specific fields of general surgery (e.g. HPB, transplantation, hernia, cancer surgery) will probably modify the characteristics of the classification in coming years, so it will no longer be sufficient to evaluate the five general surgery journals as the main search source.

When we compared our results with the Paladugu et al. study, we found several similarities. First of all, the US

continues to be the top origin of the publications, although its predominance has recently decreased from 78% to 61%. This decrease is due to the following: in large part, due to the BJS, where Europe represents 85% of the origin of its articles; to the recent increase in the number of relevant articles in Europe; to a slight decrease in Canada; the emergence of Asian countries (Japan and China); and the role of multicenter studies conducted in several countries, whose origin is defined as the country of the first author.[1] Second, the classification by article type is also similar, but there has been a notable increase in articles with higher levels of scientific evidence, RCT and meta-analyses from 0% to 9%.[1] Finally, gastrointestinal surgery was the area with more articles in the top 100 of Paladugu et al., which is the category that would probably include the majority of the articles that are collected in HPB in our study.[1]

Long et al. observed a peak in citations in the 1970s, while we observed a peak in the 1990s,[9] and they found the level of evidence in their top 35 to be low (with only one level I article), a finding that was also proven in other surgical top 100 articles (3611). As a positive result, in 2009 Brooke et al. observed a considerable improvement in the scientific quality (that is, more RCT and better statistical methodology) of the most cited articles in the last 20 years.[10]

Other bibliometric studies conducted in specific fields of surgery (urgent abdominal surgery, transplantation, obesity surgery, sepsis, etc.) also show results similar to those of our study.[4–6] The US is the main producer of top 100 articles, which tend to be original articles of a certain age, conducted at prestigious medical centers and representing milestones in their subspecialties, but these article were not published in the journals that we have included due to the more specific area of interest.[3–6]

In conclusion, the top 100 most cited articles in the 5 highest impact journals tend to be original articles reporting studies conducted in the US at prestigious hospitals, reporting significant surgical advances. Hepatobiliary and pancreatic surgery is the most common subject of study. The archetypal article among the first 15 most cited papers is an original article published in the 20th century, with an average of 2000 citations.

Conflict of Interests

The authors have no conflict of interests to declare.

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