

RESEARCH ARTICLE

CITED BRAZILIAN PAPERS IN GENERAL SURGERY BETWEEN 1970 AND 2009

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OBJECTIVES: To identify the most cited articles in general surgery published by Brazilian authors.

INTRODUCTION: There are several ways for the international community to recognize the quality of a scientific article. Although controversial, the most widely used and reliable methodology to identify the importance of an article is citation analysis.

METHODS: A search using the Institute for Scientific Information citation database (Science Citation Index Expanded) was performed to identify highly cited Brazilian papers published in twenty-six highly cited general surgery journals, selected based on their elevated impact factors, from 1970 to 2009. Further analysis was done on the 65 most-cited papers.

RESULTS: We identified 1,713 Brazilian articles, from which nine papers emerged as classics (more than 100 citations received). For the Brazilian contributions, a total increase of about 21-fold was evident between 1970 and 2009. Although several topics were covered, articles covering trauma, oncology and organ transplantation were the most cited. The majority of classic studies were done with international cooperation.

CONCLUSIONS: This study identified the most influential Brazilian articles published in internationally renowned general surgery journals.

KEYWORDS: Peer review; Surgery/history; Classical article; Surgery/statistics and numerical data

INTRODUCTION

A central aspect of general surgery is the diversity of topics and domains. General surgery has become one of the most well-known medical specialties. At present, general surgery boasts remarkable developments and refinements in basic science, diagnosis and treatment that have transcended abdominal organs, touching neighboring and more distal branches of medicine. Advances in scientific surgical research have benefited the care of men and women of all ages.

A scientific article's impact is established over time. Because publications inspire future articles, a paper's scientific impact can be measured in terms of the number of citations received.¹ Increasing numbers of scientific papers in the Internet era have provided diverse information. The frequency of citations serves as a rough guide to the importance of an article. The impact factor (IF) is now generally used to measure the prestige of journals, the influence of articles published in those journals and, by extension, the authors, institutions and countries.² In Brazil, the national agency (CNPQ) dedicated to promoting scientific and technological research has used the IF as an indicator of the national research output and to define investment priorities.³

In this paper, our goal was to identify the most frequently cited articles published by Brazilian authors in the most-cited international journals dedicated to general surgery. We aimed to provide an opportunity to recognize key historical advances and the evolution of surgery research in Brazil.

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MATERIALS AND METHODS

To identify the most frequently cited Brazilian papers published in general surgery journals, we accessed the Thompson Web of Knowledge database (Institute for Scientific Information - ISI).⁴ Inclusion criteria included articles with at least one Brazilian author and published in the 26 highly cited journals in the field of general surgery. These journals were selected based on their 2008 impact factor (Journal Citation Report). The search was limited to the period between January 1970 and June 2009.

The articles were identified and analyzed with respect to their authors, institution, year of publication, number of citations and topics.

An additional analysis was performed for articles that received more than 30 citations.

RESULTS

Of the 208,168 articles included in the study, 1,713 (0.8%) were published by Brazilian authors. Nine were cited over 100 times, and these were considered classics.⁵ The 26 screened journals are listed in Table 1. Analyzing the ranking of each country's contributions, Brazilian authors achieved the 19th overall position.

Brazilian contributions to those journals are listed by decades and presented in Table 2. Regarding Brazil's overall contribution, a rising curve was evident, with Brazil climbing from the 34th position (0.07%) in the seventies to the 13th position in the 2000s (1.47%). Figure 1 shows the number of Brazilian papers published in each year since 1970.

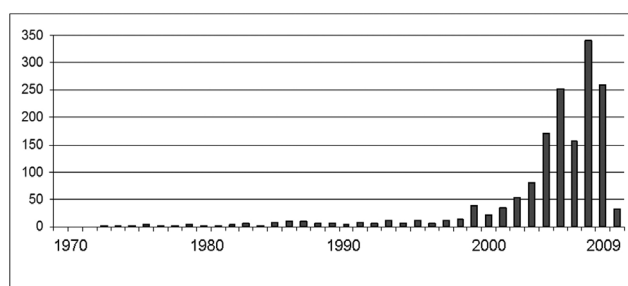
Because only nine Brazilian articles reached the classic denomination (article with more than 100 citations), we

Table 1 - Brazilian scientific contribution on the screened general surgery journals, during the period of 1970-2009 years.

		Impact factor	Articles published (n)	Brazilian articles published (n)	Brazil (countries ranking position)
1	<i>Annals of Surgery</i>	7.446	10.121	14 (0.13%)	29 th
2	<i>American Journal of Transplantation</i>	6.423	9.323	93 (0.99%)	14 th
3	<i>British Journal of Surgery</i>	4.304	23.992	24 (0.10%)	40 th
4	<i>American Journal of Surgical Pathology</i>	4.181	5.884	17 (0.28%)	29 th
5	<i>Endoscopy</i>	3.917	6.363	62 (0.97%)	23 rd
6	<i>Annals of Surgical Oncology</i>	3.917	5.457	30 (0.54%)	19 th
7	<i>Liver transplantation</i>	3.751	5.255	262 (4.90%)	7 th
8	<i>Transplantation</i>	3.641	22.092	107 (0.48%)	21 st
9	<i>Archives of Surgery</i>	3.485	12.444	17 (0.13%)	27 th
10	<i>Shock</i>	3.325	5.677	100 (1.76%)	10 th
11	<i>Journal of the American College of Surgeons</i>	3.101	6.008	20 (0.33%)	15 th
12	<i>Surgery</i>	3.004	12.696	21 (0.16%)	29 th
13	<i>Obesity Surgery</i>	2.852	4.559	411 (9.01%)	3 rd
14	<i>Lasers in Surgery and Medicine</i>	2.700	5.390	135 (0.27%)	7 th
15	<i>Diseases of the Colon and Rectum</i>	2.621	10.420	67 (0.64%)	18 th
16	<i>Wound repair and regeneration</i>	2.445	1.846	14 (0.75%)	17 th
17	<i>Journal of burn care and rehabilitation</i>	2.421	801	4 (0.49%)	20 th
18	<i>Journal of Surgical Oncology</i>	2.384	5.660	26 (0.45%)	21 st
19	<i>American Journal of Surgery</i>	2.337	13.389	46 (0.34%)	22 nd
20	<i>Journal of Trauma – Injury, Infection and Critical Care</i>	2.334	14.620	49 (0.33%)	22 nd
21	<i>Transplant International</i>	2.300	3.879	43 (1.10%)	21 st
22	<i>Journal of Gastrointestinal Surgery</i>	2.272	2.256	28 (1.24%)	12 th
23	<i>Surgical Endoscopy and other Interventional Techniques</i>	2.242	3.769	25 (0.66%)	24 th
24	<i>Clinical Transplantation</i>	1.923	2.320	37 (1.59%)	12 th
25	<i>Journal of Surgical Research</i>	1.836	7.881	21 (0.26%)	23 rd
26	<i>World Journal of Surgery</i>	1.778	6.066	40 (0.66%)	30 th
Total			208.163	1713 (0.82%)	19 th

Table 2 - The Brazilian most-cited articles in general surgery listed by periods, 1970-2009.

Decade Period	No Brazilian/total papers published (%)	Brazil overall contributing countries ranking	Papers cited ≥100 times (n)
1970/1979	17 / 22.348 (0.07)	34 th	-
1980/1989	71 / 34.940 (0.20)	28 th	1
1990/1999	182 / 52.977 (0.34)	26 th	5
2000/2009	1.441 / 97.455 (1.47)	13 th	3
Total	1.713 / 207.720 (0.82)	19 th	9

Published items in each year**Figure 1** - Number of Brazilian articles published in The General Surgery Journals, during the period of 1970-2009.

further evaluated all of the articles with more than 30 citations (the top 65 articles). This cutoff was decided arbitrarily. Table 3 summarizes the designs of the 65 articles identified to have more than 30 citations. We observed a tendency for retrospective series and cohorts (56.9%), while randomized trials accounted for 10/65 (15.3%) articles. Twelve (18.4%) experimental studies were included in the list of the top 65.

Table 3 - The Brazilian most-cited articles by study design.

Study Design	The Brazilian most cited articles *(n)
Meta-analysis	1 (1.5%)
Randomized clinical trials	10 (15.3%)
Experimental studies	12 (18.4%)
Case series/ cohorts	37 (56.9%)
Review articles	5 (7.7%)
Case reports	0 (0)

* ≥ 30 citations.

Topics covered by the “Brazilian Top 65” included oncology, transplantation, trauma and critical care, as listed in Table 4. Other topics were identified in this list, including gastrointestinal endoscopy and dentistry. The topics most frequently covered by the top 65 articles were shock and kidney transplantation at 10 articles each (15.3%), followed by colorectal tumors in 9 (13.8%) articles. Nineteen (29.2%)

articles covered themes related to oncology. The second most heavily cited theme was trauma/critical care and organ transplantation, accounting for 15/65 (22.9%) articles each. Aside from these principal categories, bariatric surgery and GI endoscopy were covered in 4/65 (6.1%) papers each (Table 4).

The 30 most-cited articles are presented in Table 5. The range of citations varied from 49 to 194, with an average of 85 citations per article. International collaboration was relevant since the earliest article to make the list, published in 1984 by

Table 4 - Topics covered.

Topic	Number of articles (n)	(%)
Oncology		
Colorectal	9	13.8
Gastric	3	4.6
Renal pathology	2	3.1
Neck tumors	2	3.1
Eshopagus	1	1.5
Sarcoma	1	1.5
Breast	1	1.5
Trauma and critical care		
Shock	10	15.3
Sepsis	3	4.6
Abdominal compartment syndrome	1	1.5
Penetrating abdominal wounds	1	1.5
Organ Transplantation		
Kidney	10	15.3
Liver	1	1.5
General	4	6.1
Bariatric surgery	4	6.1
Hepato-Biliary diseases		
Laparoscopic cholecystectomy	1	1.5
Portal hypertension	1	1.5
Gastrointestinal endoscopy	4	6.1
Dentistry	2	3.1
Others	3	4.6
Total (Top-65)	65	

Table 5 - List of the Brazilian thirty most cited articles in general surgery, during the period of 1970-2009 years.

	Number of citations	Article	Year	Journal title	1 st author	Brazilian Institutions	Country	Brazilian authors and co-authors
1	194	Restaging of colorectal cancer based on the identification of lymph node micrometastases through immunoperoxidase staining of CEA and cytokeratins.	1991	Dis Colon Rectum	Cutait R, et al.	USP Hosp Sirio Libanes	Brazil	Cutait R, Alves VA, Lopes LC, Cutait DE, Borges JL, Singer J, da Silva JH, Goffi FS.
2	140	CDX2, a highly sensitive and specific marker of adenocarcinomas of intestinal origin - An immunohistochemical survey of 476 primary and metastatic carcinomas.	2003	Am J Surg Patho	Werling RW, et al	Botucatu Unesp	USA/Brazil	Bacchi CE
3	130	The importance of thiopurine methyltransferase activity for the use of azathioprine in transplant recipients.	1992	Transplantation	Chocair PR, et al	USP	Brazil/UK	Chocair PR
4	126	The influence of intraoperative hypotension and perioperative blood transfusion on disease-free survival in patients with complete resection of colorectal liver metastasis	1991	Ann Surg	Younes RN et al	USP	USA	Younes RN
5	125	Efficacy of hypertonic 7.5% saline and 6% dextran-70 in treating trauma: a meta-analysis of controlled clinical studies.	1997	Surgery	Wade CE, et al.	USP	USA/Brazil	Younes RN
6	112	Pit pattern in colorectal neoplasia: Endoscopic magnifying view.	2001	Endoscopy	Kudo S, et al.	Fugast Porto Alegre	Japan/ Brazil/ Sweden	Teixeira CR
7	103	Complications and hazards of gastrointestinal endoscopy.	1989	World J Surg	Habr-Gama A, Wayne JD	USP	Brazil/USA	Habr-Gama A
8	102	Prospective randomized trial of mechanical bowel preparation in patients undergoing elective colorectal surgery.	1994	World J Surg	Santos JCM, et al.	USP Ribeirao Preto	Brazil	Santos JCM, Batista J, Sirimarco MT, Guimarães AS, Levy CE.
9	102	FTY720, a novel immunomodulator: efficacy and safety results from the first phase 2. A study in de novo renal transplantation.	2005	Transplantation	Tedesco-Silva H, et al.	UNIFESP	Brazil/ France/ USA/...	Tedesco-Silva H
10	86	Low rectal cancer - Impact of radiation and chemotherapy on surgical treatment.	1997	Dis Colon Rectum	Habr-Gama A, et al.	USP	Brazil	Habr-Gama A, de Souza PMSB, Ribeiro U, Nadalin W, Gansl R, Sousa AHSE, Campos FG, Gama-Rodrigues J
11	86	Supraomohyoid neck dissection in the treatment of T1/T2 squamous cell carcinoma of oral cavity.	1994	Am J Surgery	Kligerman J, et al.	INCA	Brazil	Kligerman J, Lima RA, Soares JR, Prado L, Dias FL, Freitas EQ, Olivatto LO.
12	81	Operative versus nonoperative treatment for stage 0 distal rectal cancer following chemoradiation therapy - Long-term results.	2004	Annals of Surg	Habr-Gama A, et al.	USP	Brazil	Habr-Gama A, Perez RO, Nadalin W, Sabbaga J, Ribeiro U, Sousa AHSE, Campos FG, Kiss DR, Gama-Rodrigues J

Table 5 - List of the Brazilian thirty most cited articles in general surgery, during the period of 1970-2009 years. (cont.)

	Number of citations	Article	Year	Journal title	1 st author	Brazilian Institutions	Country	Brazilian authors and co-authors
13	81	Everolimus with optimized cyclosporine dosing in renal transplant recipients: 6-month safety and efficacy results of two randomized studies.	2004	Am J Transp	Vitko S, et al.	UNIFESP, UNICAMP, Santa Casa Porto Alegre, Hosp Geral Fortaleza	Czech/ Brazil/ Spain/...	Tedesco H, Alves G, Garcia VD, Esmeraldo R
14	80	A comparison of nonoperative vs. preoperative radiotherapy in rectal carcinoma. A 10-year randomized trial.	1989	Dis Colon Rectum	Reis Neto JA, et al.	PUC Campinas	Brazil	Reis Neto JA, Quilici FA, Reis JÁ
15	77	Primary renal synovial sarcoma: molecular and morphologic delineation of an entity previously included among embryonal sarcomas of the kidney.	2000	Am J Surg Patho	Argani P, et al.	INCA	USA/Brazil	Faria PA
16	74	The role of lung innervation in the hemodynamic response to hypertonic sodium chloride solutions in hemorrhagic shock.	1985	Surgery	Younes RN, et al.	USP	Brazil	Younes RN
17	72	Exposure-response relationships for everolimus in de novo kidney transplantation: defining a therapeutic range.	2002	Transplantation	Kovarik JM, et al.	UNIFESP	Switzerland/ USA/ Brazil/...	Silva HAT
18	72	Ghrelin: a gut-brain hormone: Effect of gastric bypass surgery	2003	Obes Surg	Geloneze B, et al.	UNICAMP	Brazil	Geloneze B, Tambascia MA, Pilla VF, Geloneze SR, Repetto EM, Pareja JC
19	69	Diagnostic and therapeutic laparoscopy for penetrating abdominal trauma: A multicenter experience	1996	J Trauma	Zantut LF, et al.	USP	Brazil/USA	Zantut LF
20	68	Hypertonic solutions in the treatment of hypovolemic shock: a prospective, randomized study in patients admitted to the emergency room.	1992	Surgery	Younes RN, et al.	USP	Brazil	Younes RN, Aun F, Accioli CQ, Casale LPL, Szajnbock I, Biroloni D.
21	68	Simultaneous liver and lung injury following gut ischemia is mediated by xanthine oxidase.	1991	J Trauma	Poggetti RS, et al.	USP	USA/Brazil	Poggetti RS
22	64	Early gastric cancer: results in a general hospital in Japan.	1984	World J Surg	Abe S, et al.	USP	Japan	GamaRodrigues JJ
23	64	Focal versus diffuse anaplasia in Wilms tumor--new definitions with prognostic significance: a report from the National Wilms Tumor Study Group.	1996	Am J Surg Patho	Faria P, et al.	INCA	USA/Brazil	Faria PA
24	63	Comparison of the low level laser therapy effects on cultured human gingival fibroblasts proliferation using different irradiance and same fluence.	2001	Lasers in Surg Med	Almeida-Lopes L, et al.	USP Univ Vale do Paraiba	Brazil	Almeida-Lopes L, Rigau J, Zangaro RA, Guidugli Neto J, Jaeger MM
25	60	Effect of low-power laser irradiation on cell growth and procollagen synthesis of cultured fibroblasts	2002	Lasers in Surg Med	Pereira AN, et al.	USP	Brazil	Pereira AN, Eduardo CD, Matson E, Marques MM
26	57	Ertapenem versus piperacillin/tazobactam in the treatment of complicated intraabdominal infections: results of a double-blind, randomized comparative phase III trial.	2003	Annals of Surg	Solomkin JS, et al.	Hosp Evangelico Curitiba	USA	Malafaia O

Table 5 - List of the Brazilian thirty most cited articles in general surgery, during the period of 1970-2009 years. (cont.)

27	57	Mycophenolate mofetil substitution for cyclosporine a in renal transplant recipients with chronic progressive allograft dysfunction: the "creeping creatinine" study.	2005	Transplantation	Dudley C, et al.	UNIFESP	UK/Austria/ Czech/ Switzerland/ Brazil	Silva HAT
28	54	Individual patient cohort analysis of the efficacy of hypertonic saline/dextran in patients with traumatic brain injury and hypotension.	1996	J Trauma	Wade CE, et al.	USP	Sweden/ USA/Brazil	Younes RN
29	51	Everolimus versus mycophenolate mofetil in the prevention of rejection in de novo renal transplant recipients: a 3-year randomized, multicenter, phase III study.	2005	Transplantation	Lorber MI, et al.	UNIFESP	USA/ Switzerland/ Brazil	Tedesco H
30	51	Results of a prospective trial on elective modified radical classical versus supraomohyoid neck dissection in the management of oral squamous carcinoma. Brazilian Head and Neck Cancer Study Group.	1998	Am J Surg	Brentani RR, et al.	Hosp AC Camargo, Hosp Araujo Jorge, USP, Hosp Erasto Gaertner, Hosp Heliopolis, Hosp Napoleao Laureano, UNIFESP, Santa Casa Porto Alegre	Brazil	Brazilian Head and Neck Cancer Study Group

Abe S *et al.* (Gama-Rodrigues), described early gastric cancer in Japan.⁶ The most recent classic (102 citations), published by Tedesco-Silva *et al.* in 2005, was a phase II international clinical trial describing the immunologic response to FTY720 in kidney transplantation.⁷ Indeed, eighteen articles (60%) on this list were written with international co-authorship. The article ranked in first place on the list was published in the nineties by Cutait *et al.* and discussed colorectal cancer staging based on immunohistochemical analysis of micrometastasis in lymph nodes.⁸

Analyzing the individual contribution by state, institutions from Sao Paulo authored or co-authored 65% of these articles. The most-published institutions were the University of Sao Paulo/Hospital de Clinicas (USP), the Federal University of Sao Paulo (UNIFESP), Campinas State University (UNICAMP) and Albert Einstein Hospital, contributing 619, 173, 87 and 87 papers, respectively. Nevertheless, notable contributions came from others states, such as Rio de Janeiro, Rio Grande do Sul, Minas Gerais and Parana (Table 6).

DISCUSSION

Eventually, all surgical specialties are dependent on general surgery. General surgery is a discipline

encompassing clinical knowledge, operative techniques and scientific foundations, including wound healing, infection, metabolism, immunology, shock and resuscitation.

In this paper, we recognized articles that were published in the most cited general surgery journals, had at least one author with a Brazilian affiliation, were identified in the ISI Web of Knowledge database and were published during a 39-year period (1970 to 2009). In total, 1,713 items were published by Brazilian authors from more than 100 institutions. It is worth mentioning that 555 papers received 5,556 citations during this period. Therefore, 1,158 (67.6%) articles remained uncited. In fact, approximately one half of all published medical articles are never subsequently cited.

A limitation of our results is that we have no information on citations in journals not covered by the ISI bibliometric database. Undoubtedly, the results of this citation analysis could be different if more Latin American scientific journals were listed in the ISI Web of Knowledge or if another citation database, such as SCOPUS, had been selected. Another aspect that must be taken into consideration is that, until recently, only articles published in English were considered by the JCR.

The 26 screened journals were the periodicals dedicated to general surgery with the highest impact factor. These international journals receive contributions from all over the

Table 6 - Brazilian most-cited articles in general surgery, sorted by the top contributing Institutions.

Institutions	Number of articles published (%)	Number of articles with more than 30 citations (%)	Number of classical articles published (%)
USP – Hosp Clin SP	619 (36.1)	36 (56.2)	5 (55.5)
UNIFESP – Escola Paulista	173 (10.1)	8 (12.5)	1 (11.1)
Hospital Sirio Libanes	14 (0.8)	2 (3.1)	1 (11.1)
USP Ribeirao Preto	10 (1.4)	1 (1.5)	1 (11.1)
INCA	13 (0.7)	4 (6.2)	0
UFMG	53 (3.1)	3 (4.7)	0
UFRJ	51 (2.9)	3 (4.7)	0
Santa Casa Porto Alegre - UFCSPA	30 (1.7)	3 (4.7)	0
UNICAMP	87 (5.1)	2 (3.1)	0
UFRGS	63 (3.6)	2 (3.1)	0
Hospital AC Camargo	55 (3.2)	1 (1.5)	0
PUCRS	22 (1.3)	1 (1.5)	0
Fundação Oswaldo Cruz	8 (0.4)	1 (1.5)	0
Hospital Albert Einstein	87 (5.1)	0	0
Gastro Obeso Center	36 (2.1)	0	0
Bonsucesso General Hospital	30 (1.7)	0	0
Univ Est Londrina	25 (1.4)	0	0
UFPR	13 (0.7)	0	0
UERJ	12 (0.7)	0	0
Hospital Beneficiencia Portuguesa	9 (0.5)	0	0
Others/Unknow	322 (18.7)	13 (20.3)	2 (22.2)*

* - Botucatu Unesp and Fugast contributed with 1 classical article each. USP/Hosp Clin SP – Universidade de São Paulo/ Hospital de Clinicas; UNIFESP – Universidade Federal de São Paulo; INCA – Instituto Nacional do Câncer; UFMG – Universidade Federal de Minas Gerais; UFRJ – Universidade Federal do Rio de Janeiro; UFCSPA – Universidade Federal de Ciências da Saúde de Porto Alegre; UNICAMP – Universidade Estadual de Campinas; UFRGS – Universidade Federal do Rio Grande do Sul; Hosp AC Camargo – Hospital AC Camargo and Ludwig Institute of Cancer Research; PUC/RS – Pontifícia Universidade Católica do Rio Grande do Sul; UEL – Universidade Estadual de Londrina; UFPR – Universidade Federal do Paraná; UERJ – Universidade Estadual do Rio de Janeiro.

world, publishing milestone publications in experimental and clinical surgery.

Although English is not the native language in Brazil, our country has an established place in the general surgery literature. Nowadays, Brazilian authors have the 19th overall position in terms of the number of papers published in these renowned journals. The contribution of papers from Brazilian authors in these journals is encouraging, as the proportion of the global total increased by about 21-fold, from 0.07% in the 1970s to 1.47% in the 2000s. Nonetheless, Brazil is behind small developing countries, such as Taiwan, and it just recently surmounted Turkey. The overwhelming supremacy of United States was evident, as the United States was the top contributing country in 23 of 26 screened journals, publishing more than 52% of all papers.

In the 2000s, Brazil occupied the 13th overall position. In our point of view, this ascension can be partially attributed to the support of the Brazilian National Council, which is

dedicated to promoting science in our country. In addition, more international exchange opportunities, widespread use of the internet and more surgeons dedicated to basic and clinical research could be responsible for the rising curve of publications over the years.⁹ However, the English language can be a barrier, and other types of biases (bias towards nationality) can influence the approval rate.² We recognize that the SciELO (Scientific Electronic Library Online) database increased the visibility of Brazilian medical literature during the past decade. The SciELO will probably also contribute to increasing the impact of national journals devoted to surgery.

Specific topics were highlighted in different decades. These data reflect, at least in part, the evolution of a specific surgical area. For example, a better comprehension of the physiology of obesity, transplantation and laser therapy resulted in great amounts of new information and motivated the establishment of new journals. Our study shows that many Brazilian papers are devoted to these

topics. Concerning bariatric surgery, Brazilian authors have published continually in journals like *Obesity Surgery*, where Brazil holds the 3rd overall position.

Various observations can be made regarding the study design of the top articles. We observed a tendency of clinically oriented publications. Only 12 (18.4%) of the top 65 articles presented an experimental design. Although surgeons are conscious of the importance of evidence-based medicine, only 10 (15.3%) articles were randomized clinical trials. Prior studies corroborated these observations in other medical areas, including trauma, general surgery, urology and critical care medicine.^{5, 10-12}

Interestingly, international collaboration and multicenter trials seem to be needed for a paper to be highly cited because 7 of the 9 classics (> 100 citations) have authors from different countries. In the 1980s, 9/71 (12.6%) articles had inter-institutional collaboration. In the 1990s, 32/182 (17.1%) articles published by Brazilian authors had this characteristic, and after 2000, 185 of 1441 (12.8%) articles had international collaboration. Eighteen of the top 30 Brazilian articles were inter-institutional. In the top 65 articles (>30 citations), the United States was the country whose investigators most frequently collaborated with Brazilian authors (18/65; 27.7%).

General surgery is a heterogeneous medical specialty, covering different areas in men and women's health, basic science, clinical practice and operative techniques. The list of the top-cited articles covers some of the hottest topics in surgery today, such as surgical oncology, minimally invasive approaches and organ transplantation. In the most cited article concerning trauma and critical care, Wade *et al.* from the University of California and in collaboration with Younes from USP published a meta-analysis demonstrating similar efficacy between hypertonic and isotonic solutions in trauma. Previously, Younes *et al.* reported a cohort of Memorial Sloan-Kettering patients and analyzed perioperative risk factors and the recurrence of colorectal metastases (4th overall). The same author published the best-ranked Brazilian experimental study concerning the use of hypertonic saline in dogs (positioned 16th). The top article covering organ transplantation was presented by Chocair *et al.* (USP) and covered the activity of thiopurine methyltransferase in immunosuppressive therapy in renal transplantation. The article ranked first overall and in oncology was published by Cutait *et al.* (USP - Hospital Sirio Libanes) and was about immunohistology in colorectal cancer.

The oldest article in the list of the top 65 was published in 1979 by Paulino *et al.* (UFRJ) regarding early gastric cancer. The most recent top 65 article was published by Zorron *et al.* (RJ) in 2008, describing preliminary results of transvaginal NOTES cholecystectomy.

In the 7th most cited article, Habr-Gama *et al.* (USP) reviewed the complications of GI endoscopy. The same group addressed the use of radiotherapy and chemotherapy in low rectal cancer (10th) and more recently published two articles reporting the long-term results of operative treatment for rectal cancer following chemotherapy (14th and 60th).

Although our search included the 26 most-cited general surgery journals, we are aware that restricting our search to these journals is a limitation of the present study. Some of the most cited Brazilian papers were published in more specific or general journals; these include the description of the "Jatene procedure" for the correction of transposition of the great arteries, which was published in the *Journal of Thoracic and Cardiovascular Surgery* in 1976; the use of hypertonic NaCl for the treatment of severe hemorrhagic shock, which was published in the *American Journal of Physiology* in 1980; and the first description of liver transplantation from a living donor, which was published by Raia *et al.* in 1989 in the *Lancet*. These articles have been cited 243, 258 and 262 times, respectively.¹³⁻¹⁵

This analysis highlighted the academic influence and popularity of southeast institutions. Historically, Sao Paulo institutions provided financial and technological support for research. For decades, the University of Sao Paulo - Hospital de Clinicas has been the top published institution. However, highly contributing institutions are now also based in other states, such as Rio de Janeiro, Rio Grande do Sul, Minas Gerais and Parana.

CONCLUSIONS

In recent years, citation analysis, although imperfect, has become common and is considered to be the currency of journal prestige. The selected journals have always attracted the submission of advances and landmark articles in general surgery. This study is an opportunity to remember the most-cited Brazilian articles and to learn from distinguished Brazilian surgeons, recognizing the remarkable impact that these visionaries have had in national surgery.

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