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The increasing prominence of “non-surgical” articles in surgical literature

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Keywords:

Surgery, Non-surgical (non-technical) skills, surgical innovation

Abstract

Introduction:

Publications in the surgical field have usually to do with technical skills (TS). However, the field peripheral to surgical procedures, which brings to bear non-technical skills (NTS) has been achieving increasing prominence. The goal of this study is to objectively assess the evolution of the two fields in surgical literature.

Methods:

The authors perused all the articles published over a decade in four large-scale surgical journals and assigned them to the following three categories: 1) TS, 2) NTS or 3) miscellaneous. While the “TS group” included all aspects of surgical procedures, the “NTS group” comprised all aspects of non-surgical perioperative management, and the “miscellaneous group” was composed of all elements extraneous to the first two fields.

Results:

Of the 8775 articles analyzed, 4326 (49%) belonged to the TS group, 2343 (27%) to the NTS group and 2138 (24%) to the miscellaneous group. There was a significant decrease in the proportion of TS publications [61% in 2007, 44% in 2016 ($p < 0.001$)], accompanied by a significant increase in the proportion of NTS publications (16% in 2007, 34% in 2016 (p

<0,001)] over the course of the last decade. The trend first appeared in 2009 and has been confirmed and reinforced over the ensuing years.

Conclusion:

The increasing prominence of non-surgical skills represents a major shift in the editorial choices of high impact surgical journals. It highlights the extent to which the surgical community is manifesting increased interest in the perioperative field, which is now drawing almost as much attention as surgical procedure *per se*.

Introduction

In visceral surgery, the arrival of laparoscopy has represented a major revolution in the history of surgery, and may be considered as the most significant innovation of the last 30 years (1). Over the past decade, several “evolutions” of basic technique have been proposed for possible use to the surgical community. While sheerly technical innovations such as robotic surgery, natural orifice transluminal endoscopic surgery (NOTES) and mini-invasive single site surgery (MISS) have gained traction in a number of surgical fields, their usefulness remains contestable (2-4). In addition and less controversially, energy devices and, more particularly, electrothermal surgery have enriched the surgical arsenal (5). And yet, parallel to these “technical skills” (TS), another facet has taken on an increasingly prominent role in our practice: non-technical skills (NTS) (6). Above and beyond technical prowess, we have come to understand our need for NTS as means of improving surgical and therapeutic outcomes. After all, surgical intervention is a complex and risky act necessitating not only technical mastery, but also coordination of a surgical team before, during and after the operation. That is why numerous comparisons with the field of aviation

have been put forward: a cockpit with its crew is tasked with managing a process (flight) of which the different phases (preparation, takeoff, cruising, landing) may be likened to an operating room with an analogous multiphase process (pre-op, the intervention itself: preparation, induction, incision, surgical procedure, surgical closure, patient awakening, post-op follow-up) (7). In both instances, there exists a team whose members intervene, with numerous and complex interactions, concurrently and simultaneously (8). It stands to reason that to an ever greater extent, in view of improving the quality and safety of patient care, surgeons are called upon to attend to non-surgical aspects of their work: continued training, therapeutic strategizing, risk management in conjunction with patient safety, postoperative treatment, establishment and utilization of a safety checklist... (9).

So it is that in our practice, we find ourselves confronted with two aspects: sheerly technical, and largely non-technical. To our knowledge, the relative roles of TS and NTS in surgical literature have yet to be assessed. The objective of this study was consequently to provide a factual evaluation of the evolution of these aspects in the relevant literature, that is to say scientific publications reliably reflecting our ongoing (and probably upcoming) practices.

Methods

The basic inclusion criterion was publication between January 2007 and December 2016 of an article in one of four major surgical reviews, three of which are American (the Annals of Surgery (Ann Surg); the Journal of the American Medical Association of Surgery (JAMA Surg) and the Journal of the American College of Surgeons (JACS), and one of which is English, the British Journal of Surgery (Br J Surg). Whatever the authors' specialties, all structured articles – original series, randomized controlled studies, systematic reviews and meta-analyses - with introduction, methods, results and discussion sections were included. Were not included:

articles concerning conference proceedings, editorials, opinion pieces, technical notations, surgery images or videos. The articles were assigned to three categories: TS, NTS and miscellaneous.

Research was carried out manually, year by year, starting with the table of contents of each journal. All of the abstracts were randomly analyzed by two different authors; when perusal of an abstract did not suffice to classify an article, the manuscript was read in its entirety. In the event of disagreement on its classification, a third author entered a decision-making process aimed at achieving consensus. No article was assigned to two different categories. All of the evaluators were surgeons.

The “TS group” pertained to all aspects of surgical procedures: indications, performances or outcomes (perioperative or postoperative complications) of a given laparoscopic, mini-invasive or robotic surgical procedure; evaluation of the surgical equipment used, possible traumatism, etc.

The “NTS group” pertained to all aspects of non-surgical management : care and treatment organization, clinical pathways, training and simulation, the “learning curve” concept, communication within the team, leadership, surgical suite safety checklist, patient safety, quality, teamwork, workload, information, etc. This second group included not only all articles having to do with perioperative patient management, but also articles on training for surgeons, and medico-economic studies. In brief, they covered all aspects of patient management exterior to surgical technique in the strict sense of the term.

The “miscellaneous group” pertained to all other elements of interest to surgeons but not directly related to technical or surgical management, and that could not be classified as “TS” or “NTS”, for example articles having to do with chemotherapy, anesthesia, basic research,

experimental research, antibiotics, vascular filling, imagery, nutrition, or medico-legal aspects.

On a parallel track, we carried out a search in PubMed using the keywords "teaching" or "education" or "learning" and "non-technical skills". The purpose of this search was to observe the simultaneous evolution of teaching in the field of non-technical skills (NTS).

Statistical analyses:

Analysis was carried out using Stata 13 software (StataCorp LP, College Station, TX, United States). Categorical data were presented in the form of frequencies and associated percentages. Evolution of each type of publication over a 10-year period was analyzed by applying a generalized linear model (link function for binary outcomes), with one year being considered as the unit of analysis. A sensitivity analysis was carried out, with one month being considered as the unit of analysis (data not presented). The figures have been presented with medians and intervals. The tests were bilateral, and type I error was set at $\alpha = 0.05$.

Results

All in all, 8775 articles fulfilling the inclusion criteria were analyzed: 4326 in the TS group (49%), 2343 in the NTS group (27%) and 2138 in the miscellaneous group (24%).

Evolution of the publications between 2007 and 2016 is summarized in Figure 1. There was a significant decrease in the number of TS publications [61% in 2007, 44% in 2016, ($p < 0.001$)] and a significant increase in the proportion of NTS publications [16% in 2007, 34% in 2016] (p

<0,001)] over the course of the last decade. The trend first appeared in 2009 and has been reinforced over the ensuing years.

No significant evolution was observed in the miscellaneous group.

Analysis according to country highlighted a more prominent role of the NTS group in the three American journals, with a statistically significant increase ($p < 0.001$) that did not appear in the findings reported by the English journal ($p = 0.71$).

In addition, search for studies on NTS teaching published over the same period led to the discovery of 23 articles fulfilling the inclusion criteria. Up until 2014, only 1 or 2 such articles were published each year. Only from 2015 and 2016 did we observe an increased number of studies on NTS teaching, with 9 and 7 articles respectively.

Discussion

This study provides an original, objective and factual overview of the evolution of surgical publications since 2007 as observed in high impact factor general and visceral surgery reviews. In 2007/2008, the proportion of articles related to TS (60%) was pronouncedly higher than that of those in the NTS group (60%), but by 2009 a decrease in the former and an increase in the latter was underway in earnest; ever since that year, the trend has been continually and significantly confirmed and amplified. The strength of our study resides in the lengthy period of analysis and the sizable number of articles analyzed. On the other hand, as our objective was to study an overall trend, the different items in each sub-category were not detailed.

Our first observation was that over recent years, TS studies have represented fewer than half of the articles published in prestigious surgical reviews. Bearing in mind that these publications constitute the main means of communication concerning innovation, one might

think that this reduction reflects lessened innovation over the last decade (9). In fact, notwithstanding the importance of recent technological innovations, numerous impediments have come to counteract their adoption by university surgeons (10). Innovation in health technology and, more particularly, in surgical procedure, may be defined as a process involving introduction of a new technology or technique that will instigate changes in clinical practice (1,10). In reality, while surgical innovation has been a permanent factor since the late 19th-century introduction of asepsis and anesthesia, its implementation has occurred in fits and starts, in conjunction with the arrival of novel and enabling technological breakthroughs, one current example being mini-invasive surgery (1,15). Between 2008 and 2010, a diminution in the number of patents granted was reported (1). This somewhat surprising finding may be explained by the fact that during those years, surgical innovation was going through a phase of non-use either for economic reasons or to delay, for increasingly constraining administrative reasons, between patent application and patent issuance. That much said, since 2014 it has been commonly acknowledged that laparoscopy (and, more generally, mini-invasive surgery), constitutes the most important innovation of the last three decades, with noteworthy peaks in total number of publications and patents closely corresponding to its progressive adoption in clinical practice (1). As examples, image tracking and robotic surgery should be taking on major roles in the near future (12). However, these types of innovations have not necessarily met with expected success; they are often quite expensive, and indisputable evidence of their efficacy compared to the competing techniques currently applied in routine practice may be lacking (13).

In addition to the absence of any groundbreaking surgery-related innovation (new technique, or new technology), there exists another explanation for the reduced number of

TS articles, namely the reduced number of surgical interventions. Indeed, over the past decade numerous “surgical” conditions have to a considerable extent devolved into “non-surgical” conditions: gastric ulcer, traumatology, inflammatory bowel disease, complete response tumors, uncomplicated appendicitis...

On a parallel track, perioperative care has become increasingly prominent in the international surgical literature (or, at the very least, in the main international journals). For many years, surgeons have been apprising themselves of the technical steps of surgical procedure and figuring out how to assess their own results. However, the germane concepts have changed; the surgeon as “the one captain of the boat” is a notion that has been contested, at times by the surgeons themselves (14). They are now called upon to go above and beyond surgical gestures, however complex the latter may be, in an attempt to perceive perioperative care in its entirety. They are being asked to function as members of a “crew”, without overlooking or disregarding the technical aspects and the clinical outcomes of their procedures. The concept of “clinical pathways”/“care pathways” has compelled surgeons to move beyond their “core competencies” as they interest themselves in comprehensive care and treatment of the patients to be operated. Learned societies and academies are henceforth tasked with convincing surgeons that they are no longer mere technicians, and that they need to embrace a broader, more “encompassing” vision of their role. Technical skills alone do not allow them to avoid mistaken decisions in the operating theater, as was emphatically shown in a 2012 Scottish audit in which only 4.3% of the errors were purely technical, while the others could be attributed to flawed management (16). In point of fact, numerous studies have shown that a lack of teamwork in operating rooms significantly contributes to adverse events and harm to patients (17). Conversely, a systematic review of the impact of NTS on surgical outcomes (18) showed that effective management of stressful

events in operating theaters has a beneficial effect on surgeon performance, whereas tiredness and failed teamwork are strongly associated with technical errors (19). However, a recent meta-analysis underlined the difficulties of bringing to light a significant impact of NTS teaching on patient treatment (20). Nevertheless, it would appear essential, at an early stage of their training, to sensitize surgeons to the importance of NTS (21). A randomized trial has shown that teaching in a simulated operating room improved the attitude of surgical residents (22). Needless to say, teaching methods have got to be based on validated tools with a high level of evidence. Two systematic reviews [23,24] have convincingly demonstrated that among all the tools mentioned in publications, two NTS teaching methods can be considered as reference methods, namely Oxford NOTECHS (Oxford Non-Technical Skills) [25] and NOTSS (non-technical skills for surgeons) [26].

As of now, certain NTS parameters such as the concept of “enhanced recovery after surgery” (ERAS) (23) have helped surgeons to fully realize that preparation of preoperative and postoperative care is just as contributory to surgical outcome as surgical procedure *per se* (24).

In the final analysis, this article is illustrative of a “global” way of thinking in which surgery is to be considered not simply as “technical action”, but also as a representation of the organization of health care systems according to their capabilities, their needs, and the training of their surgeons. So it is that future surgeons will need to possess not only knowledge and technical skills, but also an array of clinical and pedagogical skills along with leadership qualities enabling them to provide their patients with top-quality services (25).

Conclusion

This study has underscored the increasing prominence of surgical publications focusing on aspects other than surgical technique *per se*. As of now, articles on surgical procedures and their outcomes represent fewer than half of the studies published in prestigious medical reviews.

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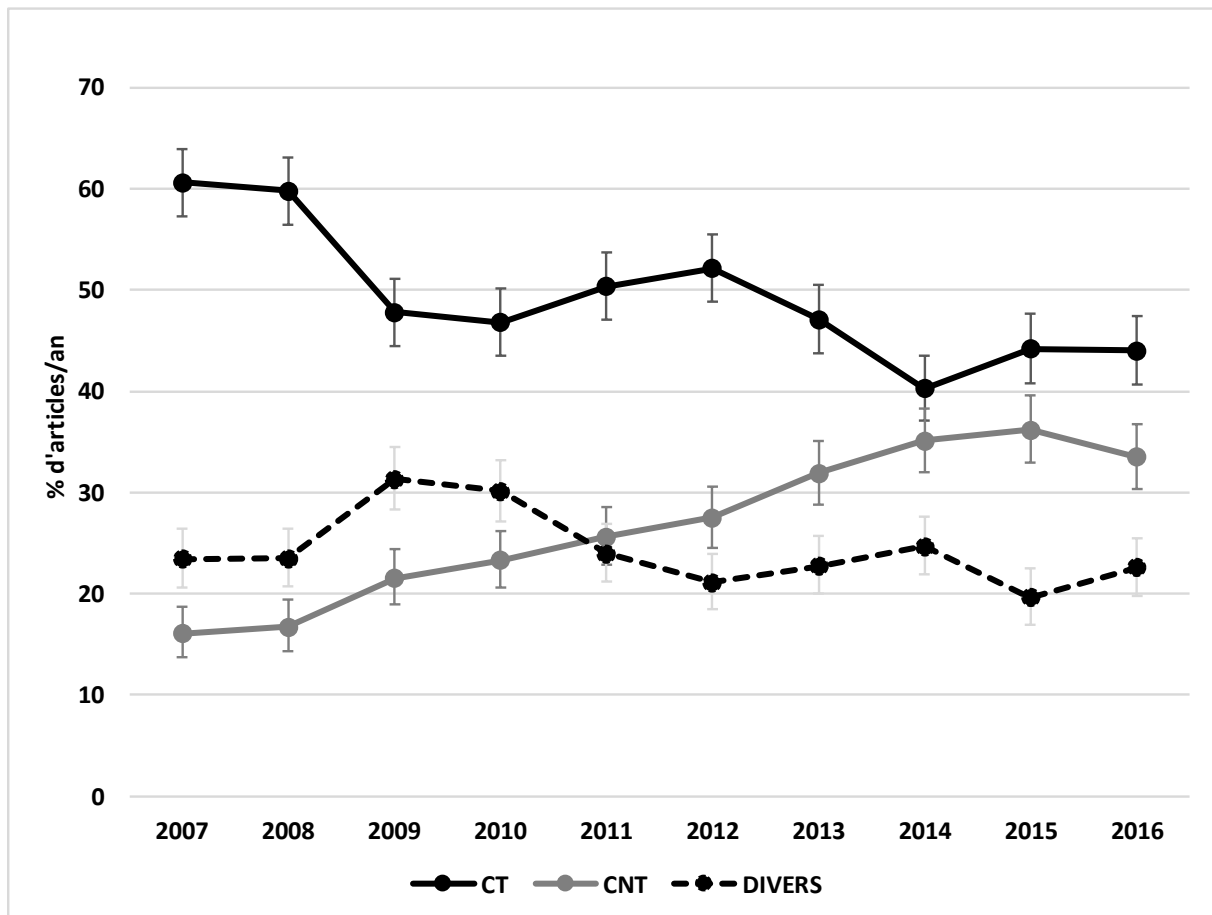
Figure legends:

Figure 1: Curb representing the evolution of publications in each group from 2007 to 2016
(TS: Technical skills; NTS: Non-technical skills)

Figure 2: Distribution of the non-technical skill (NTS) items according to journals' countries of publication

Figure legend:

Figure 1 : Curb representing the evolution of publications in each group from 2007 to 2016 (TS: technical skills, NTS: Non-technical skills)



% d'articles/ an = % of articles/year

DIVERS = MISCELLANEOUS

Figure 2 : Distribution des items de compétences non-techniques (CNT) par pays de publication des journaux

