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Electronic search strategies fail to identify randomized controlled trials (RCTs) in neurosurgery

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ABSTRACT

Randomized controlled trials (RCTs) are the gold standard studies to evaluate the efficacy of therapeutic interventions. Although they are frequently identified through open searches in electronic databases, no studies have evaluated how easy it is to identify RCTs in neurosurgery using electronic search strategies.

The present study evaluated the sensitivity and specificity of different search strategies applied to commonly used databases to identify RCTs in neurosurgery.

The total number of RCTs in neurosurgery published between 1960 and 2013 was determined through a detailed search involving open keyword searches in PubMed, Cochrane Library and Center for Reviews and Dissemination (CRD) databases, a PubMed search based on clinical entity-related keywords and hand-searches on the reference list of identified articles. The sensitivity and specificity were calculated for the open keyword searches on PubMed, the Cochrane Library and the CRD database and for the Cochrane's HSSS, based on the total number of the identified RCTs.

Compared to the total of 1102 RCTs identified, PubMed open search yielded 4660 articles, among which 365 were RCTs (sensitivity: 33.1%; specificity: 7.8%). Cochrane open search yielded 621 among which 36 were RCTs (sensitivity: 3.2%; specificity: 5.8%) and CRD open search returned 78 articles, among which 4 were RCTs (sensitivity: 0.4% sensitivity; specificity: 5.1%). The Cochrane HSSS retrieved 10702 results, among which 340 were RCTs (sensitivity: 30.9%; specificity: 3.2%).

Most RCTs in neurosurgery cannot be identified by commonly used search strategies, which emphasizes the need to improve their indexing.

1. Introduction

In medical research, Randomized Controlled Trials (RCTs) are the gold standard clinical studies to assess the efficacy of therapeutic interventions [3]. It is therefore crucial that RCTs are easily identified by health professionals and other decision-makers, thus allowing access to the best available information.

Neurosurgery is no exception, and the concept of 'evidence-based neurosurgery' (EBN) has recently been proposed [9], according to which the patient care framework is built upon integrating clinical/surgical expertise, patient's preferences and values, clinical circumstances and the best available research evidence.

The International Committee of Medical Journal Editors (ICMJE) recommends the standardization of medical data published in indexed journals. While, on one hand, this provides an opportunity to enhance data sharing, on the other hand, high profile trials and those that are particularly easy to find will be cited and used more often, which may lead to biased healthcare decisions [28]. Broad and well-implemented search strategies are therefore essential to identify as many relevant studies as possible, avoiding biased reviews and laying the foundation for sound decision-making [10,20].

Electronic search strategies aim to facilitate the identification of studies on specific topics of interest [13]. To be effective, such strategies must be able to identify as many relevant studies as possible (i.e.,

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be sensitive), while excluding as many irrelevant studies as possible (i.e., be specific) [12].

Most search strategies rely on electronic databases, with the PubMed and Cochrane library being the most commonly used [14,15,17]. To maximize the sensitivity and specificity of electronic searches, a comprehensive search strategy—the Cochrane Highly Sensitive Search Strategy (HSSS)—was developed and published in 1994 and adapted over time [8]. It remains widely used and is still considered as the best available search strategy; thus it is frequently cited in comparative studies of search methods [16].

To date, no studies have investigated how easy it is to identify RCTs in neurosurgery in commonly used databases.

The sensitivity and specificity of different search strategies to identify RCTs in neurosurgery were evaluated.

2. Methods

RCTs in neurosurgery, defined as randomized trials with two or more comparative groups and at least one neurosurgical therapeutic intervention, were included.

Search results were identified as RCTs in neurosurgery by one author (RG), through the information available in title, abstract or full text. A second author (JFF) was consulted for cases in which eligibility was unclear.

The total number of RCTs in neurosurgery published between 1960 and December 31, 2013 was determined through a detailed search, which included the following steps: a) open electronic searches on PubMed, the Cochrane Library, and the Centre for Reviews and Dissemination (CRD) databases, using “RCTs” and “neurosurgery” as keywords; b) a PubMed search using keywords related to neurosurgical clinical entities (i.e., publication type = ‘randomized controlled trial’ AND (pathology subtype) AND date-publication = ‘1960/01/01’:date-publication = 2013/12/31), and c) hand-searches on the reference lists of the identified RCTs, systematic reviews and meta-analyses (Fig. 1).

Duplications and abstracts were excluded from the total number of retrieved results, leading to the final list of published RCTs.

Once the final list was obtained, the search strategies most frequently applied to biomedical databases were assessed regarding the number of RCTs retrieved. These included the keyword searches applied to PubMed, the Cochrane library and the CRD databases, and the Cochrane’s High Sensitivity Search Strategy applied to PubMed. Based on the findings of this assessment, the specificity and sensitivity of each of those search strategies were determined.

2.1. Data analysis

Unless stated otherwise, results are presented as sums, percentages and means.

Sensitivity (i.e., the ability to identify as many RCTs as possible) was calculated as follows: number of RCTs identified by each specific search strategy divided by the total number of RCTs identified.

Specificity (i.e., the ability to exclude as many irrelevant results as possible) was calculated as follows: number of RCTs identified by each the specific search strategy divided by the total number of articles returned by that particular search strategy.

3. Results

A total of 1102 RCTs in neurosurgery were identified. The number of RCTs identified by each step of the detailed search is presented in Table 1. Open searches using “RCT” and “neurosurgery” as keywords (a) identified a total of 405 RCTs in neurosurgery, among which 365 were identified in PubMed, 36 in the Cochrane library and 4 in the CRD database. Among these, 30 were excluded as duplicates or abstracts, leaving a total of 375 RCTs to be used for further analyses. The PubMed search using clinical entity-related keywords (b) identified 314 RCTs, whereas hand-searching the references of previously identified RCTs, and systematic reviews and meta-analyses (c) retrieved 223 and 190 RCTs, respectively.

Results concerning the sensitivity and specificity of each search strategy are presented in Table 2.

Open searches on PubMed using “RCTs” and “neurosurgery” as keywords retrieved 4660 results, among which 365 were identified as RCTs. This granted PubMed with a sensitivity of 33.1% and a specificity of 7.8%. When the same keywords were used to search the Cochrane library, 621 articles were retrieved, among which 36 were classified as RCTs. This granted the Cochrane library with a sensitivity of 3.2% and a specificity of 5.8%. Using the same keywords to search the CRD database retrieved 78 articles, among which 4 were identified as RCTs. This granted the CRD with a sensitivity of 0.4% and a specificity of 5.4%. The Cochrane HSSS applied to PubMed retrieved 10702 results, among which 340 were RCTs in a neurosurgical indication, granting the HSSS with a sensitivity of 30.9% and a specificity of 3.2%.

4. Discussion

The present study evaluated the sensitivity and specificity of different search strategies to identify RCTs in neurosurgery. We found that most published RCTs in neurosurgical indications cannot be identified through commonly used electronic search strategies. From the total of 1102 RCTs published in English until the end of 2013, open keyword searches identified 33% in PubMed, 3% in the Cochrane library and less than 1% in the CRD database. Surprisingly, the Cochrane HSSS applied to PubMed did not present a higher sensitivity or specificity than open searches, identifying only about 31% of the total number of published RCTs. Several studies in other fields of medical research have previously addressed the sensitivity and specificity of the HSSS applied to PubMed. Marson and Chadwick [21] used different search strategies applied to PubMed to identify RCTs in epilepsy and found that a basic search had a sensitivity and specificity of 66% and 35%, respectively, whereas a comprehensive search had a sensitivity of 86% and a specificity of 72%. Chow et al. [4] compared the Cochrane’s optimal search strategy with a standard PubMed search and with their own algorithm to search PubMed and EMBASE, to identify RCTs in pain research. They found that the sensitivity of each method was 99.6%, 65% and 97% respectively, whereas the specificity was 78%, 97% and 98%, respectively. Sjögren and Halling [25] performed PubMed searches to identify RCTs in dental research and found that the sensitivity and specificity of each search varied widely among different areas of dental research, with the sensitivity ranging between 5% (pediatric dentistry) and 100% (orthodontics), and the specificity ranging between 81% (public health dentistry), and 100% (pediatric dentistry and oral surgery). While the reported values of sensitivity and specificity varied widely across medical fields, one finding common to all studies is that the number of RCTs identified was strongly limited by inadequate indexing and methodological reporting, especially in the abstract. This is consistent with the findings of the present study, where several studies failed to be retrieved by the investigated search strategies due to inadequate indexing. Examples include the RCTs by Kraemer et al. [19] and Smorgick et al. [26], which were not retrieved through open searches on PubMed and lacked relevant keywords in the title, although the manuscript text contained enough information about the trial design. Similarly, a trial by Schuurman et al [24], which was not retrieved by the Cochrane’s HSSS, contained a good description of the study design in the Methods section, but lacked relevant keywords in the title and abstract. Similar cases were found for the searches on the Cochrane Library and CRD database.

The need to improve the reporting of RCTs in neurosurgery was previously identified by a review of RCTs published between 2006 and 2007 [18]. The authors of that study looked at RCTs published in reference neurosurgery and medical journals and found that among the neurosurgery journals the quality of reporting was much poorer than in

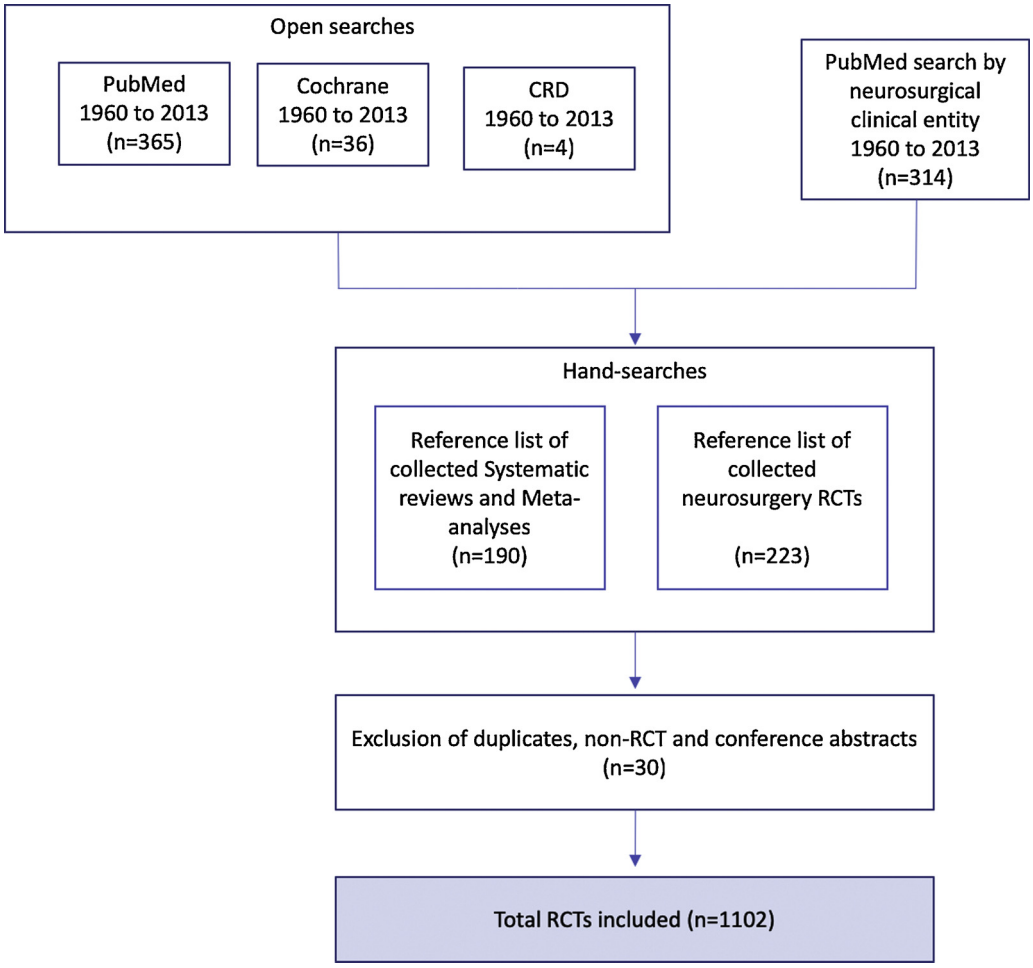

Fig. 1. Detailed search strategy performed on electronic databases and reference lists to identify the final list of RCTs in neurosurgery published between 1960 and 2013. The oldest RCTs identified were published in 1960.

Table 1
Number of RCTs in neurosurgery identified by each search for the 1960–2013 period. RCT- Randomized Controlled Trial; CRD – Centre for Reviews and Dissemination; SR – Systematic Reviews; MA – Meta-analyses.

Phase	Search strategy	Number of results
a)	Open Search on PubMed, Cochrane and CRD, using 'RCT' AND 'Neurosurgery' as keywords	375
b)	RCT AND Pathology Subtypes	314
c)	References of previously identified systematic reviews and meta analyses	190
	References of previously identified neurosurgery RCT	223
Total		**1102**
e)	Cochrane's High Sensitivity Search Strategy (HSSS)	340

Table 2
Comparison among open searches on PubMed, Cochrane Library and CRD and Cochrane's HSSS, in terms of sensitivity and specificity to identify RCTs in neurosurgery. RCTs- Randomized Controlled Trials; CRD – Centre for Reviews and Dissemination; HSSS – High sensitivity search strategy.

	Articles returned	Nº RCTs	Sensitivity (%)	Specificity (%)
PubMed	4660	365	33.1	7.8
Cochrane	621	36	3.2	5.8
CRD	78	4	0.4	5.1
HSSS in PubMed	10702	340	30.9	3.2
Total RCT = 1102				

the medical journals (mean JADAD score: 2.45 vs 3.42, for neurosurgery and medical journals, respectively; CONSORT score: 26.5 vs 41, respectively). Further studies, looking at wider time frames could therefore be useful to investigate how this issue has changed over time.

In the present study, the total number of RCTs in neurosurgery identified for the target period could only be determined by combining different searches in several databases. This shows that, within this research field, no single electronic search strategy can identify all published RCTs. This finding is not surprising, as a previous review has reported that thorough multiple-source searches are required to maximize the number of results [7].

The present study included only searches performed in generalist biomedical online databases, with no searches performed on clinical trial registries, such as the clinical trials.gov or EUDRACT.

While clinical trials registries may constitute the easiest way to identify RCTs and have been considered an important tool when performing systematic reviews [14], they include all registered trials, irrespective of the performance stage, which may not be the most effective way to gather the best information to support health-care decisions.

A previous systematic review of search strategies to identify RCTs of chronic depression [29] reported that 84% of the identified studies were gathered through electronic database searches whereas 16% were gathered through additional searches, including clinical trial registries (ClinicalTrial.gov and ICTRP). From those 16%, hand-searching the reference lists of systematic reviews had the highest contribution (10%), whereas searching clinical trial registries had the lowest

contribution (0%). On the other hand, Baudard et al. [1] reviewed all systematic reviews of pharmaceutical treatments published between 2014 and 2015 and reported that about half of the analyzed reviews did not search clinical trial registries. Upon searching clinical trial registries, the authors identified additional studies for 43% of those reviews. However, reanalysis of 14 meta-analysis with inclusion of the additional articles revealed no quantitative or interpretative changes of the results.

While previous studies suggest a low impact of searching clinical trial registries, further research is needed to evaluate the contribution of clinical trial registries to identify RCTs in neurosurgery.

Among the used databases, PubMed searches had higher sensitivity and specificity than those performed on the Cochrane library and the CRD, which may be related with the number of articles indexed in each of those databases.

Several previous studies have reported that the sensitivity of simple- and optimized-search strategies ranges between 2–51% and 67–99%, respectively [11,16,23]. Our results are consistent which such finding, as the total number of identified RCTs could only be achieved by combining several searches.

The Cochrane HSSS is still considered to be the best electronic search tool and to maximize sensitivity and specificity [14,16]. However, our results suggest that, in the field of neurosurgery, this search strategy is not effective. This may be partly due to the lack of specificity regarding the surgical techniques, reflecting inadequate indexing and methodological reporting in RCTs in neurosurgery. In fact, most developed search filters rely on the reported methodological information [22], especially that included in the abstract. This result raises concern regarding the methodological reporting of RCTs in neurosurgery, highlighting a need for review studies to critically appraise them.

Finally, the present study focused only on RCTs. While RCTs remain the gold standard studies to evaluate the efficacy of new interventions, in neurosurgery their performance is limited by several specific challenges related to patient recruitment, inclusion of an appropriate control group, surgical selection bias, lack of equipoise, among others [6]. Although prospective, observational studies have often been considered to overestimate therapeutic effects for being subject to external confounds [27], recent studies have found no significant differences between the results of RCTs and cohort or case-control studies [2,5].

Therefore, prospective observational studies may constitute an important source of information supporting the use of new surgical techniques, and further studies would be useful to evaluate their impact in the development of new neurosurgical interventions as well as their accessibility through commonly used electronic search strategies.

5. Conclusion

In conclusion, easy access to all published RCTs is crucial for systematic reviewers, meta-analysts and especially health care decision-makers. RCTs in neurosurgery are not easily identified using common search strategies, thus trial indexing should be improved, and the reporting of methodology should be evaluated.

Failure from commonly used search strategies to identify most RCTs should be a source of concern for researchers in all fields of medicine.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

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Declaration of Competing Interest

All authors certify that they have no affiliations with or involvement in any organization or entity with financial interest.

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