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Analysis of the Methodologic Quality of Reporting of Meta-Analyses in Anesthesiology and Pain Medicine

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Abstract

Study Objective: In 1999, the Quality of Reporting Meta-analyses (QUOROM) conference was convened to set standards for meta-analysis reporting. Although the number of meta-analyses has increased over the past decade, the overall scientific quality of meta-analysis reporting in the anesthesiology and pain-medicine literature is unclear. We undertook a literature review of published meta-analyses in the fields of anesthesiology and pain medicine to describe the quality of reporting.

Methods: Meta-analyses relevant to the fields of anesthesiology and pain medicine were identified by a literature search of the Medline, EMBASE, CINAHL, and Cochrane databases. Search terms included combinations of anesth* or anaesth*, preoperative, postoperative, analgesia, pain, and meta-analysis or meta-analyses. Critical care medicine articles were excluded. Publication-related data were extracted from each accepted meta-analysis. The quality of reporting for each meta-analysis was scored by using the Overview Quality Assessment Questionnaire (OQAQ) and the QUOROM checklist.

Results: A total of 374 meta-analyses were included and reviewed. The mean (± SD) overall OQAQ score for all publications was 23.9 ± 2.5 out of a maximum possible score of 27. The mean QUOROM score for all publications was 14.3 ± 2.6 out of a maximum possible score of 18. The quality of reporting of meta-analyses correlated with the region of origin and type of journal (non-anesthesiology > anesthesiology) but not with anesthesia subspecialty. Scores obtained by both OQAQ and QUOROM were higher for meta-analyses published after the QUOROM guidelines were released than for those published earlier.

Conclusions: The quality of reporting of meta-analyses in the fields of anesthesiology and pain medicine has improved since publication of the QUOROM guidelines.

Keywords: Anesthesiology; Meta-analysis

Abbreviations: OQAQ: Overview Quality Assessment Questionnaire; QUORUM: Quality of Reporting Meta-analyses

Introduction

Meta-analyses are a means of synthesizing large amounts of information into a single pooled estimate and are widely used by clinicians, investigators, and policy makers [1]. The number of published meta-analyses has increased significantly over the past decade. Although somewhat controversial, the meta-analytic approach holds many advantages over other types of evidence in part because it increases the available statistical power and allows for the evaluation of subgroups. In some cases, meta-analysis may inform the planning of clinical trials by assisting in sample size determination and hypothesis generation. The meta-analytic pooling of high-quality primary randomized controlled trials (RCTs) is considered the highest level of evidence for issues of prevention and treatment in evidence-based medicine [2]. Since the results from meta-analyses may be used to guide treatment recommendations and policy-making decisions, it becomes paramount that the reporting of meta-analyses is of high quality. The overall scientific quality of reporting of meta-analyses has come into question in part because some published meta-analyses have failed to address potential limitations (e.g., publication bias) [3]. Like the CONSORT guidelines for RCTs [4], the Overview Quality Assessment Questionnaire (OQAQ) and the Quality of Reporting Meta-analyses (QUOROM) statement were each developed to promote increased quality of meta-analysis reporting [5,6]. Specifically, the OQAQ provides a framework on which to critically appraise the quality of meta-analysis reporting, and the QUOROM is a consensus statement

that suggests a standardized way of presenting the components of a meta-analysis. The aim of this study was to determine the quality of reporting of published meta-analyses on anesthesiology and pain-medicine topics. We assessed the quality of these meta-analyses using both the OQAQ and the QUOROM statement. We compared our results with those obtained in other medical fields, when available.

Materials and Methods

Search methodology

Meta-analyses relevant to the fields of anesthesiology and pain medicine were identified by a literature search of Medline, EMBASE, CINAHL, and the Cochrane Database for Systematic Reviews. The first search string included: anesth*, anaesth*, preoperative, postoperative, analgesia, or pain. The second search string included: meta-analysis or meta-analyses. The aforementioned searches were then combined.

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Searches were limited to the English language but were not restricted to any particular years of publication. Human studies were included in the search strategy, and no restrictions were made with regard to journal subsets. No hand searching was performed.

Inclusion and exclusion criteria

A meta-analysis was defined as a review in which the statistical results from multiple studies were combined into a pooled estimate using appropriate statistical methods. Based on a review of the abstract or full text, articles were included if they were confirmed to be a meta-analysis in the study of anesthesiology or pain medicine. Articles were excluded if the statistical results from multiple studies were not combined into a pooled estimate using appropriate statistical methods, were in any language other than English, or were not in the subject of anesthesiology or pain medicine. Critical care medicine topics were excluded.

Data abstraction and synthesis

Publication-related data, including year of publication, journal information (anesthesiology vs. non-anesthesiology journal), article information (pain vs. general anesthesiology topic), author information (anesthesiology vs. non-anesthesiology department), intervention/surgery, and country of publication, were extracted from the meta-analyses that met all inclusion criteria. An individual not involved in data collection concealed this information using black indelible marker. Then data abstraction was conducted independently by primary reviewers blinded to the identity of the meta-analysis and to any identifying information collected prior. A third blinded reviewer resolved any differences between the primary reviewers.

The primary reviewers used the OQAQ and QUOROM guidelines to confirm that each article met inclusion criteria. The OQAQ comprises 10 questions on the methodological quality of the meta-analysis [6]. These questions are related to search strategy, inclusion and exclusion criteria, bias, study selection, method of study combination, conclusion, and overall quality. The OQAQ checklist has been validated [6]. To simplify the methodology, we asked the reviewers to use only the nine questions included in the OQAQ that have 3-scale answers (yes, can't tell, or no). The question that was omitted rates the scientific quality of the meta-analysis on a 1-7 Likert scale. The QUOROM statement presents a checklist of 18 items that should be present in a meta-analysis of high quality [5]. Based on responses to yes-or-no questions, the checklist assesses whether certain components are present and whether they are in the Title, Abstract, Introduction, Methods, Results, or Discussion. The answers are used to compile a QUOROM score, although this score has not been validated. Results were noted as individual component scores and overall OQAQ and QUOROM scores.

Statistical analysis

Descriptive data analysis was used to quantify the number of meta-analyses pertaining to country/region of publication, type of surgery/intervention, department of first author (anesthesiology vs. non-anesthesiology), and type of journal (anesthesiology vs. non-anesthesiology). Overall mean OQAQ and QUOROM scores were calculated. Univariate analysis was used to quantify the effect of various covariates on the overall OQAQ and QUOROM scores, including department of first author (anesthesiology vs. non-anesthesiology), journal of publication (anesthesiology vs. non-anesthesiology),

country/region of publication, and type of surgery/intervention. Mean OQAQ and QUOROM scores of meta-analyses published before and after the release of the QUOROM guidelines were also examined by subcategories [department of first author (anesthesiology vs. non-anesthesiology), journal of publication (anesthesiology vs. non-anesthesiology), country of publication, and medical/surgical subspecialty]. All analysis was carried out with STATA 9.0 (StataCorp, College Station, Texas).

Results

Study selection

The search results and selection of studies in the analysis are summarized in the trial flow diagram shown in Figure 1. A total of 7281 articles were identified in the original search. Of those, 6907 were excluded because the statistical results from multiple studies were not combined into a pooled estimate using appropriate statistical methods (1734), did not examine anesthesia or pain medicine (5058), were duplicates or withdrawn (104), or had missing data (11). Therefore, 374 meta-analyses were included and reviewed.
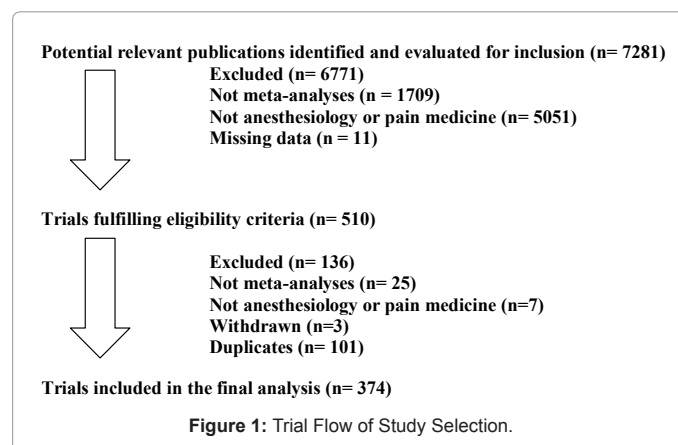
Study characteristics

The baseline characteristics of included studies are shown in Table 1. Of the meta-analyses that were reviewed, 140 (37.4%) were articles related to a general anesthesiology subspecialty, whereas 133 (35.6%) dealt with issues pertinent to pain medicine. Anesthesiology subspecialties with the most meta-analyses were cardiothoracic surgery [34 studies (9.1%)] and obstetrics [29 (7.8%)]. The meta-analyses also spanned various countries and continents. Most were from Europe (43.3%), with others originating in the United States (24.1%), Australia/Asia (13.1%), Canada (12.3%), South America (0.5%), and Africa (0.3%). Collaborations among authors from different countries or continents represented 6.4% of the articles. Of the 374 articles, the first author of 171 (45.7%) was affiliated with an anesthesiology department and 146 (39.1%) were published in an anesthesiology journal.

Overall quality scores

The mean (± SD) overall OQAQ score for all publications was 23.9 ± 2.5 out of a maximum possible score of 27. The mean QUOROM score for all publications was 14.3 ± 2.6 out of a maximum possible score of 18.

Factors affecting quality of meta-analyses

The quality of reporting of meta-analyses was found to depend on

Potential relevant publications identified and evaluated for inclusion (n= 7281)
  Excluded (n= 6771)
  Not meta-analyses (n 1709)
  Not anesthesiology or pain medicine (n= 5051)
  Missing data (n = 11)

Trials fulfilling eligibility criteria (n= 510)
  Excluded (n= 136)
  Not meta-analyses (n= 25)
  Not anesthesiology or pain medicine (n=7)
  Withdrawn (n=3)
  Duplicates (n= 101)

Trials included in the final analysis (n= 374)

Figure 1: Trial Flow of Study Selection.

Characteristic	N	Percent
Surgical intervention		
Cardiothoracic surgery	34	9.1
Obstetrics	29	7.8
Vascular surgery	9	2.4
Orthopedic surgery	8	2.1
ENT	6	1.6
General surgery	5	1.3
Gynecology	1	0.3
Plastics	0	0
Neurology	0	0
Pain medicine	133	35.6
Multiple subspecialties	140	37.4
Other	9	2.4
Location		
Europe	162	43.3
United States	90	24.1
Australia/Asia	49	13.1
Canada	46	12.3
South America	2	0.5
Africa	1	0.3
Multiple	24	6.4
First author anesthesiologist	171	45.7
Anesthesiology journal	146	39.1

ENT = Ear, Nose, and Throat.

Table 1: Characteristics of Included Studies.

Factor	OQAQ Score (mean ± SD)	P-value	QUOROM Score (mean ± SD)	P-value
Location (N)				
Europe (161)	24.0 ± 2.3		14.3 ± 2.6	
United States (90)	23.0 ± 2.9	0.003	13.5 ± 2.7	0.01
Canada (46)	24.7 ± 1.8	0.06	15.2 ± 1.7	0.02
Australia/Asia (49)	24.9 ± 2.1	0.02	15.3 ± 2.1	0.01
Africa (1)	25	0.67	15	0.78
Multiple (24)	22.9 ± 3.2	0.05	13.6 ± 3.3	0.23
South America (2)	24.5 ± 0.7	0.75	15 ± 1.4	0.69
Anesthesiology journal	23.8 ± 2.3		12.5 ± 2.3	
Non-anesthesiology journal	24.0 ± 2.6	0.46	14.8 ± 2.6	<0.001
Surgical intervention (N)				
Multiple surgeries/general anesthesiology (139)	23.8 ± 2.2		14.1 ± 2.6	
Obstetrics/gynecology (30)	23.8 ± 2.3	0.95	14.7 ± 2.1	0.23
General surgery (5)	24.6 ± 1.8	0.50	16.2 ± 1.3	0.08
Cardiothoracic surgery (34)	24.4 ± 2.1	0.23	14.4 ± 2.2	0.53
Orthopedic surgery (8)	24.8 ± 2.5	0.31	15.0 ± 1.6	0.34
Vascular surgery (9)	23.2 ± 3.2	0.48	14.6 ± 2.4	0.61
Pain medicine (133)	23.9 ± 2.8	0.86	14.3 ± 2.8	0.51
ENT (6)	23.8 ± 3.1	1.00	13.5 ±3.2	0.58
Other (9)	21.8 ± 1.7	0.10	13.8 ± 2.5	0.79
First author anesthesiologist	24.1 ± 2.1		14.1 ± 2.3	
First author non-anesthesiologist	23.7 ± 2.8	0.18	12.4 ± 2.8	0.28

ENT = Ear, Nose, and Throat

Table 2: Factors Affecting Quality of Reporting for Meta-analyses.

numerous factors (Table 2). Scores varied significantly with country of origin. Meta-analyses from North America and Australia/Asia received higher scores than those from Europe in terms of both OQAQ scores and QUOROM scores (meta-analyses from Europe were used as the baseline for comparison because the sample size was largest). Scores of meta-analyses published in Africa and South America also appeared to be higher than those of meta-analyses from Europe; however, the number from these continents was too small to detect a statistically significant difference. The type of journal in which the meta-analysis had been reported was also found to be statistically significantly associated with the quality of reporting of the study. Non-anesthesiology journals had a statistically higher mean QUOROM score than did anesthesiology journals (14.5 vs. 12.5; p < 0.001); however, the difference in OQAQ scores was not statistically significant (24.0 vs. 23.8; p = 0.46). Mean quality scores did not vary with the subspecialty of the meta-analysis. No statistically significant differences were found between meta-analyses in general anesthesiology and those in any other subspecialty (including pain medicine). Articles also had similar overall quality scores regardless of whether the first author was affiliated with an anesthesiology or non-anesthesiology department.

Effect of the QUOROM statement

We investigated the effect of the release of the QUOROM statement by comparing the quality scores of meta-analyses published before the 1999 statement release date and those published after the release. Overall, both OQAQ and QUOROM scores were higher in meta-analyses published after the statement was released. The mean post-QUOROM OQAQ score was 24.2 ± 2.5, which was significantly higher

than the pre-QUOROM score of 23.1 ± 2.7 (p < 0.001). Similarly, the mean post-QUOROM QUOROM score of 14.8 ± 2.4 was significantly higher than the pre-QUOROM score of 13.1 ± 2.7 (p < 0.001).

Quality of meta-analyses in general anesthesia subspecialty and pain medicine

The overall quality of reporting of meta-analyses in the general anesthesiology subspecialty literature was found to be comparable to that in the pain-medicine literature. Values for general anesthesia and pain medicine were 23.9 ± 2.3 and 23.9 ± 2.8, respectively (p = 0.96), for the OQAQ and 14.3 ± 2.4 and 14.4 ± 2.8, respectively (p = 0.58), for the QUOROM.

Discussion

In our study, we identified 374 meta-analyses in the anesthesiology and pain medicine literature. The quality of reporting correlated with the region of origin and type of journal (non-anesthesiology > anesthesiology) but not with anesthesia subspecialty. Both OQAQ and QUOROM scores were significantly higher for meta-analyses published after the QUOROM statement was released than for those published before its release.

In our study, the overall quality of reporting of meta-analyses for anesthesiology and pain medicine topics appeared to be high, as scores achieved 88% on the OQAQ scale and 79.4% on the QUOROM scale. In a previous study of the anesthesia literature, Choi et al. [7] reviewed 82 systematic reviews and also found the quality of reporting to be

high, with half of the reviews receiving an OQAQ score of 5/7 or more. However, our study differs from that of Choi et al. in that ours examined only meta-analyses and incorporated the QUOROM scale (which was not available to Choi et al. at that time). Although Choi et al. found no difference in quality of reporting between systematic reviews published in anesthesiology and non-anesthesiology journals, we found the quality of reporting to be higher for meta-analyses published in non-anesthesiology journals.

We examined the effect of the release of the QUOROM statement (in 1999) on quality of reporting of meta-analyses for anesthesiology and pain medicine topics to determine whether establishment of the QUOROM guidelines improved the quality of reporting of meta-analyses and the conclusions that may be drawn from them [5]. Based on our analysis, it does appear that the quality of reporting (based on both the OQAQ and QUOROM checklists) has improved for meta-analyses published in the anesthesiology and pain medicine literature since the release of the QUOROM statement.

Investigations of the quality of meta-analyses reporting in other medical fields have yielded varied results. A review published in 2005 evaluated the quality of reporting of meta-analyses in 139 critical care publications [8]. The results were similar to ours in that overall quality on the OQAQ was poor before publication of the QUOROM statement and improved thereafter. A review of the five major emergency medicine journals from 1990-2001 yielded 29 meta-analyses [1]. Overall, the authors found that meta-analyses published in the emergency medicine literature had extensive flaws and earned a mean OQAQ score of only 2.7 (out of 7); however, the authors included both qualitative and non-qualitative reviews, which may have artificially decreased the OQAQ score. They found no association between year of publication and quality. An evaluation of the general surgical literature (n = 51 meta-analyses) also revealed the presence of poor quality reporting as assessed by the OQAQ scale [mean quality score of 3.3 (out of 7)] [9]. The authors found that factors associated with high quality of reporting were authors having a background in public health/epidemiology and one author having published at least one prior meta-analysis. A factor associated with a low quality score was all authors being in the Department of Surgery. The authors also found that meta-analyses published in high-impact journals tended to have higher quality scores.

Although the QUOROM guidelines promise transparency of the methodological and analytic aspects of meta-analyses, there are some differences between the QUORUM and OQAQ checklists. The QUOROM guidelines recommend a standardized reporting structure primarily to ensure that the methodology of the meta-analysis is transparent. Though it ensures, for instance, that the search strategy is listed, it does not ensure that the search was conducted comprehensively. The OQAQ questionnaire, on the other hand, is more qualitative and potentially a superior tool for assessing the reporting quality of reviews. The OQAQ has been validated but still remains somewhat subjective. As such, a meta-analysis that utilizes both the QUOROM statement and the OQAQ in its design and implementation is likely to have the highest level of quality of reporting possible for a meta-analysis.

There are several limitations to our work. Although a comprehensive literature search was conducted, individual journals were not searched by hand. Therefore, we may have missed several meta-analyses. The fact that our search was limited to the English language may have contributed to publication bias. In addition, reliance on the OQAQ and QUOROM

checklists may have been problematic as portions of the OQAQ require a fair amount of subjective judgment, which led to inter-rater variability in our study. The QUOROM has not been validated as a tool to evaluate quality of reporting for meta-analyses. In its current state, it is intended to act as a guideline for improving the quality of meta-analyses reporting and standardizing their design and implementation [5]. We did not compare the quality of methodologic reporting between Cochrane versus non-Cochrane review although some data indicates that Cochrane reviews may have a higher methodologic quality ratings [10,11]. Finally, the characteristics that make up a high-quality meta-analysis are still unclear, and newer instruments for quality assessment [e.g., assessment of multiple systematic reviews (AMSTAR) and PRIAMA] may provide superior results in future assessments.

In summary, we reviewed meta-analyses published on anesthesiology and pain medicine topics and found that the quality of reporting of meta-analyses appeared to improve significantly after the release of the QUOROM scale. However, the quality of reporting of meta-analyses was higher in non-anesthesiology than in anesthesiology journals. It has been shown that meta-analyses that incorporate studies of poor quality can overestimate treatment effect by as much as 30–50% [12]. Hence the publication of poor-quality meta-analyses may adversely affect clinical care practices or healthcare policy. To further improve the quality of meta-analyses published on anesthesiology and pain medicine topics, journals might consider requiring authors to follow a standard format similar to that suggested by the QUOROM statement. Like similar studies in other medical fields, our study reiterates the need for future improvement in the quality of meta-analyses.

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