

Review of 20 years of vascular surgery research in Australasia: Defining future directions

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Abstract

Objectives: High-quality research is fundamental to the advancement of surgical practice. Currently, there is no quantitative assessment of the research output of vascular surgeons in Australia and New Zealand. By conducting this bibliometric analysis, we aim to provide an objective representation of the trends in vascular surgery and guide future research.

Methods: A list of all current vascular surgeons in Australia and New Zealand was compiled from the Royal Australasian College of Surgeons 'Find a Surgeon' website tool and correlated with the Australia and New Zealand Society for Vascular Surgery database. A Scopus search of each surgeon's author profile over the last 20 years was conducted.

Results: In total, 2120 articles were published by 208 Australasian vascular surgeons between 1998 and July 2018, with an overall increase in publications over time. Audits or case series were the most published type of study and only 8% of the publications were of high-level evidence. The most popular topics were thoracoabdominal aortic pathologies (24%), followed by peripheral arterial disease (15%). Chronological analysis illustrates an increasing volume of peripheral arterial disease research over time and there is a clear trend towards more endovascular and hybrid surgery publications. The top 10 (5%) highest publishing authors by h-index account for 41% of all publications and 49% of all citations and are also responsible for producing significantly more high-level evidence research.

Conclusion: Australasian vascular surgeons have made a significant contribution to medical research. However, the majority of these articles are of low-level evidence. In this time, there has been an increasing number of publications on endovascular and hybrid surgery in keeping with the trend in clinical practice. These areas, as well as research regarding peripheral arterial disease, show potential for high-evidence research in the future.

Keywords

Vascular surgical procedures, research, vascular diseases, bibliometrics, endovascular procedures

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Introduction

High-quality research is fundamental to the continuing advancement of surgical practice. Over time, publications can lead to refinement in the diagnosis, investigation and treatment of various surgical conditions. It also provides a means of communication between surgeons internationally and allows dissemination of information that can potentially impact clinical practice on a global scale.

A bibliometric analysis is a standardised method of quantifying research output and ascertaining trends, strengths and gaps in the literature.¹ An author analysis examining the individual productivity of each surgeon allows appreciation of research output disparities based on author characteristics and identifies authors of high output in particular areas of interest.¹

Vascular surgery is a specialty that has seen significant growth in recent decades, with number of vascular surgeons in Australasia increasing from 124 in 2005 to 212 in 2015.^{2,3} There have been several high-evidence publications by

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Australasian vascular surgeons over the past two decades, such as the GALA⁴ and COBEST⁵ trials, which have had significant impact on clinical practice. There has been some limited data regarding the academic output of other medical cohorts in Australasia,^{6–8} including orthopaedic surgery and general practice.^{6–8} Internationally, there are also several studies investigating publication trends in plastic surgery, otolaryngology and cardiac surgery among other specialties.^{9–11} As of yet, no quantitative assessment of research output has been published in the area of vascular surgery. Furthermore, most existing studies base their analysis upon publications from a defined set of journals, which may not provide a complete representation of the data for the entire cohort of specialists.

The aim of this bibliometric study is to provide an objective representation of the research output of all vascular surgeons in Australia and New Zealand over the past two decades, and provide a detailed analysis of the chronological developments and gaps in vascular surgery literature. This information allows the ability to identify high contributors and evaluate future research prospects as a first step for directing resource allocation for future research.

Methods

Literature search

A list of all current consultant vascular surgeons in Australia and New Zealand was compiled from the Royal Australasian College of Surgeons (RACS) 'Find a Surgeon' website tool¹² and correlated with the Australia and New Zealand Society for Vascular Surgery (ANZSVS) database.¹³ A retrospective search of Scopus was conducted by two independent reviewers in July 2018 to collate, assess and define all publications by Australasian vascular surgeons. Scopus was chosen above others as the primary research database as it possesses an author search function that uses an algorithm to determine authorship based on criteria such as name, affiliation and location. It also produces unique author profiles based on the matched publications and allows analysis of metrics such as Hirsch index (h-index) and citation count. Author profiles were matched if the recorded affiliation corresponded to that of the surgeon, either current or previous. Results were filtered to include only publications within the last 20 years (1998–July 2018). Letters, replies and abstract-only entries were excluded.

Analysis

The gender and location of each surgeon was recorded, as well as their total publication count, citation count, h-index and publication age. Each included entry was assessed for level of evidence using the National Health and Medical Research Council of Australia (NHMRC) guidelines.¹⁴ The year of publication, primary topic covered and surgical

technique used for each article was documented. If the topic or technique related to vascular surgery, but did not fit a main category, it was classified as 'other vascular'. All articles not pertaining to vascular surgery were categorised as 'non-vascular'.

H-index was the chosen metric to reflect each surgeon's research contribution. It is an unbiased mathematical model, defined as the number (h) of publications which are cited at least h times.¹⁵ This allows adjustment for both the quantity and quality of an author's work, and has been shown to be an accurate and simple measure of each individual's academic output.^{16–18}

Statistical analysis was performed using Microsoft Excel (2016, v16.0; Microsoft Corporation, Redmond, WA, USA). Tests for significant were performed using the Mann–Whitney U test.

Results

In all, 208 consultant vascular surgeons were collated from the RACS website, of which 188 were published authors on Scopus. Over the past two decades, these authors contributed to 2120 publications with a total citation count of 48,650.

Level of evidence

Figure 1 is a breakdown of all 2120 publications by study type and level of evidence based on the NHMRC guidelines.

It is clear that research output by vascular surgeons in Australia and New Zealand is predominantly comprised of level IV evidence publications. This is inclusive of expert opinion articles (12%), literature and narrative reviews (6%), case reports (16%) and case series/audits (23%). Almost a quarter (24%) of publications are case-control or cohort studies, many of which are retrospective articles based on prospectively collected data. High (level I or II) evidence is reflected within only 8% of total publications, consisting of 39 systematic reviews, 33 meta-analyses and 97 randomised control trials (RCTs).

Topics

Among the publications, the most popular vascular topic is thoracoabdominal aortic pathologies (24%), primarily consisting of aneurysmal disease, trauma-related presentations and occlusive aortic disease. This is followed by peripheral arterial disease (15%) and carotid artery disease (9%). A total of 10% of articles are not able to be categorised into a major vascular topic and 20% are unrelated to vascular surgery.

A chronological depiction of the research output, stratified by topic (Figure 2), allows identification of trends within the literature. It is important to note that the data for 2018 are complete only until July and therefore figures for 2017 is

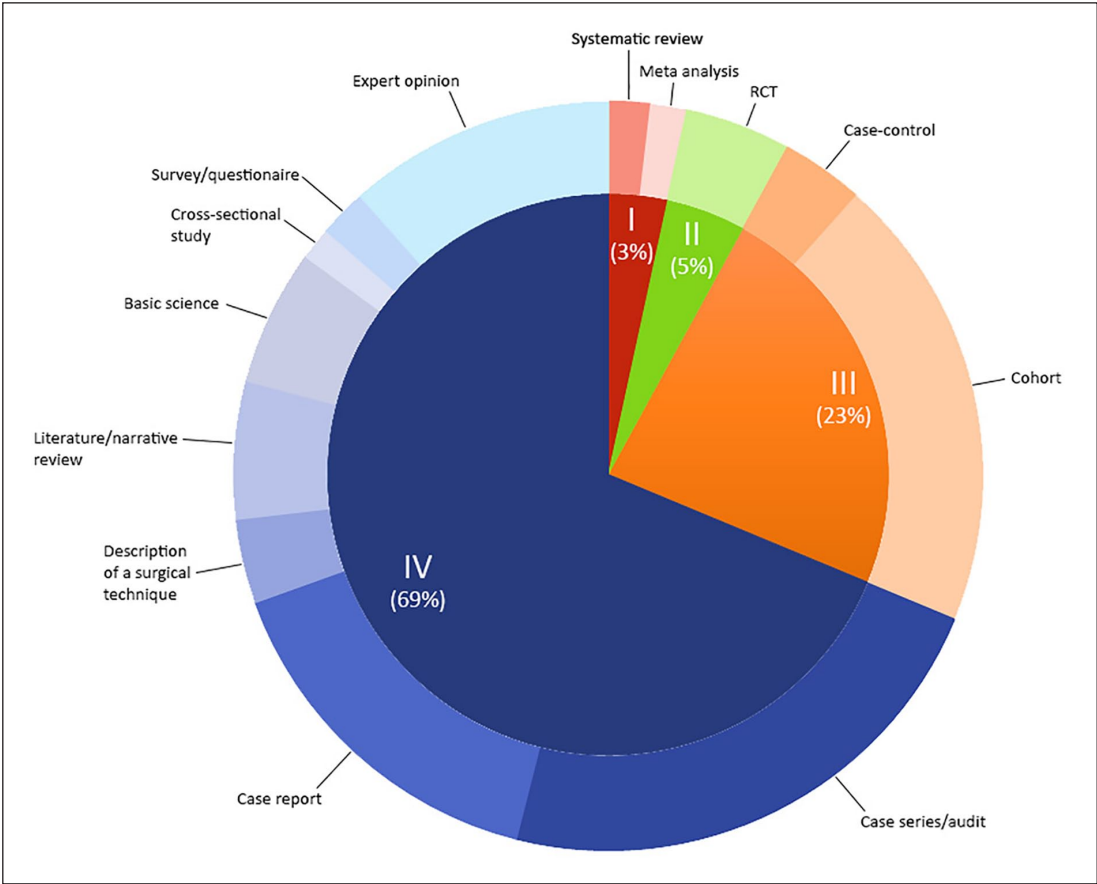


Figure 1. Distribution of vascular surgery publications over 20 years by type of study and NHMRC level of evidence.

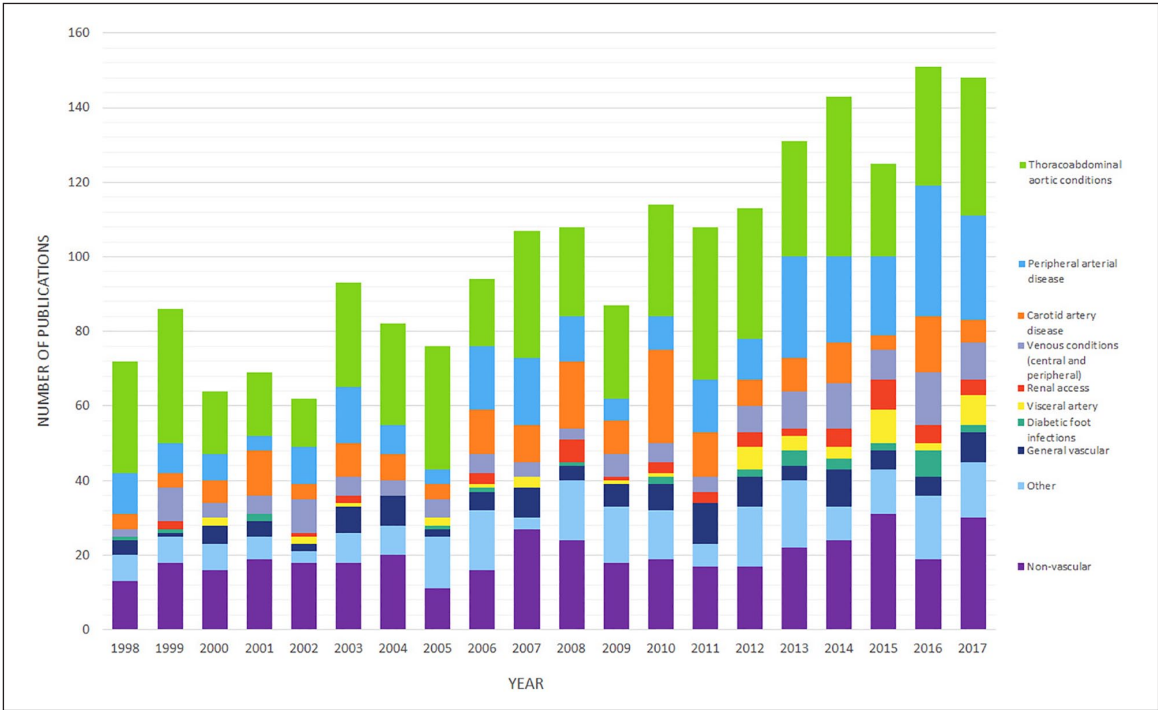


Figure 2. Chronological trend of vascular surgery publications by topic.

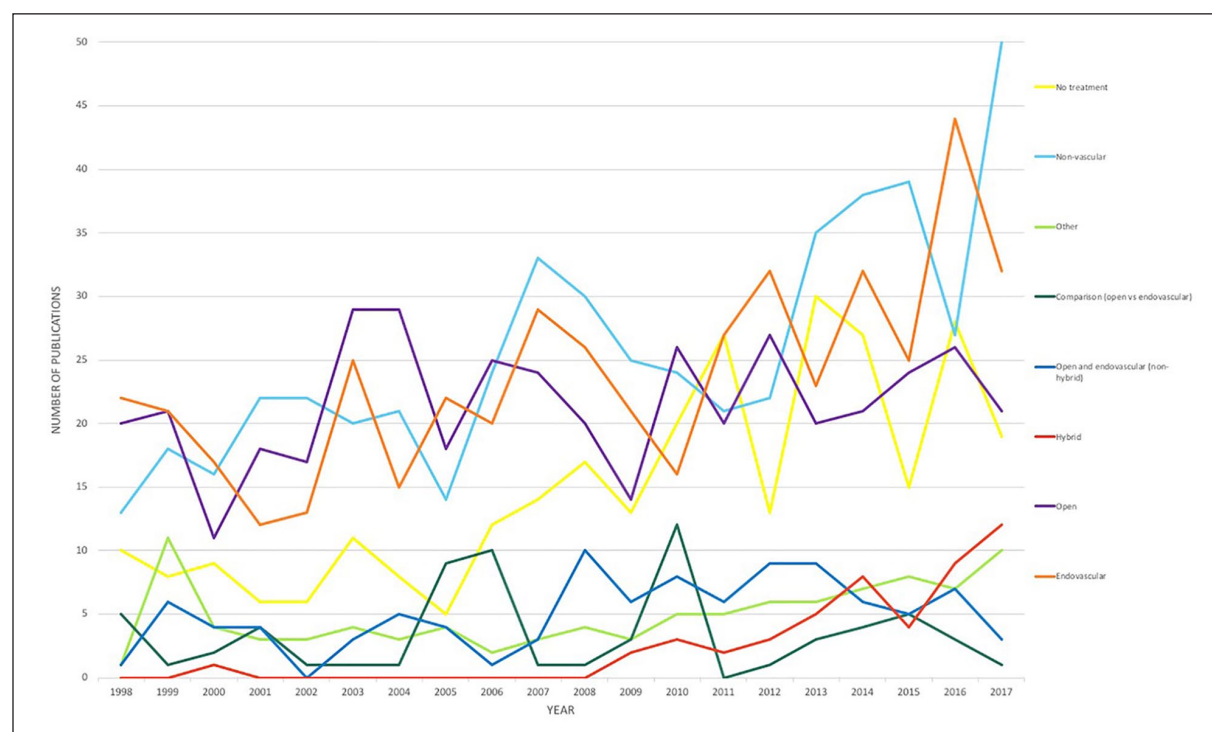


Figure 3. Chronological trend of vascular surgery publications by surgical technique.

used for comparison. Collectively, the academic productivity of vascular surgeons has doubled over the past two decades, from 74 publications in 1998 to 148 in 2017. While the quantity of published articles for thoracoabdominal aortic conditions has remained relatively stagnant over this time, there is a clear trend showing increasing literature regarding peripheral arterial disease.

Techniques

The vascular surgical technique with the largest representation is endovascular surgery (24%), which is a collective category encompassing peripheral arterial angiograms, endoluminal aortic repairs, carotid stenting, endovascular embolisation and endovenous procedures. Open surgery is not far behind, accounting for 21% of articles. More than a quarter (26%) of publications describe non-vascular surgical techniques, and 14% are unrelated to treatment.

Chronological analysis (Figure 3) shows that the number of endovascular surgical publications have gradually increased over the past 20 years, while open surgical research has been relatively stable. Importantly, it is evident that the literature regarding hybrid vascular surgical techniques (combining both endovascular and open surgery)¹⁹ has seen significant growth, particularly over the last decade.

Top authors

Table 1 depicts a comparative analysis of the top 10 (5%) authors, as measured by h-index, compared to the remainder

Table 1. Comparative analysis of the top 10 authors to all other authors.

Metric	Top 10 authors (5%)	All other authors (95%)
Publications		
Total	875	1245
Median	62	4
Citations		
Total	23,700	24,950
Median	1694	35
Publication age		
Median	30	15
Level I evidence		
Total	48	24
Median	1	0
Level II evidence		
Total	32	65
Median	1	0
Level III evidence		
Total	234	260
Median	13	1
Level IV evidence		
Total	561	896
Median	50	3

of the group. The top authors account disproportionately for 41% of all publications and 49% of all citations. They are also responsible for double the total number of level I evidence articles than the rest of the cohort, and published a significantly higher number of median publications in all

evidence categories ($p < 0.05$). In addition, analysis of the data shows that the top 10 authors have a significantly longer median publication age (years from first publication to present) than the remaining authors ($p < 0.05$).

Discussion

Research output by Australian and New Zealand vascular surgeons has been steadily on the rise over the past 20 years. This is consistent with previously published studies in other medical specialties, both locally^{6,20} and worldwide.^{10,21} This bibliometric analysis highlights the quality of research output based on level of evidence, patterns in publication topics and the distribution of author productivity.

Despite the large volume of research produced by Australasian vascular surgeons in the past 20 years, the distribution of levels of evidence also suggests scope for improvement. This propensity towards publishing observational studies such as case reports, audits and narrative reviews in preference to RCTs and guidelines is not unique and has been previously reported in many other medical cohorts.^{20,22,23} There are a number of explanations for why there is such a high prevalence of low-level evidence research among surgeons. Higher quality research almost universally places greater demands on funding and time, resources that are not readily available to all surgeons. Limited research funding from both commercial and academic sources is therefore a major deterrent to many authors who may wish to undertake a large-scale or high-level evidence research project.

In addition, there are constraints to conducting experimental studies, such as RCTs, for surgical procedures. Logistical issues, such as recruitment and blinding, have to be factored in to the process and can come at a significant financial cost.²⁴ Furthermore, ethics approvals can be time-consuming and difficult to obtain, leading to delays in project completion.²⁴ As such, it is more common that large observational cohort studies are used instead of RCTs to assess the efficacy and risks of surgical therapies. However, there are certain steps that can be taken in order to encourage surgeons to produce higher quality publications, such as improving education regarding research methodologies, development of large prospective patient databases and greater funding towards surgical research.

It is clear from the results (Table 1) that there are a select number of vascular surgeons who author a disproportionate number of publications compared to the remaining cohort. In particular, these authors are responsible for producing significantly more high-level evidence research. This is likely due to a number of contributing factors. The results show that the top 10 authors have a significantly longer publication age compared to the rest of the cohort (30 vs 15 years, $p < 0.05$), which suggests that senior authors publish higher quality research. It is also likely that these top authors are employed as heads of department or are affiliated with major

academic institutions, and therefore have greater resources to produce high-quality research.

Thoracoabdominal aortic pathologies and peripheral vascular disease were the two most popular topics of research among Australasian vascular surgeons. Furthermore, endovascular surgery techniques surpassed open surgery as the most researched technique. This distribution is unsurprising given that endovascular management of aortic and peripheral arterial diseases have in recent years become first-line therapy for many conditions, prompted by major studies such as the DREAM,²⁵ EVAR^{26,27} and BASIL.²⁸ RCTs which have demonstrated equivalence and arguable advantages to endovascular over open techniques, through follow-up trials of similar scientific robustness, are limited. Furthermore, the clear increase in hybrid surgical publications, from only 1 article between 1998 and 2008, to over 50 articles in the following decade is in keeping with the current trend in clinical practice, which has seen increasing adoption of hybrid operating theatres and techniques to treat complex vascular pathologies that require simultaneous open and endovascular approaches.^{29–32}

Limitations

There are several limitations to note within this study.

First, the use of the RACS 'Find a Surgeon' website tool to extract the list of vascular surgeons in Australia and New Zealand had the potential to omit newer surgeons. Correlation of the list with ANZSVS, a second source, was performed in order to produce a more accurate cohort of surgeons.

Second, Scopus was used as the sole research database to collate the list of publications by Australasian vascular surgeons. While it is a reliable resource with the capability to produce and analyse individual author profiles, there is the possibility that relevant publications may have been omitted from the analysis. Efforts were made to minimise this by correlating each surgeon's author profile with their known affiliations and merging separate profiles for the same author where appropriate.

Future directions

This bibliometric analysis describes an objective process of quantifying research output by Australasian vascular surgeons. The methodology is simple, easily accessible and reproducible for other clinician cohorts. Within this group, comparative author analysis demonstrates that there are a small number of Australasian vascular surgeons contributing to not only the bulk of research output with respect to publication and citation numbers but also the production of high-quality research. A further study that directly analyses each author's research background, as well as their co-author relationship with other surgeons would also be of significant benefit in analysing factors that influence research output. The data from this study, in conjunction with other metrics

such as h-index, enable stratification of authors in an unbiased and transparent manner. This allows identification of high contributors in particular topics in order to direct resource allocation for future research.

Conclusion

This bibliometric study is a comprehensive and objective analysis of the research output of all vascular surgeons in Australia and New Zealand in the last 20 years. They have made a significant contribution to medical research, with 2120 publications in this time. However, there is a propensity for low-evidence work and disproportionately fewer higher-level publications such as RCTs, systematic reviews and meta-analyses, highlighting an area of improvement. The top 5% of authors account for 41% of the total publications and are responsible for significantly more high-level evidence studies. Quantitative analysis demonstrates that thoracoabdominal aortic pathologies and peripheral arterial disease are the most popular topics, while there has been an increasing number of publications on endovascular and hybrid surgery in keeping with the trend in clinical practice. This information allows for improved identification of top contributing authors to vascular surgery research and can be used in resource allocation for future research projects or identification of research gaps.

Declaration of conflicting interests

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