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Avi Robinson

Carolyn A. Ardizzone

Anne D. Strong

Hytham S. Salem MD

Stephen Thon MD

See next page for additional authors

Authors

Avi Robinson, Carolyn A. Ardizzone, Anne D. Strong, Hytham S. Salem MD, Stephen Thon MD, Andres Barandiaran, and Rachel Frank MD

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Avi S. Robinson MS, Carolyn A. Ardizzone MS, Anne D. Strong MS, Hytham S. Salem MD, Stephen G. Thon MD, Andres F. Barandiaran MS, Rachel M. Frank MD

Lehigh Valley Health Network, Allentown, Pennsylvania

Background

Modern day surgical training is based upon a residency system developed over a century ago by William Halsted, MD. Much like an apprenticeship, surgical residents learn their trade gradually, through the instruction and direct guidance of an expert. Surgical training must, above all else, be safe for our patients. In the past, popular media has portrayed this apprenticeship model as potentially dangerous for patients. The evidence in the literature is mixed. Some studies conclude that resident involvement harms patients, some assert no difference, and some even report a benefit to having a resident involved in your surgery. Does the apprenticeship model work in terms of being safe for patients? Part of the issue lies in the literature itself, owing to a mixed bag of results across studies. Clarification of the conflicting information in the literature, characterized by data pooling and Meta analysis, motivated the efforts of our project

Problem Statement

The primary purpose of this study was to determine the effect of resident involvement on patient outcomes in orthopedic surgery. The secondary purpose was to determine the impact of study quality on any significant variables.

Methods

Our study followed the Preferred Reporting Items of Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Two independent reviewers searched PubMed, Embase, and the Cochrane Library to find studies assessing the impact of resident involvement on patient outcomes in orthopedic surgery cases. Study quality was assessed using the Newcastle-Ottawa Scale (NOS). NOS numerical scores were then given a qualitative label of “poor”, “fair”, or “good” based on conversion using Agency for Healthcare Research and Quality (AHRQ) standards. Sub analysis of data from studies rated as AHRQ “good” was performed to investigate the effect of study quality on reported patient outcomes.

Results

Thirty-seven studies and some 400,000 patients were included in our Meta analysis (Table 1). Pooled analysis of all 37 studies revealed statistically significant differences between cohorts ($p<0.05$) for ten variables (see Table 2 and Figure 1).

Table 1. Studies and Participants by AHRQ Rating

AHRQ Rating	Studies, n (%)	Participants, n (%)
Poor	17 (46)	203,518 (47)
Fair	3 (8)	21,034 (5)
Good	17 (46)	212,005 (49)

Table 2. Sub Analysis of AHRQ “Good Quality” Data*

Pooled estimates of all 37 studies revealed a significant difference ($p<0.05$) in eight variables, all of which reversed to *not* statistically significant ($p>0.05$) upon sub analysis. This suggests that the AHRQ-rated “poor” and “fair” studies are confounding the true impact of resident involvement on patient outcomes; showing an impact when in fact there is none. *The AHRQ “good quality” studies presented here used the National Surgical Quality Improvement Program (NSQIP) database for study participants. NSQIP reports 30-day outcomes from US hospitals.

ŦOdds Ratio (OR) reported as (M-H Random, 95% CI).

Body Mass Index (BMI), Chronic Obstructive Pulmonary Disease (COPD), Deep Vein Thrombosis (DVT), Myocardial Infarction (MI), Ventilation for over 48 hours (V>48), Peripheral Nerve Injury (PNI), Sepsis (S) or Septic Shock (SS), Surgical Site Infection (SSI)

Variable	Studies	Participants	Odds RatioŦ	Conclusion
1. BMI	3[1-3]	8,346	0.03 [-0.22 0.29]	No negative effect
2. COPD	6[1-6]	16,246	0.96 [0.80, 1.15]	No negative effect
3. DVT	6[1-3, 5-7]	11,922	1.53 [0.95, 2.46]	No negative effect
4. MI	2[1,3]	5,936	0.99 [0.37, 2.68]	No negative effect
5. V>48	2[1,3]	5,936	0.94 [0.46, 1.90]	No negative effect
6. PNI	4[1,3,7,8]	7,520	0.86 [0.39, 1.91]	No negative effect
7. S or SS	7[1-3,5-8]	12,370	2.02 [0.91, 4.50]	No negative effect
8. SSI – Deep	3[1-3]	8,346	1.59 [0.63, 3.99]	No negative effect

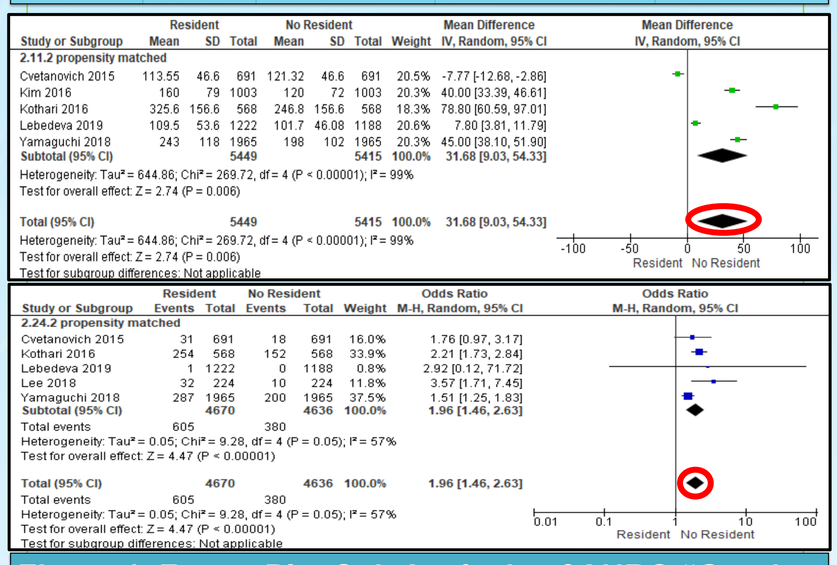

Figure 1. Forest Plot Sub Analysis of AHRQ “Good Quality” Data

Pooled estimates of all 37 studies revealed a significant difference ($p<0.05$) between cohorts for mean operative time (top) and transfusion ≥ 5 units of pRBCs (bottom). Notably, these variables remained significantly different between cohorts after sub analysis. This suggests that there is in fact a true difference between these two variables with resident involvement.

Results cont.

However, sub analysis of the studies rated as AHRQ “good quality” revealed *no significant* difference between cohorts ($p>0.05$) for eight of these variables (Table 2). Notably, two outcome variables remained statistically significant (Figure 1). Finally, spine (44%) and sports medicine (41%) together accounted for most patients in this Meta-Analysis.

Discussion

In SELECT, we learn about Health Systems and the iron triangle of healthcare. The three components of the triangle are cost, quality and access. I was taught that you can improve one or two of these things, but it had to come at the expense of the third. For example, one can make the health care system more accessible by adding more trainees, but that would increase the cost of training or decrease the quality of the training. After all, more staff would have to be hired to train this influx of new recruits. If training capabilities are not expanded, the quality of the training would be expected to decline.

Conclusions

The main finding of this Meta-Analysis show that resident involvement in orthopedic surgeries is associated with longer operative times and an increased risk of blood transfusion; however, other perioperative complications are not increased. This meta-analysis demonstrated that resident involvement is safe in orthopedic surgery. While resident involvement does lead to longer operative times, it does not appear to increase the rate of postoperative complications. In relation to SELECT, this meta-analysis illustrates that in health systems, quality of care of care will always have to be balanced with cost and access.

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