

Concept Paper

Surgeons' Re-operative Valve Replacement Practices with Patients with Endocarditis Due to Drug Use

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Running Head. Heart Valve Replacement for IVDU

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Abstract:

Background: This study discerns surgeons' attitudes and practices in the determination of heart valve replacement for patients with endocarditis due to intravenous drug use (IVDU-IE). We aimed to identify factors contributing to surgeons' decision-making process for initial and recurrent surgical heart valves, and the availability of institutional guidance.

Methods: An IRB approved, anonymous mixed-methods survey instrument was designed and validated with 24 questions. Cardiothoracic surgeons in the U.S. and globally were recruited with a total of 220 enrolling in the study with 176 completing every question on the survey.

Results: A cluster analysis revealed that although surgeons can be divided into sub-groups based on their previous experience with valve replacements, these groups are not perfectly homogenous, and the number of identified clusters is dependent on technique used. ANOVA analysis revealed that the variables that most clearly divided the surgeons into subgroups were, in order of importance, years of practice, number of valve replacements, and geography.

Conclusions: Our analysis showed heterogeneity among cardiothoracic surgeons regarding how they make clinical decisions regarding re-operative valve replacement related to IVDU-IE. Therefore, an opportunity exists for an interprofessional team to develop guidelines to decrease variability in surgical decision-making regarding valve replacement associated with IVDU-IE

Background

The treatment and management of endocarditis due to IVDU-IE is largely centered on eradicating infection and reversing the intracardiac and systemic manifestations of infection [1]. Treatment begins with prolonged parenteral antibiotic therapy on admission to the hospital and completed in the outpatient setting [2]. The delivery of parenteral antibiotics via central intravenous access creates concerns that IVDU-IE patients will misuse their intravenous access and create further infection [3].

Identifying which patients would benefit from surgery is an important feature of management of IE; the decision to operate is made using case by case surgical judgement and personal experience [4]. The number of IVDU-IE patients requiring surgery increased from 14.8% in 2002 to 26% in 2012 [5]. Indications for valve replacement surgery, supported by observational studies and include heart failure, severe regurgitation, persistent infection, infection caused by fungi or highly resistant organisms, and large, embolic vegetations. Current guidelines recommend early surgery in patients with IE, along with comprehensive addiction treatment [6].

Despite risks of surgery, patients with IVDU-IE who receive first-time surgery were found to have lower 1-year mortality than patients who received medical treatment only, indicating a survival

benefit to patients with surgical indications [2]. Compared to other patients with IE, the 30-day postoperative mortality for patients with IVDU-IE is similar, with some studies estimating mortality at 10% for both groups [7,8]. Although surgery is initially successful, some studies suggest that long-term outcomes are worse for patients with IVDU-IE [3,9,10].

In a retrospective study of 180 patients (54 IVDU) from 2011- 2016, the leading cause of death at mid-term (median equals 20.7 months) was continued drug use (69.2% of patients) [7]. Multiple studies found 60% to 81% of IVDU-IE patients return to drug use following surgery [3,11–13]. Some surgeons create care plan agreements with patients, stating that noncompliance and reinfection might result in withholding redo surgeries [4]. The 1-year survival of patients with recurrent IE was 63.3% compared to 95.4% in patients with a single episode of IVDU-IE, suggesting recurrent IVDU-IE patients are critically ill with a more complicated course [8].

The decision for second operations on IVDU-IE patients after relapse of IVDU and reinfection is highly contested and physician-dependent [4]. IVDU-IE patients differ from traditional IE patients in terms of characteristics, demographics, diagnosis, and outcomes, which complicates clinical and ethical decision-making for physicians. Published recommendations and consensus guidelines are not specific to IVDU and the sequelae of SUD, especially in patients with recurrent IE [3]. It is unknown if repeated surgical interventions will benefit patients given their poor long-term outcomes. Some surgeons believe surgical treatment of repeat IVDU-IE is futile or intervening on an end-stage disease, despite the fact that IVDU-IE patients are younger and could benefit from added life expectancy if they manage to cease their drug use [3,4].

This study discerns surgeons' attitudes and practices in the determination of heart valve transplantation for patients with endocarditis due to intravenous drug use (IVDU-IE). We aimed to identify factors contributing to surgeons' decision-making process for initial and recurrent surgical artificial valves, and the availability of institutional guidance.

Methods

We utilized a mixed methods survey to best recruit and assess cardiothoracic surgeons' demographics, quantify practices specific to IVDU-IE, and determine the influence of various medical and social factors on surgical decision making in patients with IVDU-IE. Approximately 1,000 cardiothoracic surgeons in the United States and internationally were recruited using national email lists including, "The Heart Surgery Forum Discussion" and The Society for Thoracic Surgeons (STS).

This study as well as waiver of signed informed consent due to the anonymous nature of the survey, were reviewed and approved by the IRB (IRB#18-008). The survey was implemented on SurveyMonkey.com (Gold Edition) including the following demographic and practice-based questions:

- Demographic and background information included years in practice in five-year increments, total cases per year performed as the primary surgeon (0-50, 51-100...,200+), and choice of setting(s) (urban, suburban, rural, or all that apply).
- Self-reported Region of practice (Pacific, West, Midwest, South, and Northwest)
- The greatest number of valve replacements done for a single patient
- Policies or guidelines in place regarding recurrent IVDU-IE (yes or no) and whether such guidelines would benefit their practice (yes, no, or undecided).
- Source of current practice choices regarding recurrent IVDU-IE included: textbooks/guidelines, taught by another physician/mentor, gained from personal experience, or other; surgeons could choose more than one option.
- Personal beliefs surrounding addiction, including moral problem, medical problem, social problem, and/or other (with the option to specify).
- Percent changes in consultations per year for IVDU-IE in the past five years, the percent change in cases per year in the past five years for first-episode IVDU-IE, and the percent change in cases per year in the past five years for recurrent IVDU-IE; these options were presented in 9-point Likert scale and ranged in increments of 25% from "-100% or more", to "no change", to "+100% or more".

Cluster Analysis

Cluster analysis is a multivariate method to classify subjects (or objects), based on a set of variables, into different subgroups such that similar subjects are placed in the same sub-group. In the current study, cluster analysis was performed to explore subgroups of cardiothoracic surgeons based on their responses to the survey questions, i.e., their practices and beliefs surrounding IVDU-IE and valve replacement surgeries.

In order to identify the optimal number of clusters to extract, we used Gaussian finite mixture models, which fits variety of models to the data and then compares their fit for the data using Bayesian information criterion (BIC) statistics. The quantitative analysis was performed in R Studio [14], specifically package “cluster” was used for cluster analysis [15,16]. In addition, Fixed –Effects ANOVA (Analysis of Variance) was used to determine the importance of variables in determining cluster membership.

Thematic Analysis

Thematic analysis was used to analyze all open-ended responses that either clarified or expanded upon descriptive survey responses, providing context for participants’ answer choices within the survey.

Results

Of the 176 surgeons who completed the survey, 29.4% reported they have been in practice for 25 years or more followed by 17% reporting they have been in practice for 16-20 years. 31.7% of these surgeons reported they perform greater than 200 cases per year as the primary surgeon followed by 23.9% who report they perform 151-200 cases per year. Of the 176 surgeons who responded, 33% reported their region of practice as the South followed by 17.9% reporting the Midwest. 51.8% of 203 surgeons reported the demographics of their practice as an urban setting, followed by 29.4% suburban and 11.9% rural.

Cardiothoracic surgeons most commonly reported their personal belief of addiction aligns with it being a social problem (n =152) followed by medical (n=115) and moral (n=63). 104 of 176 cardiothoracic surgeons (47.7%) reported that they have performed a maximum of two valve replacements, followed by 44 (20.2%) reporting a maximum of one valve replacement and 26 (11.9%) reporting a maximum of three or more valve replacements in a single patient. In the free response section, one surgeon responded, “only one replacement no matter the circumstances” and another stated, “denied replacement if still using drugs.” Conversely, one surgeon responded they “will give [a] second or third chance”, another responded they “will give 3+ replacements if young, healthy, good social support, and sober”, and another indicated “3+ replacements if duration is long between surgeries” without indicating the meaning of “long” duration.

When asked whether their institutions have policies or guidelines regarding surgery in patients with recurrent IVDU-IE, 71.1% (155/168) reported “no” with only 6% (13/168) reporting “yes.” For those who reported “yes,” 7 individuals indicated their institutions have a one (1) valve replacement policy for persons with addictions.

When asked where cardiothoracic surgeons learned their current practices, surgeons most commonly chose “personal experience” (158 responses), followed by “another physician or mentor” (65 responses) and textbook guidelines (45 responses). Two surgeons reported consulting with ethics consultants and/or committees to guide their decisions for recurrent valve surgeries.

Asked what they perceived to be the percent change in consultations and cases of IVDU-IE in the past five years, surgeons reported a percent increase in consultations and first episode with 24.4% and 25.1% reporting a 50% increase respectively. Nearly a third of surgeons (32%) reported no change in the cases of recurrent IVDU-IE, although a cumulative 65.1% reported a 25% to 100% increase.

Cluster Characteristics

When models were compared to each other based on their fit to the data (BIC = -6225.7), the best practically fitting and useful solution consisted of 3 clusters. ANOVA revealed having a practice in a rural setting, belief addiction is a social problem, performing either 1 or more than 3 valve replacements, and using personal knowledge as source of current practice for subsequent valve replacement were the most influential variables in dividing surgeons into clusters (subgroups).

The three clusters include surgeons in practice on average with a similar amount of years, with Cluster 1 having the highest proportion of rural demographic, Cluster 2 having highest proportion of urban demographic, and Cluster 1 and 2 about equal proportion of suburban demographic (**Table 1**). Higher percentages of surgeons indicated addiction is a medical problem in Cluster 3, then in Cluster 1 and 2. Additionally, Cluster 3 had the lowest percentage of surgeons who indicated addiction is a moral problem. Only Cluster 1 had percentage of surgeons who did not indicate that addiction was a social problem. Cluster 1, which is the largest cluster, identifies surgeons not performing more than 1 valve replacement as compared to surgeons in Cluster 3 who all completed 3 or more surgeries. Surgeons in Cluster 2 performed about 2 replacements. A subset of Cluster 1 surgeons reported not using personal experience for practice guidance. Surgeons in Clusters 1 and 3 endorsed textbooks to guide their practices of heart valve replacements more frequently than surgeons in Cluster 2. Surgeons in Clusters 1 and 2 endorse having a mentor or colleague Inform practice more often than surgeons in Cluster 3 (**Table 1**).

Table 1. Cluster Characteristics.

	Cluster 1 (n=86)	Cluster 2 (n=69)	Cluster 3 (n=20)
Variable	Count (%)	Count (%)	Count (%)
Years in Practice	M (4.37) SD (1.65) Range (1-6)	M (4.61) SD (1.41) Range (1-6)	M (3.95) SD (1.54) (Range 1-6)
Urban	49(57)	48 (69.6)	5(25)
Suburban	34 (39.5)	27 (39.1)	3 (15)
Rural	24(27.9)	0(0)	2(10)
Moral Problem	31(36)	29(42)	3(15)
Medical Problem	50 (58.1)	48 (69.6)	17 (85)
Social Problem	62 (72.1)	69 (100)	20 (100)
1 Replacement	44 (51.2)	0 (0)	0 (0)
2 Replacements	34 (39.5)	69 (100)	0 (0)
3+ Replacements	6 (7)	0 (0)	20 (100)
Textbook Knowledge	23 (26.7)	13 (18.8)	8 (40)
Mentor Knowledge	33 (38.4)	26 (37.7)	5 (25)
Personal Knowledge	67 (77.9%)	69 (100)	20 (100)

Note. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively. Survey questions that correspond to variable names can be found in Appendix 1.

Discussion

Surgeons in Cluster 1 (the largest cluster) perform fewer subsequent valve replacement surgeries compared to surgeons in Clusters 2 and 3, although they have been in practice, on average, about the same amount of time. Relevant to the number of valve replacement surgeries is that over 2/3 of the surgeons in Cluster 1 practice in suburban and rural environments where resources, including surgical personnel and administrative support, could be barriers to multiple valve replacement surgeries, as well as increased risks, for a single patient. Surgeons in this cluster seem to utilize policies or establish their own guidelines that limit valve surgeries to 1 or 2 except in rare circumstances (e.g., multiple valves needing replaced in a single surgery due to extensive vegetation).

Surgeons in Cluster 3 (the smallest cluster) performed many more subsequent valve replacement surgeries compared to the surgeons in Clusters 1 and 2 (100% of the Cluster 3 group). A smaller percentage of Cluster 3 surgeons reported addiction is a moral problem, though 100% reported that addiction was a social problem and 85% reporting it was a medical problem. Cluster 3 surgeons also endorsed personal knowledge to guide valve replacement decisions, thus suggesting when they are doing 3 or more valve replacement surgeries, they are not heavily relying on textbooks or mentors to make these surgical decisions; 40% look to the literature for guidance. Data also suggests surgeons in Cluster 3 are less likely to support policies that impose on decision-making and of treating each patient as an individual.

More surgeons in Cluster 2 endorsed addiction is a moral problem embedded among social and medical factors, yet more likely to place blame on patients or society, resulting in potentially more stringent rules imposed by the practicing surgeon (e.g., no more than 2 replacement surgeries per patient). Experience with subsequent valve replacements might be a contributor to how surgeons conceptualize addiction and how current practices emerged regarding subsequent valve replacement.

The majority of surgeons (71.1%) in our study do not have hospital policies or guidelines to guide decisions for recurrent valve replacement surgeries; they greatly rely on personal knowledge and experience, which may be inconsistent among surgeons and not necessarily motivated by best practices of patient care. Findings also suggest that if surgeons believe recurrent valve replacements for IVDU are not just medical and social issues, but also moral issues, they are less likely to do more than 2 valve replacements for a given patient with IE due to IVDU. Nevertheless, regardless of age, years of practice, or location of surgical practice (e.g., rural), nearly 60% (59.6%) of our surgeons are willing to give this patient population a second chance and recognize the complexities associated with addiction and of the circumstances surrounding each patient.

There is a sense of humility and compassion in surgeons' decisions, and a need for guidance that acknowledges patient variability while establishing clear conditions for recurrent valve replacements.

Limitations

This study attempted to understand the physician-dependent practices in treating IVDU-IE, particularly in cases of recurrent disease. Published recommendations and consensus guidelines are not specific to IVDU-IE. In an effort to generalize the results of this study, participants of this study were recruited from and represent a broad geographic and demographic area to capture the diversity of IVDU-IE and the differences in clinical judgement and treatment in the greater population of cardiothoracic surgeons. However, the study was limited by sample size. The results of this study may not capture the thoughts and opinions of physicians practicing in rural areas and other demographic regions that received lower response rates. It is notoriously difficult to attain high response rates among surgeons.

While surgeons appeared forthcoming in their responses, written views and expressed attitudes may not translate to their actual clinical practice due to social desirability, recall, and response bias. The findings of this study, such as the number of physicians who indicate they are likely to initiate treatment for substance use disorder, would need to be compared to retrospective clinical data to eliminate bias.

Our findings suggest surgeons are more likely to perform recurrent valve replacement surgeries, giving patients a second chance at life, and would value concrete guidance in decision-making when patients are identified on a case-by-case basis, that surgeon autonomy is respected, and that other health care professionals are involved in the care of this patient population to address addiction and the need for social support toward recovery.

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