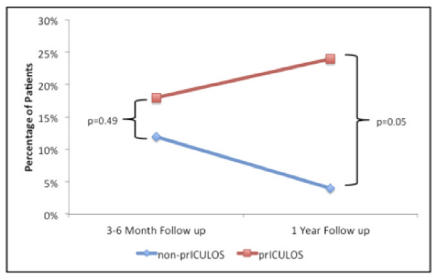
Patients With a Prolonged Intensive Care Unit Length of Stay Have Decreased Health-Related Quality of Life After Cardiac Surgery

K. Barrie,[*,†] A. Cornick,[*] S. Debreuil,[*,†] E. Lee,[*] B.M. Hiebert, MS,[*] R.A. Manji, MD, PhD, MBA,[*,‡,§] O.J. Bienvenu, MD, PhD,[‖] B. McDonald, MD, PhD,[¶] R.K. Singal, MD, MS,[*,‡,§] and R.C. Arora, MD, PhD[*,‡,§,1]

Cardiac surgery patients with a prolonged ICU length of stay (prICULOS) have lower rates of functional survival following their procedure, however detailed information on their health related quality of life (HRQoL) is lacking. We sought to investigate the potential need for intervention in these high-risk patients through comprehensive HRQoL assessments in the months to year following their surgery. A prospective, observational pilot study was undertaken and cardiac surgery patients with a prICULOS (ICU length of stay of ≥5 days) were recruited. A control group was obtained through recruitment of cardiac surgery patients with an ICU length of stay of <5 days. In-person clinical or telephone survey HRQoL assessments were completed at 3–6 months and 1-year time points after their procedure. The standardized mean difference (SMD) was calculated for all study variable comparisons to quantify the standardized effect size observed between non-prICULOS and prICULOS patients. 789 cardiac procedures were performed during the study period and 89 patients experienced a prICULOS (10.7%). Of these 89 patients, 35 prICULOS patients were recruited along with 35 controls. 29 out of 35 prICULOS patients completed the study (83%). At the 3–6 month follow up the prICULOS patients had higher levels of weight loss, fear of falling, and driving deficits. At 1-year, prICULOS patients had persistent difficulties with activities of daily living and required more family and external support. This study demonstrates the need for closer follow up and intervention for cardiac surgery patients with a prICULOS who were found to have poorer mid and long-term HRQoL.

Semin Thoracic Surg 31:21–31



Percentage of patients with any ADL deficit.

Central Message

Prolonged intensive care unit length of stay (prICULOS) following cardiac surgery has worse HRQoL demonstrating the need for improved follow-up and interventions for these vulnerable patients. prICULOS (prolonged Intensive Care Unit Length of Stay).

Perspective Statement

Cardiac surgery patients with prolonged intensive care unit length of stay have long-term functional deficits and increased reliance on family and other social support systems therefore demonstrating the need to develop interventions to improve transition of patient care following hospital discharge.

Abbreviations: HRQoL, Health-Related Quality of Life; PICS, Post Intensive Care Syndrome

*Institute of Cardiovascular Sciences, St. Boniface Hospital Research Centre, Winnipeg, Manitoba.
†Max Rady College of Medicine, University of Manitoba, Winnipeg, Manitoba.
‡Section of Cardiac Surgery, Department of Surgery, Max Rady College of Medicine, University of Manitoba
§Section of Critical Care, Department of Medicine, Max Rady College of Medicine University of Manitoba.
‖John Hopkins School of Medicine, Baltimore, Maryland.
¶Cardiac Surgical Intensive Care Unit, Division of Cardiac Anesthesia & Critical Care Medicine, University of Ottawa Heart Institute, Ottawa, Ontario.

Funding: University of Manitoba, Department of Surgery Research Grant Award.

[1]R.C. Arora has received an unrestricted educational grant from Pfizer Canada Inc. and honoraria from Mallinckrodt Pharmaceuticals.

Address reprint requests to Rakesh C. Arora MD PhD CR 3012 – 369 Tache Ave University of Manitoba, St. Boniface Hospital Winnipeg, Manitoba R2H 2A6, Canada. E-mail: rarora@sbgh.mb.ca

1043-0679/$–see front matter

https://doi.org/10.1053/j.semtcvs.2018.07.005

INTRODUCTION

Over the last 20 years, the increasing burden of heart disease within an aging population has resulted in cardiac surgery being offered to older patients with higher levels of frailty and multiple comorbidities.[1] Advances in surgical, anesthesia, and cardiac critical care medicine have allowed for improved perioperative care of these patients; however, many experience a more complicated postoperative course resulting in a prolonged intensive care unit length of stay (prICULOS). Examination of prICULOS patients with non-cardiac surgery critical illnesses has shown long-term depression, anxiety, and post-traumatic stress disorder (PTSD) symptoms, cognitive impairments as well as functional disability often referred to as Post-Intensive Care Syndrome (PICS).[2–6] Less is known about the effect of prICULOS and the occurrence of PICS in the postoperative cardiac surgery patient.

Intuitively, a potential key difference with the cardiac surgery prICULOS patient compared to the non-cardiac surgery ICU patient is that there has been an attempt to restore function (via cardiac surgery) prior to their ICU stay. For example, the patient may have had a coronary bypass graft for coronary artery stenosis or a heart valve replacement for a stenotic valve. A patient with a prICULOS following a severe respiratory illness, in contrast, generally has a loss of pulmonary function that may or may not fully recover in addition to the deconditioning that occurs while in the ICU. As such, it may be anticipated that a cardiac surgery patient may recover differently than a non cardiac surgery patient. On the contrary, recent data has suggested that the cardiac surgery patient with a prICULOS experiences similar difficulties following hospital discharge.[7]

A recent large retrospective analysis performed in Manitoba[7] found that rates of prICULOS patients are increasing rapidly due to the changing demographic of the cardiac surgery patient. During the period of 2000–2009, 7.6% of cardiac surgery patients required a prlCULOS. The percentage had increased to 11.3% between 2010 and 2013, a 57% increase. Functional survival (alive and not institutionalized) decreased between 1 and 5 years in the prICULOS patient; however, a lack of more granular information remains regarding the HRQoL aspect of functional survival.

Thus, at present, there is a gap in knowledge regarding the presence and extent of PICS and associated decrements in HRQoL in the postoperative cardiac surgery patient with a prICULOS. Specifically, there is insufficient detailed post-discharge information regarding these patients' ability to function physically and mentally at home and in the community thereby providing the rationale behind our study.

We hypothesized that patients with a prICULOS following cardiac surgery will experience worse HRQoL than the non-prICULOS patients at both midterm (3–6 months) and long-term (1 year) time points following their cardiac surgery. The objectives of this initiative were to gain detailed long-term HRQoL data in patients who have prICULOS following cardiac surgery and demonstrate the need for further intervention and follow up in this patient group.

METHODS

Study Population

A postoperative follow-up clinic was established to conduct a prospective, observational cohort analysis for prICULOS patients undergoing cardiac surgery at a tertiary care center, with a patient catchment of approximately 1.1 million people. The study was approved by the University of Manitoba Research Ethics Board (REB) and the St Boniface Hospital Research Review Committee (RRC).

Inclusion/exclusion criteria: Any adult patient (≥18 years of age) with a prICULOS (defined as an ICCS (Intensive Care Cardiac Surgery) stay of ≥5 days)[7] was potentially eligible for inclusion regardless of procedure type or urgency status. The ≥5 day cutoff was selected based on previous work completed locally which aimed at identifying the "best" definition of prICULOS[8] Eligibility was determined at the time of cardiac surgery ward discharge or via the Manitoba Cardiac Surgery and Winnipeg Regional Health Authority ICU databases. Due to the complexity of the assessments, patients who could not be reliably assessed were excluded (e.g. due to severe developmental delay, severe hearing disabilities, and inability to understand English with no access to a translator). A control group was formed utilizing the Manitoba Cardiac Surgery database. In order to be considered a "control," the patients had to have an ICU length of stay <5 days. Once a list was generated, a manual attempt to "match" a control patient to each prlCULOS patients was undertaken by one of the researchers. Five characteristics were chosen to determine who would be a suitable to serve as a control. First, gender followed by age (<5 years age difference), then procedure date or length of time from the procedure (<1-month difference) to ensure that the subjects had a similar amount of recovery time postprocedure. Finally, an attempt to match procedure type and urgency was made although most patients could not be matched without compromising the characteristics that were already matched (gender, age, and procedure date).

Patient Recruitment and Data Collection

Patient recruitment occurred from June until December 2015. Patients were contacted by phone at 3–6 months after their cardiac surgery to consent for participation in the study. The time period range of 3–6 months was used in order to generate a larger cohort. Patients were given the option to participate in either a 45-minute to 1-hour in-person clinical assessment at St. Boniface Hospital, Winnipeg, Manitoba or via a 20- to 25-minute phone survey. A list of multiple non-prICULOS "control" patients per prICULOS patient was also generated. The control patients were subsequently contacted by telephone, the most closely matched first. Additional control

patients were not contacted if the most closely-matched control patient agreed to participate in the same assessment (clinic or phone) as the prICULOS patient on whom they were matched. If all suitable controls declined a clinical assessment (and this was preferred for matching purposes) they were given the opportunity to participate in a phone survey as an alternative.

Enrolled study participants underwent detailed assessments in order to determine their HRQoL at midterm (3−6 months) and long-term (1 year) time points. HRQoL is a multidimensional concept that includes domains related to physical, mental, emotional, and social functioning.[9] Many of the assessments and questionnaires assessed multiple realms related to HRQoL and PICS. We arranged them into five areas: functional status, mental health, decision regret, frailty, and patient-perceived overall HRQoL. We chose to include decision regret and frailty in our assessments as both can contribute to HRQoL.[10,11]

All study participants were assessed using standardized questionnaires for both in-person clinic and telephone interview. Functional Status was assessed by inquiring about the level of assistance the patient required with their ADLs (Activities of Daily Living) and (Independent Activities of Daily Living). Other scales used were the Falls Efficacy Scale (FES)[12,13] and the NYHA (New York Heart Association) classification.[14,15] Additionally, patients were asked about their current living arrangements and the presence of hospital readmissions and medical complications. The Physical Activity Scale for the Elderly (PASE)[16,17] was used in both the phone survey and clinical assessment and the Timed Get up and Go (TUG)[18,19] only in the clinical assessment. Mental Health was assessed by using the Hospital Anxiety and Depression Scale (HADS)[20] and PTSD Check List-Civilian Version (PCL-C).[21] Decision regret was assessed utilizing the Decision Regret Scale.[22] In order to assess frailty in the clinical assessments, the following three assessments were used: the Modified Fried Criteria that included seven criteria: slowness (as determined by the 5-m gait speed measurement), weakness (handgrip strength measurement), weight loss (self-reported weight loss), exhaustion (the modified 2-item CES-D Scale), depression (the 5-GDS), low physical activity (the Paffenbarger Physical Activity Index) and cognitive impairment (the MoCA)[23] (the 5-GDS, self-reported weight loss, modified 2-item CES-D, and Paffenbarger Physical Activity Index questionnaires were also included in the phone survey). The other two frailty assessments were the Short Physical Performance Battery (SPPB),[24] and the Clinical Frailty Scale (CFS).[25] The EQ-VAS is a part of the EQ-5D questionnaire and was used to assess patient-perceived overall HRQoL.[26,27]

Statistical Analysis

Categorical variables were expressed in all tables as the number and percentage of patients with a particular characteristic present in a given cohort. The normality of all continuous variables was assessed using a Kolmogorov−Smirnov Test, and expressed as a mean and standard deviation or median and interquartile range where appropriate. The standardized mean difference (SMD) was calculated for all study variable comparisons to quantify the standardized effect size observed between non-prICULOS and prICULOS patients. All analyses were performed using SAS version 9.3.

RESULTS

Follow-Up Patient Recruitment

During the period of January 2015 until August 2015, a total of 789 cardiac surgical procedures were performed at St. Boniface Hospital of which 89 patients were identified as having a prICULOS (12.1%). Of the 89 patients, 7 (8%) died in-hospital. Of the remaining surviving eligible patients, 17 patients declined participation, 23 could not be contacted, and 3 were excluded (Fig.1). Of the 3 that were excluded, one had an inability to participate secondary to limited English with no access to a translator and severe hearing disability, the second had developmental delay (Trisomy 10), and the third was still in hospital after 6 months due to other medical complications. The remaining 39 patients were matched to controls and 4 patients were excluded due to an incomplete match (unable to match on gender, age, and procedure date). A total of 35 prICULOS and 35 non-prICULOS patients agreed to participate in the study. One prICULOS patient was recruited at the 1-year follow up and thus missed the 3−6 month follow-up. A higher proportion of phone surveys were completed in the non-prICULOS group, (4 control patients could not come in for clinical assessments therefore phone surveys were done instead). At the 1-year follow-up, 6 prICULOS patients did not participate, 5 declined, and 1 was out of the country with no means of making contact. Two patients who did a clinical assessment at the 3−6 month follow-up could not make it in at the 1-year follow-up to complete a clinical assessment but did agree to a phone survey. At the 1-year follow-up in the non-prICULOS group, 8 did not participate, 7 declined, and 1 could not be contacted. The control that only completed the 1-year follow-up did a phone survey instead of a clinical assessment, contrary to her prICULOS match. During the follow up if a prICULOS patient dropped out of the study, then the non-PrICULOS patient was excluded from the study at the 1-year follow-up. If either the prICULOS or non-prICULOS group completed a phone survey and the other one completed a clinical assessment at the 1-year follow up, then only the aspect of the clinical assessment that was the same as the phone survey was incorporated into the final data.

Study Population Characteristics

Enrolled patients' demographic and preoperative characteristics are shown in Table 1. The prICULOS patients had somewhat similar comorbidities as compared to their matched non-prICULOS patients although there was a significantly higher amount of prICULOS patients that had a

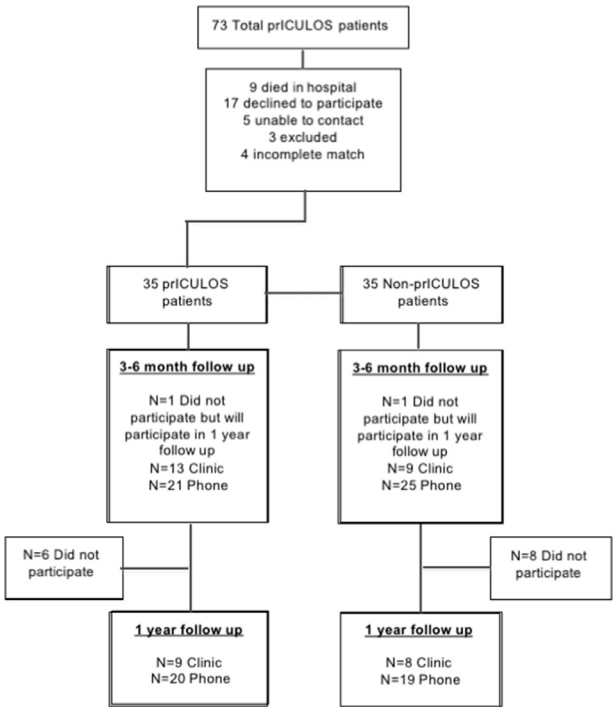


Figure 1. Patient recruitment diagram.

previous Myocardial Infarction and Atrial Fibrillation. The intraoperative and postoperative characteristics are shown in Table 2. The prICULOS patients had more surgical and postoperative complications and remained in hospital longer than non-prICULOS patients.

HRQoL Outcomes

At the 3–6 month follow-up time point, patients with a prICULOS had greater self-reported weight loss, a higher Falls Efficacy Score (greater fear of falling), and more deficits with the ability to drive (Table 3). At the 1-year follow-up, prICULOS patients were found to have deficits with their ability to complete ADLs and IADLs and walking distance. In addition, the prICULOS patients required more assistance from their family or home care (Table 4). Reported weight loss tended to improve in both groups at 1 year and was no longer statistically significant between groups. Initially, both groups had similar deficits with ADLs and IADLs; however, they began to diverge by the 1-year follow-up time point (Figs. 2 and 3). Non-emergent prICULOS patients demonstrated higher Decision Regret scores at both the 3–6 month follow-up (3 points difference SMD = 0.38) and 1-year follow-up (3 points difference SMD = 0.27) (Tables 3 and 4).

DISCUSSION

The goal of "Patients with a Prolonged Intensive Care Unit Length of Stay have decreased Health-Related Quality of Life after Cardiac Surgery" study was to demonstrate the need for further intervention and follow up in the prICULOS cardiac surgery patients by evaluating their HRQoL. This study examining mid- and long-term functional outcomes in patients with a prICULOS following cardiac surgery has demonstrated that indeed intervention and comprehensive follow up is needed in this patient group whose HRQoL is impaired. We believe this is one of the first studies to comprehensively examine granular HRQoL in the prICULOS cardiac surgery patient.

We have discovered, not only do prICULOS patients have more intraoperative and postoperative complications that put them at risk for death, but they also experience long-term functional deficits placing them at risk for poor functional survival and increased reliance on family and other social system supports. In order for patients and families to make informed decisions and possibly minimize regret,[10] they need to know about both the mortality associated with cardiac surgery and risk of a deterioration in their HRQoL.[7] This would not necessarily change their decision to undergo surgery but provide them and the health care team with expectations to allow preparation for their path towards recovery. This potentially could assist in preventing functional complications and physical and mental hardship in the months to years following their surgery.

Previous studies[28–30] have examined the prICULOS cardiac surgery population with a focus on outcomes related to mortality as opposed to HRQoL. We were able to find three studies[31–33] that included an analysis of HRQoL. All three studies were larger in size than the current study; however, they did not include several of the assessments included in this analysis nor did they include an in-person clinical component or a control group. One of the two more recent studies was completed in Germany[31] with a study group of 119 patients who had a mean age of 72 and a mean ICU length of stay of 19 days. The investigators administered the Barthel Index to assess mobility and the SF-12 questionnaire to assess mental and physical health over the phone at 1-year follow up. They concluded that prICULOS patients had a higher in-hospital and follow-up mortality but their psychological and physical status at 1-year follow-up was similar to the general population. The other more recent study was completed in Sweden[32] with a study group of 141 patients who had a mean age of 68 years old and a mean ICU length of stay of 16 days. Patients were followed up at 1, 3, and 5 years after cardiac surgery. The investigators utilized the Karnofsky performance score to assess functional status via phone interview and the SF-36 for HRQoL by mail. They found that two-thirds of patients had close to normal functional capacity but lower physical and mental health when compared to the general population. It is difficult to compare these studies to our study as they used different measures, had much longer ICU lengths of stay, and did not include control groups. The paucity of literature and varying results underscore the need for further research in this area.

Table 1. Preoperative Characteristics of Non-PrICULOS and PrICULOS Patients

Variable	Non-PrICULOS Patients ($N = 35$)	PrICULOS Patients ($N = 35$)	Standardized Mean Difference[†]
Demographics			
Age	67 (61–73)	66 (59–73)	−0.05
Sex (female)	13 (37%)	13 (37%)	0.00
BMI (kg/m^2)	30.4 (25.6–33.7)	27.3 (26.2–30.9)	−0.32
Comorbidities			
Diabetes	13 (37%)	11 (31%)	−0.12
Hypertension	21 (60%)	28 (80%)	0.45
Dyslipidemia	20 (57%)	17 (49%)	−0.17
Smoking history	15 (43%)	17 (49%)	0.12
Current smoker	4 (11%)	6 (17%)	0.16
Previous MI	8 (23%)	16 (46%)	0.50
Congestive heart failure	4 (11%)	8 (23%)	0.31
Stroke	3 (9%)	3 (9%)	0.00
Peripheral vascular disease	3 (9%)	3 (9%)	0.00
Chronic obstructive pulmonary disease	3 (9%)	0 (0%)	−0.43
Preoperative atrial fibrillation	2 (6%)	9 (26%)	0.57
Cardiogenic shock	0 (0%)	4 (11%)	0.51
Preoperative hemoglobin	130 (121–141)	130 (120–141)	−0.10
Preoperative creatinine	78 (69–95)	89 (70–115)	−0.10
Preoperative medications			
Aspirin	21 (60%)	12 (34%)	−0.53
Ace inhibitors	7 (20%)	10 (29%)	0.20
Beta blockers	17 (49%)	13 (37%)	−0.23
Ca antagonist	12 (34%)	9 (26%)	−0.19
Diuretics	4 (11%)	8 (23%)	0.31
Plavix (clopidogrel)	4 (11%)	6 (17%)	0.16
Operative status			
Ejection fraction (%)	60 (60–60)	50 (33–60)	−1.06
EuroSCORE II (%)	1.5 (1.0–2.3)	3.4 (2.2–5.3)	0.86
Procedure urgency			
Elective	18 (51%)	10 (29%)	−0.48
Urgent	12 (34%)	10 (29%)	−0.12
Emergent	5 (14%)	15 (43%)	0.67
Previous procedures			
Previous coronary artery bypass graft	0 (0%)	0 (0%)	0.00
Previous valve	0 (0%)	3 (9%)	0.43
Previous percutaneous coronary intervention	2 (6%)	5 (14%)	0.29

*Data are presented as median (quartile 1–quartile 3) or *N* (%).
[†]Standardized mean difference = difference in means or proportions divided by standard error.

Limitations

The primary intention of this study was to demonstrate the need for comprehensive follow up and intervention in prICU-LOS cardiac surgery patients in Manitoba. While the sample size was too small to be able to demonstrate widespread significant statistical differences between groups, we feel that the study still provides valuable data and identifies the need for a future intervention study.

We attempted to manually match prICULOS patients to "controls" based on five characteristics and were successful in matching patients based on age, sex, and date followed up from surgery. Unfortunately, we could not match patients based on procedure type or urgency without sacrificing the former three characteristics which were felt by the authors to be important to maintain. We acknowledge that procedure urgency and type of procedure are likely determinates of poor long-term functional outcomes in addition to a prICU-LOS and know that these confounding variables likely affected the study outcomes. We emphasize though, that the goal of our study was not to demonstrate that a prolonged

Table 2. Intraoperative and Postoperative Characteristics of Non-PrICULOS and PrICULOS Patients

Variable	Non-PrICULOS Patients (*N* = 35)	PrICULOS Patients (*N* = 35)	Standardized Mean Difference[†]
Operative characteristics			
Procedure			
Isolated coronary artery bypass graft	19 (54%)	11 (31%)	−0.48
Isolated valve	7 (20%)	4 (11%)	−0.24
Coronary artery bypass graft + valve	4 (11%)	8 (23%)	0.31
Other	5 (14%)	12 (34%)	0.48
Clamp time (min)	82 (65−107)	100 (64−131)	0.21
Pump time (min)	110 (89−141)	149 (115−190)	0.56
Blood transfusions			
Red blood cells (intraoperative)	12 (34%)	23 (66%)	0.66
Fresh frozen plasma (intraoperative)	4 (11%)	19 (54%)	1.03
Platelets (intraoperative)	5 (14%)	21 (60%)	1.07
Red blood cells (postoperative)	15 (43%)	28 (80%)	0.83
Fresh frozen plasma (postoperative)	2 (6%)	14 (40%)	0.89
Platelets (postoperative)	3 (9%)	11 (31%)	0.60
Complications			
Ventilation time (h)	4 (2−6)	31 (12−71)	0.92
New atrial fibrillation	10 (30%)	11 (42%)	0.25
Cardiac arrest	0 (0%)	2 (6%)	0.35
Chest tube output in first 24 h (mL)	663 (420−968)	935 (585−1407)	0.47
Return to operating room for bleeding	1 (3%)	5 (14%)	0.42
Return to operating room − any reason	2 (6%)	9 (26%)	0.57
Postop myocardial infarction	0 (0%)	0 (0%)	0.00
Any infection	5 (14%)	22 (65%)	1.20
Pneumonia	2 (6%)	6 (17%)	0.37
Delirium (any confusion assessment method +)	5 (14%)	20 (57%)	1.00
Stroke	1 (3%)	2 (6%)	0.14
Highest postoperative creatinine	85 (69−118)	151 (108−223)	0.91
Acute kidney injury (rise in creatinine by 1.5x)	2 (6%)	14 (54%)	1.22
New dialysis	0 (0%)	4 (11%)	0.51
ICU length of stay (h)	28 (22−51)	172 (140−264)	1.61
Hospital length of stay (d)	9 (6−15)	23 (16−47)	0.92
Discharge and readmission			
Discharge location			
Home	33 (94%)	28 (82%)	−0.38
Transferred to hospital	2 (6%)	4 (12%)	0.22
Rehab/restorative care	0 (0%)	2 (6%)	0.35
Readmitted to hospital in 30 d	1 (3%)	3 (9%)	0.25

*Data are presented as median (quartile 1−quartile 3) or *N* (%).
[†]Standardized mean difference = difference in means or proportions divided by standard error.

ICU length of stay was the sole determinate of a poor HRQoL in of itself, but rather another patient characteristic that could be used as a marker for the need of a more extensive follow up regime.

With most studies of this nature, there is potential for volunteer bias due to those who were willing to participate and those who did not. Furthermore, Manitoba has a large geographical spread and many patients live in rural communities that are hours away from the hospital in Winnipeg. We attempted to mitigate this bias with telephone surveys; however, many still refused to participate. Finally, we had a lack of baseline functional and mental health data as this is difficult to obtain for patients requiring emergent procedures. In the future, this could possibly be addressed by asking the patient to retrospectively comment on their mental health and general function prior to their surgery as done previously,[31] or part of a more comprehensive, prospective study design that could formally assess this preoperatively.

CONCLUSION AND FUTURE AIMS

Patients who experienced a prICULOS following their cardiac surgery procedure suffered from worse functional

Table 3. Three to Six Month Follow-Up of Non-PrICULOS and PrICULOS Patients (Clinic and Phone Call Parameters)

Variable	Non-PrICULOS Patients ($N = 34$)	PrICULOS Patients ($N = 34$)	SMD[†]
Time between surgery and contact (d)	127 (98–162)	101 (93–142)	−0.35
Activities (reported deficit − 2 or 3)			
Can you eat?	1 (3%)	1 (3%)	0.00
Can you dress and undress yourself?	2 (6%)	2 (6%)	0.00
Can you take care of your own appearance?	1 (3%)	1 (3%)	0.00
Can you walk (includes cane, does not walker)?	2 (6%)	3 (9%)	0.11
Can you get in and out of bed?	0 (0%)	1 (3%)	0.25
Can you take a bath or shower?	2 (6%)	5 (15%)	0.29
Do you ever have trouble getting to the bathroom on time?	2 (6%)	2 (6%)	0.00
Can you use the telephone?	0 (0%)	0 (0%)	0.00
Can you get to place out of walking distance?	1 (3%)	4 (12%)	0.34
Can you go shopping for groceries or clothes?	4 (12%)	9 (26%)	0.40
Can you prepare your own meals?	1 (3%)	5 (15%)	0.44
Can you do housework?	9 (26%)	13 (38%)	0.31
Can you handle your own medicine?	1 (3%)	3 (9%)	0.25
Can you handle your own money?	2 (6%)	2 (6%)	0.00
Can you pull or push a large object like a living room chair?	11 (32%)	16 (47%)	0.37
Can you bend over, crouch, or kneel?	7 (21%)	7 (21%)	0.00
Can you raise your arms over your head?	2 (6%)	4 (12%)	0.21
Can you pick up or handle small objects with your fingers?	1 (3%)	2 (6%)	0.14
Can you lift something that weighs over 10 pounds?	5 (15%)	8 (24%)	0.24
Can you walk up or down a flight of stairs?	1 (3%)	4 (12%)	0.34
Can you walk 1.5 km?	7 (21%)	11 (32%)	0.22
Any Deficit Reported Above?	22 (65%)	22 (65%)	0.00
Number of Deficits	1 (0–3)	2 (0–4)	0.37
Hospital anxiety and depression score			
Depression score			
Borderline or depressed	3 (9%)	8 (24%)	0.41
Anxiety score			
Borderline or anxious	5 (15%)	4 (12%)	−0.09
Modified fried characteristics			
GDS depression	14 (41%)	14 (41%)	0.00
Weight loss	10 (29%)	20 (59%)	0.62
Exhaustion	14 (41%)	16 (47%)	0.12
Low physical activity	13 (38%)	14 (41%)	0.06
Falls efficacy	11 (10–14)	13 (10–24)	0.53
PASE	54 (31–79)	43 (31–77)	−0.05
Paffenberger	625 (168–1008)	406 (168–672)	0.02
ADLs and IADLs			
Feeding	2 (6%)	2 (6%)	0.00
Bathing	3 (9%)	5 (15%)	0.18
Dressing	3 (9%)	2 (6%)	−0.11
Toileting	2 (6%)	1 (3%)	−0.14
Any ADL	4 (12%)	6 (18%)	0.17
Cooking	4 (12%)	5 (15%)	0.09
Cleaning	8 (24%)	14 (41%)	0.35
Shopping	5 (15%)	7 (21%)	0.09
Medications	1 (3%)	3 (9%)	0.25
Driving	4 (12%)	11 (32%)	0.42
Banking	3 (9%)	3 (9%)	0.00
Any IADL	11 (32%)	18 (53%)	0.43
Rating of own health	3 (2–3)	3 (2–4)	0.10
Rating of own mobility	2 (2–2)	2 (2–2)	−0.11

(*continued*)

Table 3. (*Continued*)

Variable	Non-PrICULOS Patients (*N* = 34)	PrICULOS Patients (*N* = 34)	SMD†
EQ-VAS	70 (50−80)	70 (50−80)	−0.13
EQ-VAS ≤ 60	12 (35%)	14 (41%)	0.12
EQ-5D-3 L - Mobility (any issue)	7 (21%)	13 (38%)	0.40
EQ-5D-3 L - Self care (any issue)	3 (9%)	6 (18%)	0.26
EQ-5D-3 L - Usual activities (any issue)	15 (44%)	21 (62%)	0.36
EQ-5D-3 L - Pain or discomfort (Any Issue)	22 (65%)	24 (71%)	0.13
EQ-5D-3 L - Anxiety or depression (any issue)	10 (29%)	11 (32%)	0.06
PTSD severity score (/85)	21 (17−24)	20 (18−24)	0.00
DRS score total (non-emergent procedures) (/25)	5 (5−7)	8 (5−9)	0.38

SMD, standardized mean difference.
*Data are presented as median (quartile 1−quartile 3) or *N* (%).
†Standardized mean difference = difference in means or proportions divided by standard error.

Table 4. One Year Follow-Up of Non-PrICULOS and PrICULOS Patients (Clinic and Phone Call Parameters)

Variable	Non-PrICULOS Patients (*N* = 27)	PrICULOS Patients (*N* = 29)	SMD†
Activities (reported deficit − 2 or 3)			
Can you eat?	0 (0%)	0 (0%)	0.00
Can you dress and undress yourself?	0 (0%)	3 (10%)	0.48
Can you take care of your own appearance?	0 (0%)	2 (7%)	0.39
Can you walk (includes cane, does not walker)?	1 (4%)	4 (14%)	0.36
Can you get in and out of bed?	0 (0%)	4 (14%)	0.57
Can you take a bath or shower?	3 (11%)	6 (21%)	0.26
Do you ever have trouble getting to the bathroom on time?	3 (11%)	4 (14%)	0.08
Can you use the telephone?	0 (0%)	0 (0%)	0.00
Can you get to place out of walking distance?	1 (4%)	6 (21%)	0.54
Can you go shopping for groceries or clothes?	1 (4%)	9 (31%)	0.77
Can you prepare your own meals?	1 (4%)	7 (24%)	0.62
Can you do housework?	3 (11%)	8 (28%)	0.43
Can you handle your own medicine?	1 (4%)	4 (14%)	0.36
Can you handle your own money?	1 (4%)	3 (10%)	0.26
Can you pull or push a large object like a living room chair?	7 (26%)	9 (31%)	0.17
Can you bend over, crouch, or kneel?	8 (30%)	8 (28%)	−0.05
Can you raise your arms over your head?	1 (4%)	2 (7%)	0.14
Can you pick up or handle small objects with your fingers?	1 (4%)	1 (3%)	−0.01
Can you lift something that weighs over 10 pounds?	1 (4%)	5 (17%)	0.46
Can you walk up or down a flight of stairs?	2 (7%)	4 (14%)	0.21
Can you walk 1.5 km?	4 (15%)	12 (41%)	0.65
Any Deficit Reported Above?	15 (56%)	17 (59%)	0.06
Number of Deficits	1 (0−3)	1 (0−6)	0.58
Hospital anxiety and depression score			
Depression score			
Borderline or depressed	6 (22%)	5 (17%)	−0.13
Anxiety score			
Borderline or Anxious	6 (22%)	7 (24%)	0.05
Modified fried characteristics			
GDS depression	10 (37%)	9 (31%)	−0.13
Weight loss	5 (19%)	10 (34%)	0.37
Exhaustion	11 (41%)	8 (28%)	−0.28
Low physical activity	9 (33%)	11 (38%)	0.10

(*continued*)

Table 4. (*Continued*)

Variable	Non-PrICULOS Patients (*N* = 27)	PrICULOS Patients (*N* = 29)	SMD[†]
Falls efficacy	10 (10−20)	10 (10−20)	−0.12
PASE	63 (45−116)	61 (45−92)	−0.19
Paffenberger	504 (224−931)	476 (196−850)	0.22
ADLs and IADLs			
Feeding	0 (0%)	0 (0%)	0.00
Bathing	1 (4%)	6 (21%)	0.54
Dressing	0 (0%)	3 (10%)	0.48
Toileting	0 (0%)	1 (3%)	0.27
Any ADL	1 (4%)	7 (24%)	0.62
Cooking	1 (4%)	7 (24%)	0.62
Cleaning	1 (4%)	8 (28%)	0.70
Shopping	1 (4%)	8 (28%)	0.70
Medications	0 (0%)	3 (10%)	0.48
Driving	2 (7%)	10 (34%)	0.71
Banking	1 (4%)	3 (10%)	0.26
Any IADL	5 (19%)	13 (45%)	0.59
Rating of own health	3 (2−3)	3 (2−3)	−0.05
Rating of own mobility	2 (2−2)	2 (2−2)	−0.44
EQ-VAS	70 (50−80)	60 (50−70)	−0.36
EQ-VAS ≤ 60	10 (37%)	15 (52%)	0.30
EQ-5D-3 L - Mobility (any issue)	8 (30%)	14 (48%)	0.39
EQ-5D-3 L - Self care (any issue)	2 (7%)	8 (28%)	0.55
EQ-5D-3 L - Usual activities (any issue)	9 (33%)	15 (52%)	0.38
EQ-5D-3 L - Pain or discomfort (any Issue)	13 (48%)	18 (62%)	0.28
EQ-5D-3 L - Anxiety or depression (any issue)	7 (26%)	6 (21%)	−0.12
PTSD severity score (/85)	20 (17−23)	19 (18−24)	0.24
DRS score total (non-emergent procedures) (/25)	5 (5−7)	8 (6−10)	0.27
NYHA classification			
I	20 (74%)	20 (71%)	0.06
II	3 (11%)	6 (21%)	0.28
III	3 (11%)	1 (4%)	−0.29
IV	1 (4%)	1 (4%)	−0.01
Living situation			
At home, independent	25 (92%)	18 (65%)	−0.73
At home, assistance from family	0 (0%)	7 (25%)	0.82
At home, hired help	2 (7%)	3 (11%)	0.12
Complications post-discharge			
Stroke	1 (4%)	2 (7%)	0.15
Other heart surgery	2 (7%)	2 (7%)	0.00
Stent	0 (0%)	0 (0%)	0.00
Dialysis	0 (0%)	0 (0%)	0.00
Hospital admission	10 (37%)	12 (43%)	0.12
Has surgery improved your health?	6 (22%)	11 (41%)	0.41

SMD, standardized mean difference.

*Data are presented as median (quartile 1−quartile 3) or *N* (%).

[†]Standardized mean difference = difference in means or proportions divided by standard error.

long-term deficits than non-prICULOS patients. Future studies should engage patients, their caregivers and community-based practitioners in a process to develop a larger study to examine methodologies to improve transition of care following hospital discharge.

Acknowledgments

The authors would like to acknowledge: This study has received funding for the Department of Surgery Research Grant Award. In addition, we would like to thank Alison E. Turnbull,

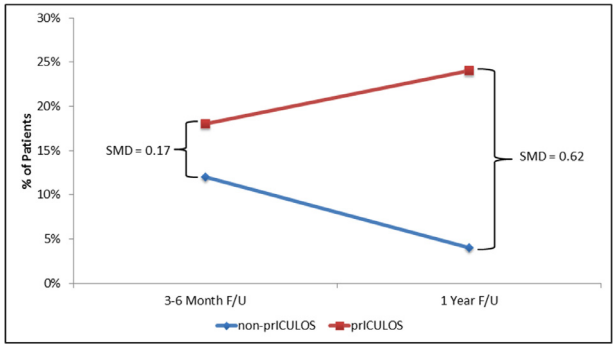


Figure 2. Percentage of patients with any ADL deficit.

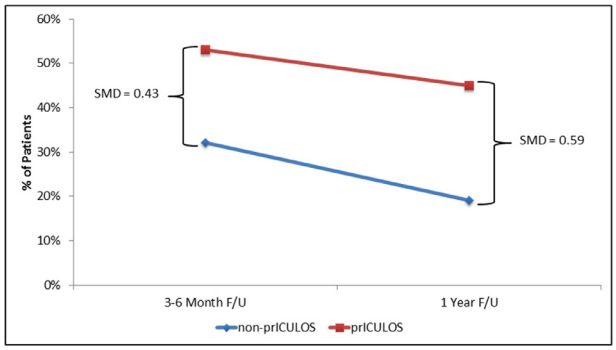


Figure 3. Percentage of patients with any IADL deficit.

DVM, MPH, PhD, Division of Pulmonary and Critical Care, Department of Medicine, Department of Epidemiology, Outcomes After Critical Illness & Surgery (OACIS) Group, Johns Hopkins University for providing and recommending the use of the Decision Regret Scale.

For further detailed information in regards to the assessments used and results, as well as population characteristics please see the supplementary file online.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.semtcvs.2018.07.005.

REFERENCES

1. Ferguson TB, Hammill BG, Peterson ED, et al: A decade of change—Risk profiles and outcomes for isolated coronary artery bypass grafting procedures, 1990-1999: A report from the STS National Database Committee and the Duke Clinical Research Institute. Ann Thorac Surg 73(2):480–489, 2002. https://doi.org/10.1016/S0003-4975(01)03339-2
2. Herridge MS, Cheung AM, Tansey CM, et al: One-year outcomes in survivors of the acute respiratory distress syndrome. N Engl J Med 348(8):683–693, 2003. https://doi.org/10.1056/NEJMoa1404304
3. Herridge MS, Tansey C, Matte A, et al: Functional disability 5 years after acute respiratory distress syndrome. N Engl J Med 364(14):1293–1304, 2011
4. Kowalczyk M, Nestorowicz A, Fijałkowska A, et al: Emotional sequelae among survivors of critical illness: a long-term retrospective study. Eur J Anaesthesiol 30(3):111–118, 2013. https://doi.org/10.1097/EJA.0b013e32835dcc45
5. Paparrigopoulos T, Melissaki A, Tzavellas E, et al: Increased co-morbidity of depression and post-traumatic stress disorder symptoms and common risk factors in intensive care unit survivors: A two-year follow-up study. Int J Psychiatry Clin Pract 18(1):25–31, 2014. https://doi.org/10.3109/13651501.2013.855793
6. Elliott D, Davidson JE, Harvey MA, et al: Exploring the scope of post-−intensive care syndrome therapy and care. Crit Care Med 42(12):2518–2526, 2014. https://doi.org/10.1097/CCM.0000000000000525
7. Manji RA, Arora RC, Singal RK, et al: Long-term outcome and predictors of noninstitutionalized survival subsequent to prolonged intensive care unit stay after cardiac surgical procedures. Ann Thorac Surg 101(1):56–63, 2016. https://doi.org/10.1016/j.athoracsur.2015.07.004
8. Williams BA, Mandrekar JN, et al: Finding optimal cutpoints for continuous covariates with binary and time-to-event outcomes. Tech Rep Ser (79):1–26, 2006. http://www.mayo.edu/research/documents/biostat-79pdf/doc-10027230
9. Healthy People 2020. Health-related quality of life and well-being. Off Dis Prev Heal Promot 2016 https://www.healthypeople.gov/2020/about/foundation-health-measures/Health-Related-Quality-of-Life-and-Well-Being
10. Becerra Pérez MM, Menear M, Brehaut JC, et al: Extent and Predictors of Decision Regret about Health Care Decisions: A Systematic Review. Med Decis Making 2016. https://doi.org/10.1177/0272989X16636113
11. Haas B, Wunsch H: How does prior health status (age, comorbidities and frailty) determine critical illness and outcome? Curr Opin Crit Care 22 (5):500–505, 2016. https://doi.org/10.1097/MCC.0000000000000342
12. Tinetti ME, Richman D, Powell L: Falls efficacy as a measure of fear of falling. J Gerontol 45(6):P239–P243, 1990
13. Bosscher RJ, Raymakers ERPM, Trompe EAM, et al: [Fear of falling: psychometric aspects of Tinetti's Falls Efficacy Scale]. Tijdschr Gerontol Geriatr 36(1):5–10, 2005. http://www.ncbi.nlm.nih.gov/pubmed/15903091
14. Bennett JA, Riegel B, Bittner V, et al: Validity and reliability of the NYHA classes for measuring research outcomes in patients with cardiac disease. Hear Lung J Acute Crit Care 31(4):262–270, 2002. https://doi.org/10.1067/mhl.2002.124554
15. Miller-Davis C, Marden S, Leidy NK: The New York Heart Association Classes and functional status: What are we really measuring? Hear Lung J Acute Crit Care 35(4):217–224, 2006. https://doi.org/10.1016/j.hrtlng.2006.01.003
16. Washburn RA, McAuley E, Katula J, et al: The Physical Activity Scale for the Elderly (PASE): Evidence for validity. J Clin Epidemiol 52(7):643–651, 1999. https://doi.org/10.1016/S0895-4356(99)00049-9
17. Washburn R, Smith K: The physical activity scale for the elderly (PASE): development and evaluation. J Clin Epidemiol 46(2):153–162, 1993. https://doi.org/10.1016/0895-4356(93)90053-4
18. Shumway-Cook A, Brauer S, Woollacott M: Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. Phys Ther 80(9):896–903, 2000
19. Shumway-Cook A, Brauer S, Woollacott M: Timed Up & Go Test (TUG). Missouri Edu 80:9–10, 2000. http://web.missouri.edu/~proste/tool/Timed-Up-and-Go.doc
20. Zigmond AS, Snaith RP: The hospital anxiety and depression scale. Acta Psychiatr Scand 67(6):361–370, 1983. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x
21. Veterans Affairs UD. PTSD Checklist — Civilian Version (PCL-C). 1994:16-17.
22. O'Connor A: User Manual - Decision Regret Scale. Ohri 1:1–3, 2003
23. Fried LP, Tangen CM, Walston J, et al: Frailty in Older Adults: Evidence for a Phenotype. J Gerontol Ser A Biol Sci Med Sci 56(3):M146–M157, 2001. https://doi.org/10.1093/gerona/56.3.M146
24. Aires da Camara SM, Alvarado BE, Guralnik JM, et al: Using the Short Physical Performance Battery to screen for frailty in young-old adults with distinct socioeconomic conditions. Geriatr Gerontol Int 13(2):421–428, 2013. https://doi.org/10.1111/j.1447-0594.2012.00920.x

25. Rockwood K, Song X, MacKnight C, et al: A global clinical measure of fitness and frailty in elderly people. CMAJ 173(5):489–495, 2005. https://doi.org/10.1503/cmaj.050051
26. P K: The EuroQoL Instrument: An Index of Health Related Quality of Life. Philadelphia:Lippincott-Raven Publishers; 1996
27. Brooks R: EuroQol: the current state of play. Health Policy 37(1):53–72, 1996. https://doi.org/10.1016/0168-8510(96)00822-6
28. Hassan A, Anderson C, Kypson A, et al: Clinical outcomes in patients with prolonged intensive care unit length of stay after cardiac surgical procedures. Ann Thorac Surg 93(2):565–569, 2012. https://doi.org/10.1016/j.athoracsur.2011.10.024
29. Heimrath OP, Buth KJ, Légaré J-F: Long-term outcomes in patients requiring stay of more than 48 hours in the intensive care unit following coronary bypass surgery. J Crit Care 22(2):153–158, 2007. https://doi.org/10.1016/j.jcrc.2006.09.009
30. Mazzoni M, De Maria R, Bortone F, et al: Long-term outcome of survivors of prolonged intensive care treatment after cardiac surgery. Ann Thorac Surg 82(6):2080–2087, 2006. https://doi.org/10.1016/j.athoracsur.2006.07.028
31. Deschka H, Schreier R, El-Ayoubi L, et al: Survival, functional capacity, and quality of life after cardiac surgery followed by long-term intensive care stay. Thorac Cardiovasc Surg 61(8):696–700, 2013. https://doi.org/10.1055/s-0033-1342942
32. Lagercrantz E, Lindblom D, et al: Survival and Quality of Life in Cardiac Surgery Patients With Prolonged Intensive Care. Ann Thorac Surg 89(2):490–495, 2010. https://doi.org/10.1016/j.athoracsur.2009.09.073
33. Gaudino M, Girola F, Piscitelli M, et al: Long-term survival and quality of life of patients with prolonged postoperative intensive care unit stay: Unmasking an apparent success. J Thorac Cardiovasc Surg 134(2):465–469, 2007. https://doi.org/10.1016/j.jtcvs.2007.04.028