Does Obesity Influence the Outcome of the Patients Following a Cardiac Arrest?

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ABSTRACT

Background: Obesity is one of the major risk factors for cardiovascular and peripheral vascular diseases. However, the obesity paradox confers survival benefits in heart failure and cardiac surgery patients. Studies examining the outcomes of obese patients following cardiac arrest provided conflicting results.

Objective: To study the association between obesity and outcome in patients following cardiac arrest.

Materials and methods: We conducted a retrospective cohort study at a tertiary intensive care unit (ICU). Data were collected from medical records between January 1, 2018 and December 31, 2018, for all adult ICU patients who were admitted to our ICU following a cardiac arrest. Data collected included demographics, anthropometrics, and details of the cardiac arrest. The primary outcome was survival to hospital discharge. Secondary outcomes were duration of mechanical ventilation, ICU, and hospital length of stay.

Results: A total of 126 patients were admitted to the ICU following a cardiac arrest during the study period, of whom 14 patients were excluded due to missing body mass index (BMI) data. Seventy-six patients were non-obese (BMI < 30) and 36 patients were obese (BMI ≥ 30). There was no difference in survival to hospital discharge between obese and non-obese patients (52.8% vs 59.2%, p = 0.52, OR = 0.77, 95% CI 0.35–1.71). Moreover, there was no difference between obese and non-obese patients in ICU length of stay (81.50 vs 76.0 hours, p = 0.42), hospital length of stay (9 vs 10 days, p = 0.63), and duration of mechanical ventilation (55 vs 43 hours, p = 0.30). In the logistical regression analysis, BMI was not associated with improved survival (OR = 0.97, 95% CI 0.92–1.03, p = 0.23).

Conclusion: For patients admitted to ICU following cardiac arrest, we could not show that obesity improves survival, length of stay, or duration of mechanical ventilation.

Keywords: Body mass index, Cardiac arrest, Intensive care, Obesity.

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INTRODUCTION

Out-of-hospital cardiac arrest is a leading cause of death, with an estimated 15,000 people suffering a cardiac arrest in Australia every year.¹ Between 12% and 25% of out-of-hospital cardiac arrest, victims in Australia survive to hospital discharge.² Recent Australian observational study by ANZ-CODE investigators showed that 26.3% of in-hospital cardiac arrest patients survive hospital discharge.² Older age, cardiac arrest occurring at home, initial rhythm other than ventricular fibrillation and ventricular tachycardia, longer duration of no flow, longer duration of low flow, and treatment with adrenaline are known independent predictors of poor outcome after cardiac arrest.³

In recent times, obesity has emerged as one of the biggest health issues involving all age groups worldwide. It is one of the major risk factors for cardiovascular and peripheral vascular disease. However, obesity is associated with a lower mortality risk after cardiac surgery⁴ and with heart failure patients.⁵

Studies examining obese patients who suffered cardiac arrest provided conflicting results.⁶⁻¹⁰ The American Heart Association National Registry of Cardiopulmonary Resuscitation (NRCPR) demonstrated a higher rate of survival to discharge for overweight and obese patients compared with underweight and normal-weight patients with cardiac arrest caused by shockable rhythms.⁸ In contrast, body mass index (BMI) was not associated with in-hospital mortality in those who underwent extracorporeal cardiopulmonary resuscitation (ECPR).⁶ Body mass index ≥ 30 kg/m² was shown to be a significant risk factor for mortality post-therapeutic hypothermia following cardiac arrest.¹⁰ Moreover, there is a lack of research on this topic from Australia. Therefore, we conducted this study to understand the association between obesity and mortality in patients following cardiac arrest.

MATERIALS AND METHODS

Study Design and Populations

We performed a retrospective cohort study at a tertiary metropolitan intensive care unit (ICU) in Melbourne. Data were collected from medical records for all adults who were admitted to our ICU following in-hospital or out-of-hospital cardiac arrest between January 1, 2018 and December 31, 2018. We identified potential cases from our ICU’s software program iCURE (Intensive Care Unit Reporting Excellence) and cross-checked with our clinical
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We collected patients’ data on demographics and anthropometrics, comorbidities, location of cardiac arrest, initial rhythm, the highest and lowest temperature in the first 24 hours of ICU admission, interventions (including a coronary angiogram, intra-aortic balloon pump, extracorporeal membrane oxygenation), duration of mechanical ventilation, ICU, and hospital length of stay. The primary outcome was survival to hospital discharge and the secondary outcomes were duration of mechanical ventilation, ICU, and hospital length of stay.

We conducted this observational study as a part of a quality assurance project and approval from our institutional Human Research and Ethics Committee was therefore not required.

Statistical Analysis
A comparison between groups was performed using complete-case analysis. We used chi-square tests for categorical variables and Student’s t-test or Mann–Whitney U test for parametric and non-parametric variables. The relationship between BMI and survival was assessed using logistic regression. Continuous data are presented as means with standard deviations or medians with interquartile ranges as appropriate. Binary data are presented as proportions and comparisons presented as odds ratio (OR) with a 95% confidence interval (CI). Statistical analysis was performed using SPSS (Version 25, IBM Corporation). A two-tailed p value <0.05 was considered statistically significant for all tests.

RESULTS
A total of 126 patients were admitted to the ICU following in-hospital (38) or out-of-hospital (74) cardiac arrest, from which 14 patients were excluded because of missing BMI data. Out of 112 patients, 76 patients had calculated BMI <30 and 36 patients had BMI ≥30.

The demographic characteristics of patients are summarized in Table 1. The mean age was similar between the two groups (61.7 vs 61.1 years). Both groups had more males than females. The obese (BMI ≥30) group more commonly had diabetes (47 vs 32%) and hypertension (61 vs 36%).

There was no difference in the primary outcome of survival to hospital discharge between obese (BMI ≥30) and non-obese (BMI <30) groups (52.8 vs 59.2%, p = 0.52, OR = 0.77, 95% CI 0.35–1.71; Table 2 and Fig. 1). There was no difference between non-obese and obese patients in ICU length of stay (76.0 vs 81.5 hours, p = 0.42; Table 3), hospital length of stay (10 vs 9 days, p = 0.63; Table 3), and duration of mechanical ventilation (43 vs 55 hours, p = 0.30; Table 3).

On subgroup analysis, there was a trend toward better survival in non-obese patients who had initial shockable rhythm (OR = 0.39, 95% CI 0.11–1.38, p = 0.15; Table 4).

In the logistical regression analysis, BMI was not associated with improved survival (OR = 0.97, 95% CI 0.92–1.03, p = 0.23, Table 5). There was a better survival with in-hospital cardiac arrest (OR = 2.94,
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95% CI 1.02–8.49, p = 0.05) and initial shockable rhythm (OR = 3.74, 95% CI 0.94–14.82, p = 0.06) independent of BMI.

**DISCUSSION**

We could not show that obesity improves survival to hospital discharge among the patients admitted to the ICU following a cardiac arrest. Moreover, we found that obesity does not affect hospital or ICU length of stay or duration of mechanical ventilation.

There is an impression that obesity confers some survival advantages in heart failure and cardiac surgery. This inverse correlation between BMI and mortality is known as the obesity paradox. Greater metabolic reserve, younger age, and better cardioprotective medical therapy to obese patients are some hypotheses postulated for this phenomenon. Saba et al. showed that higher BMI is associated with lower all-cause mortality in the survivor of sudden cardiac arrest, suggesting the obesity paradox also applies to the post-cardiac arrest population. In contrast, a single-center trial by Breathett et al. demonstrated BMI <30 compared with BMI ≥30 was associated with better survival post-hypothermia for cardiac arrest.

In our study, we could not demonstrate that obesity confers survival benefit to patients who suffer cardiac arrest. We noted better survival to hospital discharge for the non-obese group. Although this difference was statistically non-significant, a 6.4% absolute difference in mortality in favor of non-obese can be clinically important. Possible explanations behind this observation

### Table 3: Length of stay and duration of mechanical ventilation

|                        | BMI <30 | BMI ≥30 | p value |
|------------------------|---------|---------|---------|
| ICU length of stay (in hours) |         |         |         |
| Median                 | 76      | 81.5    | 0.42    |
| IQR                    | 99      | 165     |         |
| Hospital length of stay (in days) |         |         |         |
| Median                 | 10      | 9       | 0.64    |
| IQR                    | 13      | 10.8    |         |
| Duration of mechanical ventilation (in hours) |         |         |         |
| Median                 | 43      | 55      | 0.30    |
| IQR                    | 100     | 142     |         |

BMI, body mass index; IQR, interquartile range
Mann–Whitney U test

### Table 4: Outcome by initial rhythm and location of cardiac arrest

|                     | BMI <30 | BMI ≥30 | OR   | 95% CI | p value |
|---------------------|---------|---------|------|--------|---------|
| **Shockable rhythm** |         |         |      |        |         |
| Dead                | 7 (20%) | 7 (38.9%) | 0.39 | 0.11–1.38 | 0.15   |
| Alive               | 28 (80%)| 11 (61.1%)|     |        |         |
| **Non-shockable rhythm** |         |         |      |        |         |
| Dead                | 24 (58.5%) | 10 (55.6%) | 1.13 | 0.37–3.46 | 0.83   |
| Alive               | 17 (41.5%)| 8 (44.4%)  |     |        |         |
| **Out-of-hospital cardiac arrest** |         |         |      |        |         |
| Dead                | 21 (40.1%)| 11 (50%)  | 0.68 | 0.25–1.84 | 0.44   |
| Alive               | 31 (59.6%)| 11 (50%)  |     |        |         |
| **In-hospital cardiac arrest** |         |         |      |        |         |
| Dead                | 10 (41.7%)| 6 (42.9%)  | 0.95 | 0.37–3.46 | 0.94   |
| Alive               | 14 (58.3%)| 8 (57.1%)  |     |        |         |

CI, confidence interval; BMI, body mass index; OR, odds ratio

Our study provides baseline data from an Australian center regarding outcomes following cardiac arrest in obese patients. Although our sample size was small and the difference between the two groups for the primary outcome was statistically non-significant, a 6.4% absolute difference in primary outcome in favor of non-obese can be important. If this difference is present, any future study would need approximately 1,880 patients (considering 80% study power and α = 0.05) and multicenter participation. Our study may inform future investigators who seek to undertake prospective studies in this area regarding the effects of obesity on hospital outcomes.
survival, length of stay, or duration of mechanical ventilation with regards to sample size determinations.

**Conclusion**

We could not show that obesity (BMI ≥ 30) contributes to either a protective or harmful effect among the patients following either an in-hospital or out-of-hospital cardiac arrest. Further larger studies would be required to determine the impact of obesity on the outcome of patients following cardiac arrest.

**References**

1. Beck B, Bray J, Cameron P, Smith K, Walker T, Grantham H, et al. Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the aus-ROC Epistry. Resuscitation 2018;126:49–57. DOI: 10.1016/j.resuscitation.2018.02.029.

2. The Australia and New Zealand Cardiac Arrest Outcome and Determinants of ECMO (ANZ-CODE) Investigators. The epidemiology of in-hospital cardiac arrests in Australia: a prospective multicentre observational study. Crit Care Resusc 2019;21(3):180–187.

3. Martinell L, Nielsen N, Herlitz J, Karlsson T, Horn J, Wise MP, et al. Early predictors of poor outcome after out-of-hospital cardiac arrest. Crit Care 2017;21(1):96. DOI: 10.1186/s13054-017-1677-2.

4. Mariscalco G, Wozniak MJ, Dawson AG, Serraino GF, Porter R, Nath M, et al. Body mass index and mortality among adults undergoing cardiac surgery. Circulation 2017;135(9):850–863. DOI: 10.1161/CIRCULATIONAHA.116.022840.

5. Oreopoulos A, Padwal R, Kalantar-Zadeh K, Fonarow GC, Norris CM, McAlister FA, Body mass index and mortality in heart failure: a meta-analysis. Am Heart J 2008;156(1):13–22. DOI: 10.1016/j.ahj.2008.02.014.

6. Matinrazm S, Ladejobi A, Pasupula DK, et al. Effect of body mass index on survival after sudden cardiac arrest. Clin Cardiol 2018;41(1):46–50. DOI: 10.1002/clc.22847.

7. Stone P, Rizzolo K, Craig W, Pinz I, McCrum B, Qazi M, et al. Postresuscitation experience of obese and underweight patients after cardiac arrest. Chest 2017;152(4):A373.

8. Jain R, Nallamothu B, Chan P, American Heart Association National Registry of Cardiopulmonary Resuscitation (NRCPR) investigators. Body mass index and survival after in-hospital cardiac arrest. Circ Cardiovasc Qual Outcomes 2010;3:490–497.

9. Breathett K, Mehta N, Yildiz V, Abel E, Husa R. The impact of body mass index on patient survival after therapeutic hypothermia after resuscitation. Am J Emerg Med 2016;34(4):722–725. DOI: 10.1016/j.ajem.2015.12.077.

10. Adabag S, Huxley RR, Lopez FL, Chen LY, Siscovick D, et al. Obesity related risk of sudden cardiac death in the atherosclerosis risk in communities study. Heart 2014;101(3):215–221. DOI: 10.1136/heartjnl-2014-306238.

11. International Obesity Task Force. Managing the Global Epidemic of Obesity. Report of the World Health Organization (WHO) Consultation on Obesity: June 5-7, 1997; Geneva, Switzerland.

12. Amandson D, Djurkovic S, Matyiwoff G. The obesity paradox. Crit Care Clin 2010;26(4):583–596. DOI: 10.1016/j.ccr.2010.06.004.

13. Alexopoulos N, Katritsis D, Raggi P. Visceral adipose tissue as a source of inflammation and promoter of atherosclerosis. Atherosclerosis 2014;233(1):104–112. DOI: 10.1016/j.atherosclerosis.2013.12.023.

14. Empna JP, Ducimetiere P, Charles MA, Jouven X. Sagittal abdominal diameter and risk of sudden death in asymptomatic middle-aged men. The Paris prospective study I. ACC Curr J Rev 2005;14(3):46. DOI: 10.1016/j.accreview.2005.02.020.