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ORIGINAL ARTICLE

Cardiogenic Shock Challenges and Priorities: A Clinician Survey

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Background Cardiogenic shock (CS) is common and survival outcomes have not substantially improved. Australia's geography presents unique challenges in the management of CS. The challenges and research priorities for clinicians pertaining to CS identification and management have yet to be described.

Method We used an exploratory sequential mixed methods design. Semi-structured interviews were conducted with 10 clinicians (medical and nursing) to identify themes for quantitative evaluation. A total of 143 clinicians undertook quantitative evaluation through online survey. The interviews and surveys addressed current understanding of CS, status of cardiogenic systems and future research priorities.

Results There were 143 respondents: 16 (11%) emergency, cardiology 22 (16%), 37 (26%) intensive care, 54 (38%) nursing. In total, 107 (75%) believe CS is under-recognised. Thirteen (13; 9%) of respondents indicated their hospital had existing CS teams, all from metropolitan hospitals, and 40% thought additional access to mechanical circulatory support devices was required. Five (5; 11%) non-tertiary hospital respondents had not experienced a delay in transfer of a patient in CS. All respondents felt additional research, particularly into the management of CS, was required.

Conclusions Clinicians report that CS is under-recognised and further research into CS management is required. Access to specialised CS services is still an issue and CS protocolised pathways may be of value.

Keywords Cardiogenic shock • Protocolised management

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Introduction

Cardiogenic shock (CS) is common, with an incidence between 3% and 13% following acute myocardial infarction (AMI) [1,2], and AMI CS constitutes only 30% of all CS cases. Despite advances in medical therapy, revascularisation, and mechanical circulatory support (MCS), survival outcomes have not substantially improved in the past two decades and in-hospital mortality rates still exceed 40% [3]. Delayed recognition, transfer and treatment, and variability in that treatment may, in part, account for poor outcomes [4]. New South Wales (NSW) and Australia's geography and demographic spread represent unique challenges for the timely management of CS. The CS teams and protocolised management of CS have been proposed to improve access to advanced therapies and skillsets [5]. Therefore, the aim of our study was to describe clinician knowledge, experience and research priorities pertaining to CS to inform system planning and future research priorities.

Methods

Study Design

In the qualitative phase, the principal investigator completed a literature review of CS review articles and end-user point testing of 10 clinicians (four cardiology, two intensive care unit, one nursing, two anaesthesia, and one emergency) in person to inform survey design. The interviews lasted approximately 20 minutes and were conducted between January and May 2023. A prospective electronic survey was developed in November 2022 (Online Appendix). Two (2) clinicians piloted the survey, and the survey was refined based on feedback. The final online survey was administered to clinicians between September and November 2023. Respondents did not receive any honorarium.

Participant Population

Respondents were identified through the NSW Agency for Clinical Innovation (ACI), Intensive Care and Emergency Medicine Networks and the Cardiology Society for Australia and New Zealand (CSANZ) Heart Failure Council email distribution lists. Subsequent snow-balling sampling allowed for clinician involvement from other states and territories and New Zealand. Medical and nursing clinicians were included.

Statistical Analysis

Data collected were analysed using SPSS, version 25 (IBM Corp. Armonk, NY, USA). Statistics, version 25 (IBM Corp). Categorical data were reported as the number and percentage of responses. Likert-scale responses of importance ranked from 1 to 5 were summarised using a weighted average.

Ethical Approval

This study was completed in accordance with Royal Prince Alfred Human Research and Ethics 2023/ETH01881.

Results

There were 143 respondents; the specialty breakdown of respondents is reported in Table 1. A total of 108 (76%) respondents were from NSW; 102 (71%) worked at city or metropolitan hospitals, 44 (31%) were from regional or rural locations; all had access to a cardiac catheterisation laboratory. In total, 107 (75%) respondents believed CS was underrecognised, and nine (6%) did not believe it was underrecognised. A total of 67% thought CS was undertreated, 8% did not.

CS Teams and Pathways

Thirteen (13; 9%) of respondents indicated their hospital had existing CS teams and 15 (11%) of respondents' hospitals were considering implementing such teams. Only five (11%) regional/rural respondents indicated that they had not experienced a delay in transfer of a patient in CS and 83% of regional and rural respondents experienced delays that they perceived may have impacted patient care. Seven (7; 5%) of respondents did not feel structured CS referral pathways had value. Forty-five (45) of 76 (59%) applicable respondents had experienced resistance to transfer of patients. Only 15% (11) of respondents were aware of existing CS pathways in their hospital network, all of whom were from metropolitan/city hospitals. In total, 128 (90%) of respondents thought additional research is required into CS pathways.

Mechanical Circulatory Support

A total of 93 (65%) felt MCS can improve outcomes, 22% (34) felt there was insufficient evidence. In total, 132 respondents (92%) had access to MCS at their hospital, with wide

Table 1 Breakdown of respondents by specialty.

Specialty	n	%
Anaesthetist	12	8.40
Cardiothoracic surgeon	1	0.70
Emergency physician	16	11.20
General cardiologist	9	6.30
Heart failure specialist	2	1.40
Imaging specialist	3	2.10
Intensive care specialist	37	25.90
Interventional cardiologist	7	4.90
Nursing	54	37.80
Retrieval physician	1	0.70
Transplant specialist	1	0.70

variation in the modality of MCS accessible (Supplementary Material Question 19). A total of 40% thought additional access to MCS is required. The preferred devices for additional access are provided in Supplementary Material Question 22.

Myocardial Biopsy and Right Heart Catheterisation in Management

A total of 41% of respondents (n=59) indicated that the institution had performed myocardial biopsy in acute/fulminant CS, and 46 (32%) felt that a biopsy does change management. Fifty (50) respondents (56%), never or almost never use Right Heart Catheterisation (RHC) in CS, and only 10% utilise it most of the time or all the time. A total of 6% of respondents felt RHC was never useful in CS, 17% of respondents felt it was useful in all CS patients, 17% in very few CS patients, and 78 (59%) in selected CS patients; 36% felt RHC should be used more to guide CS treatment.

Future Research Priorities

A total of 132 (92%) of respondents felt CS outcomes could be improved. All respondents felt additional research into proposed research areas was of value. Early recognition of CS and research into various interventions in the management of CS were identified as the most important areas of future research though all areas were deemed important (Table 2).

Discussion

This survey of clinicians provides a snapshot of CS challenges and priorities within NSW and Australia, and to our knowledge is the first of such completed. It identified important clinical and research priorities to guide future service development and research, and highlighted significant management concerns with most respondents experiencing resistance and delays to transfer, which a number of these clinicians felt had affected patient care.

For peripherally located clinicians, it is evident that significant referral and transfer challenges still exist. Almost all had experienced delays in transfers and a significant proportion experienced resistance to transfer CS patients. While the reasons for the transfer delays and whether the delays resulted in poorer outcomes were beyond the scope of this survey, and do need to be investigated, delays in transfer of care are documented to affect outcomes in a number of medical conditions [6]. Of note, only a minority of respondents were aware of any CS pathways—all were from large metropolitan hospitals. The CS pathways that include predefined calling and transfer criteria, access to CS teams, and rapid protocolised assessment for and implementation of advanced therapies (including MCS) are increasingly being utilised, may improve outcomes [5,7] and have the potential to improve timely access to higher level services [8]. However, as yet, such protocols lack high-quality trial evidence, and the resource implications of such pathways, including patient transfers, bed stays, and the additional use of MCS devices, are yet to be elucidated.

A vast majority of respondents indicated that some mechanical support technology was available (with intra-aortic balloon pump being the most common), with a significant proportion feeling additional MCS device access was required. Despite no randomised evidence of survival benefit with any MCS device [9], the use of MCS in CS is increasing substantially [10,11] with significant cost to health care systems [12]. The discrepancy between desire for additional MCS devices, and the lack of randomised evidence for their benefit, needs to be reconciled through increased education of clinicians as well as ongoing efforts to produce high-quality evidence through randomised trials, a number of which are ongoing. The use of RHC in CS was variable. Like MCS there exists no randomised control data that RHC improves outcome in CS [2,13]. However, there is renewed interest in RHC utilisation in CS to protocolise CS management and to enable the rational selection of the most appropriate MCS type to match the patient's shock [14].

Table 2 Research priority areas.

Research area	Very unimportant		Un important		Neutral		Important		Very important		Weighted average
	n	%	n	%	n	%	n	%	n	%	
Translational CS	6	4.20	3	2.10%	27	18.90	71	49.70	34	23.80	3.88
Early recognition of CS	5	3.50	2	1.40%	5	3.50	43	30.10	87	60.80	4.44
Biomarkers in CS	5	3.50	4	2.80%	25	17.50	62	43.40	46	32.20	3.99
Pharmacological management of CS	5	3.50	1	0.70%	6	4.20	59	41.30	70	49.00	4.33
Interventional treatment of CS	5	3.50	1	0.70%	7	4.90	59	41.30	70	49.00	4.32
Mechanical circulatory support of CS	5	3.50	-	NA	13	9.10	63	44.10	60	42.00	4.23
Heart teams in CS	4	2.80	2	1.40%	17	11.90	70	49.00	70	49.00	4.23
Protocolised management of CS	6	4.20	4	2.80%	14	9.80	52	36.40	66	46.20	4.18

Abbreviations: CS, cardiogenic shock; NA, not applicable.

All areas of research were deemed important for future research, likely reflecting the need to improve CS outcomes which have remained largely static [15]. Early recognition of CS and interventions in the management of CS were ranked highest as areas for future research, though all were important. Early recognition and management of shock, before established end-organ dysfunction, is critical in achieving best the outcomes [16]. An education program akin to the successful "surviving sepsis" [17] campaign could be considered, given the time-critical nature of CS and that the survival benefit of both mechanical and pharmacological therapies for CS has, thus far, been disappointing [18].

Our study has highlighted current clinical priorities, knowledge gaps, and research priorities pertaining to CS in Australia. There is a need for further clinician education and awareness in detecting CS. Further, barriers and delays in access to specialist CS care still occur, and investigation into protocolised CS pathways should be considered.

Study Limitations

As the survey included snowball sampling, it is not possible to identify the response rate. However, the survey, to our knowledge is the first survey on CS in Australia, and has a higher number of respondents compared to other similar non-CS surveys [19], with a low rate of missing data. Most respondents were from NSW (one of eight states and territories in Australia), which may limit the generalisability of the finding, although similar geographical challenges exist throughout Australia. Most of the regional and rural respondents had access to a cardiac catheterisation lab, suggesting remote clinicians were under-represented. It is likely that access and referral issues for these clinicians are more significant. While delays to transfer were present and respondents felt these did affect outcomes, the reasons for the perceived delays and whether any such delays did impact outcomes were beyond the scope of this survey.

Conclusion

Our survey identified and prioritised evidence gaps and systems issues that can be addressed with future research into the management and outcomes of patients with CS.

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Conflicts of Interest

There are no conflicts of interest to disclose.

Author Contributions

Mark Dennis: Conceptualisation, methodology, investigation, writing the original draft, visualisation, editing.
Aidan Burrell: Writing - review and editing.
Sean Lal: Methodology, validation, writing - review and editing.
Caleb Ferguson: Conceptualisation, methodology, validation, writing - review and editing.
John French: review and editing.
Emma Bowcock: review and editing.
Natalie Kruit: Methodology, resources, conceptualisation.
Brian Burns: Resources, investigation, writing - review and editing.
Pankaj Jain: Conceptualisation, resources, methodology, validation, writing - review and editing.

Appendices

Supplementary data associated with this article can be found, in the online version, at https://dx.doi.org/10.1016/j.hlc.2024.04.166.

References

[1] Thiele H, Ohman EM, de Waha-Thiele S, Zeymer U, Desch S. Management of cardiogenic shock complicating myocardial infarction: an update 2019. Eur Heart J. 2019;40:2671–83.
[2] van Diepen S, Katz JN, Albert NM, Henry TD, Jacobs AK, Kapur NK, et al. Contemporary management of cardiogenic shock: a scientific statement from the American Heart Association. Circulation. 2017;136:e232–68.
[3] Hochman JS, Buller CE, Sleeper LA, Boland J, Dzavik V, Sanborn TA, et al. Cardiogenic shock complicating acute myocardial infarction–etiologies, management and outcome: a report from the SHOCK Trial Registry. SHould we emergently revascularize Occluded Coronaries for cardiogenic shocK? J Am Coll Cardiol. 2000;36(Suppl A):1063–70.
[4] Vallabhajosyula S, Dunlay SM, Barsness GW, Rihal CS, Holmes DR Jr, Prasad A. Hospital-level disparities in the outcomes of acute myocardial infarction with cardiogenic shock. Am J Cardiol. 2019;124:491–8.
[5] Tehrani BN, Sherwood MW, Rosner C, Truesdell AG, Ben Lee S, Damluji AA, et al. A standardized and regionalized network of care for cardiogenic shock. JACC Heart Fail. 2022;10:768–81.
[6] Rogers B, Legaspi JP, Bastiampillai T. Hospital congestion: a market solution to address delayed transfers of care from hospital beds. Med J Aust. 2023;218:298–300.
[7] Taleb I, Koliopoulou AG, Tandar A, McKellar SH, Tonna JE, Nativi-Nicolau J, et al. Shock team approach in refractory cardiogenic shock requiring short-term mechanical circulatory support: a proof of concept. Circulation. 2019;140:98–100.
[8] Moghaddam N, van Diepen S, So D, Lawler PR, Fordyce CB. Cardiogenic shock teams and centres: a contemporary review of multidisciplinary care for cardiogenic shock. ESC Heart Fail. 2021;8:988–98.
[9] Kruit N, Hambly J, Ong A, French J, Bowcock E, Kushwaha V, et al. Protocolised management of cardiogenic shock and shock teams: a narrative review. Heart Lung Circ. 2023;32:1148–57.
[10] Stretch R, Sauer CM, Yuh DD, Bonde P. National trends in the utilization of short-term mechanical circulatory support: incidence, outcomes, and cost analysis. J Am Coll Cardiol. 2014;64:1407–15.

[11] Amin AP, Spertus JA, Curtis JP, Desai N, Masoudi FA, Bach RG, et al. The evolving landscape of Impella use in the United States among patients undergoing percutaneous coronary intervention with mechanical circulatory support. Circulation. 2020;141:273–84.
[12] Nunes AJ, MacArthur RG, Kim D, Singh G, Buchholz H, Chatterley P, et al. A systematic review of the cost-effectiveness of long-term mechanical circulatory support. Value Health. 2016;19:494–504.
[13] Binanay C, Califf RM, Hasselblad V, O'Connor CM, Shah MR, Sopko G, et al. Evaluation study of congestive heart failure and pulmonary artery catheterization effectiveness: the Escape trial. JAMA. 2005;294:1625–33.
[14] Tehrani BN, Truesdell AG, Psotka MA, Rosner C, Singh R, Sinha SS, et al. A standardized and comprehensive approach to the management of cardiogenic shock. JACC Heart Fail. 2020;8:879–91.
[15] Sterling LH, Fernando SM, Talarico R, Qureshi D, van Diepen S, Herridge MS, et al. Long-term outcomes of cardiogenic shock complicating myocardial infarction. J Am Coll Cardiol. 2023;82:985–95.
[16] Mebazaa A, Tolppanen H, Mueller C, Lassus J, DiSomma S, Baksyte G, et al. Acute heart failure and cardiogenic shock: a multidisciplinary practical guidance. Intensive Care Med. 2016;42:147–63.
[17] Levy MM, Dellinger RP, Townsend SR, Linde-Zwirble WT, Marshall JC, Bion J, et al. The Surviving Sepsis Campaign: results of an international guideline-based performance improvement program targeting severe sepsis. Intensive Care Med. 2010;36:222–31.
[18] Jentzer JC, Pöss J, Schaubroeck H, Morrow DA, Hollenberg SM, Mebazaa A. Advances in the management of cardiogenic shock. Crit Care Med. 2023;51:1222–33.
[19] Monagle SR, Spear E, Abrahams T, Thakur U, Pol D, Tan S, et al. Cardiologists' knowledge and perceptions of the seasonal influenza immunisation. Int J Cardiol. 2024;399:131654.