Implementation of a Multidisciplinary CODE SHOCK Strategy for Cardiogenic Shock

H. A. Garuba[1], M. Boodhwani[2], M. Ruel[2], E. Stadnick[1], R. A. Davies[1], M. Le May[1], B. Bowes[3], L. M. Mielniczuk[1], S. Chih[1].

[1]Division of Cardiology, [2]Division of Cardiac Surgery, [3]Department of Clinical Services, University of Ottawa Heart Institute, Ottawa, ON, Canada,

INTRODUCTION

Cardiogenic shock (CS) is a challenging clinical problem associated with high early mortality. Factors contributing to poor outcomes include delayed diagnosis or late referral, mixed shock etiology, inadequate specialist support, and inadequate access to mechanical circulatory support (MCS). Clearly defined clinical protocols that enable rapid mobilization of a multidisciplinary team may improve management and outcomes.

In 2017, our institution adopted a CODE SHOCK strategy for CS patients involving rapid assessment and intervention by a Shock Team comprising of physicians from advanced heart failure and transplant, cardiac surgery, intensive care, and interventional cardiology (Figure 1).

The aim of this study was to evaluate patient outcomes of the CODE SHOCK strategy compared to a historical cohort.

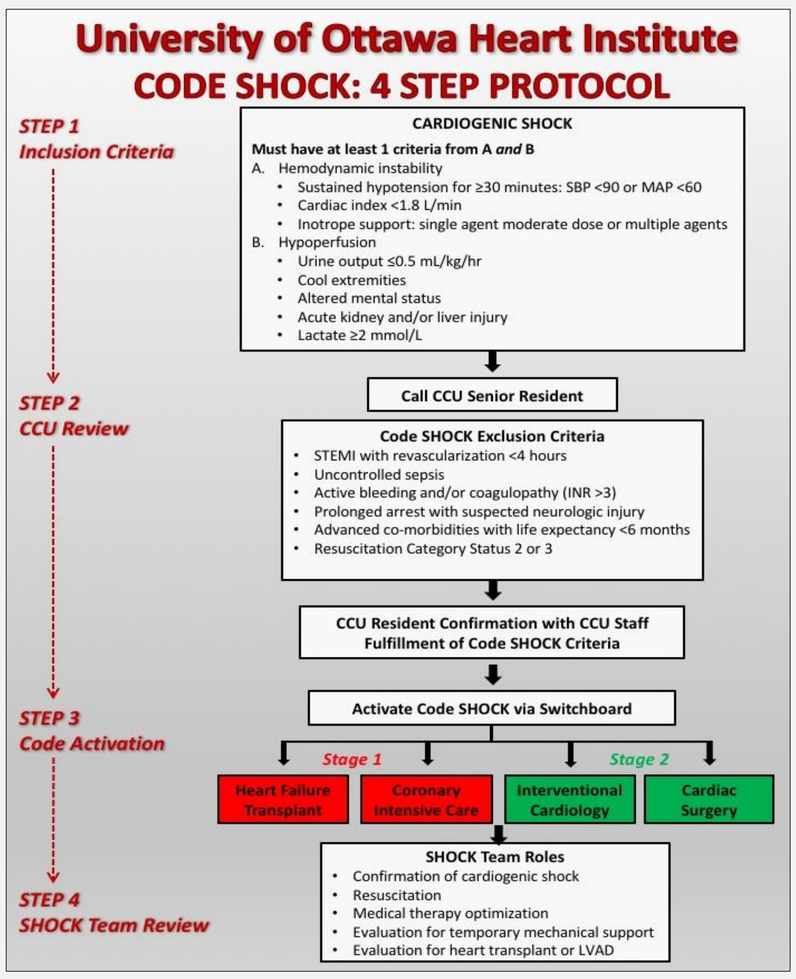

Figure 1: University of Ottawa Heart Institute CODE SHOCK Protocol

METHODS

We performed a retrospective analysis of cardiogenic shock patients admitted to the University of Ottawa Heart Institute cardiac intensive care unit (CICU) between January 2015 and October 2017. Patient clinical characteristics, treatment, and survival were compared between patients managed with the CODE SHOCK protocol from April to October 2017 (treatment group) and a historical cohort from 2015 prior to CODE SHOCK implementation (control group).

RESULTS

We evaluated 62 CS patients: n=37 treatment, n=25 control (Table 1). The cohort was predominantly male (74%) with a mean age of 56±16 years, and severe left ventricular systolic dysfunction at presentation (left ventricular ejection fraction 22±13%). Mean age was higher in the historical cohort, and a higher proportion of patients had an ischemic cardiomyopathy etiology.

Compared to controls, patients in the treatment group had higher mean lactate and aspartate aminotransferase (p = ns). Mean creatinine was similar between groups. Inotropes, invasive ventilation and dialysis were required in 80%, 63%, and 34% patients respectively, with no significant differences between treatment and control groups. Temporary mechanical circulatory support (MCS) was implemented more often in the treatment (46%) than the control (16%) group with the major difference being in the use of intra-aortic balloon pumps (Table 2). Few patients (18%) underwent durable left ventricular assist device implant and/or heart transplantation. Mean hospital length of stay was 22 ± 23 days and was comparable between treatment and control groups (Table 3). Survival at 30-days was higher in the treatment group and maintained at 90-days follow up (Figure 2).

Table 1: Baseline Characteristics

	All patients n = 62	Treatment n = 37	Control n = 25	p
Age	56±16	52±13	62±17	**0.01**
Male	46 (74)	29 (78)	17 (68)	0.39
Etiology of shock				
Acute MI	8 (13)	5 (14)	3 (12)	0.99
Dilated cardiomyopathy	21 (34)	13 (35)	8 (32)	0.99
Ischemic cardiomyopathy	14 (23)	4 (11)	10 (40)	**0.01**
Myocarditis	6 (10)	6 (16)	0 (0)	0.08
Tachycardia-induced	6 (10)	5 (14)	1 (4)	0.39
Other*	7 (11)	4 (11)	3 (12)	0.38
Biochemistry				
Initial lactate	3.9 ± 3.9	4.3 ± 4.5	3.2 ± 2.6	0.29
Initial AST	2069 ± 3950	2541 ± 4307	1331 ± 3269	0.71
Creatinine	170 ± 92	155 ± 84	193 ± 100	0.17
Initial LVEF	22 ± 13%	21 ± 10%	23 ± 17%	0.53

Values are presented as mean ± standard deviation and number (percentage). Creatinine and AST are in mmol/L.*Other includes mixed etiology of cardiogenic shock, congenital heart disease, Takotsubo, severe valvular disease, transplant rejection, and hypertrophic cardiomyopathy.

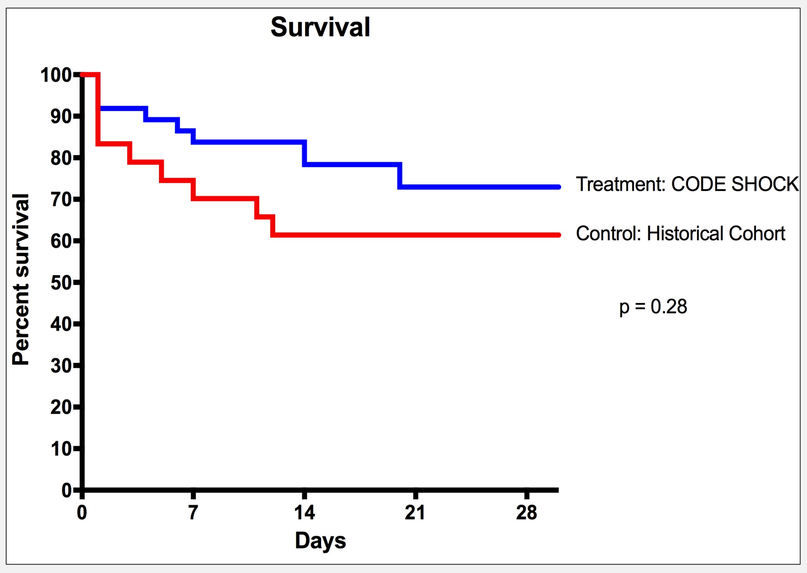

Figure 2: Thirty day survival curves of patients in the CODE SHOCK group compared with a historical cohort.

Table 2: Treatments

	All n = 62	Treatment n = 37	Control n = 25	p
Support				
Inotropes	50 (80)	32 (86)	18 (72)	0.20
Intubated/ventilated	39 (63)	22 (59)	17 (68)	0.59
Dialysis	21 (34)	11 (30)	10 (40)	0.42
Mechanical Circulatory Support	21 (34)	17 (46)	4 (16)	**< 0.01**
Intra-aortic balloon pump	18 (29)	15 (41)	3 (12)	**0.02**
Impella	7 (11)	6 (16)	1 (4)	0.22
Extracorporeal membranous oxygenation	3 (5)	3 (8)	0 (0)	0.26
Definitive Therapy				
Durable left-ventricular assist device	6 (10)	3 (8)	3 (12)	0.67
Cardiac transplant	5 (8)	4 (11)	1 (4)	0.64

Table 3: Outcomes

	All n = 62	Treatment n = 37	Control n = 25	p
Hospital length of stay (days)	22 ± 23	21 ± 17	22 ± 29	0.86
Critical care unit length of stay (days)	14 ± 16	13 ± 12	15 ± 20	0.69
Survival				0.28
Alive at 7 days	48 (77)	32 (86)	16 (64)	
Alive at 30 days	42 (68)	27 (73)	15 (60)	
Alive at 90 days	37 (60)	23 (62)	14 (56)	

DISCUSSION

The American Heart Association 2017 Scientific Statement on Contemporary Management of Cardiogenic Shock recommends incorporating multidisciplinary shock teams in CS management as a key step in regionalizing time-sensitive CS care.

Preliminary data from adoption of such a strategy at our centre demonstrates that even though patients in the CODE SHOCK treatment group were sicker at presentation (higher lactate, shock liver), their 30-day survival was numerically higher compared to the historical cohort and this trend appeared to be sustained at 90 days.

In addition, the CODE SHOCK protocol led to greater implementation of MCS in the treatment cohort without prolonging length of stay in hospital or in critical care units, which is an important consideration for planning of resource utilization in centres managing CS patients.

These initial results are encouraging and warrant further investigation in larger-scale prospective multi-centre trials.

CONCLUSION

A multidisciplinary CODE SHOCK strategy for cardiogenic shock patients is feasible, and may improve patient outcomes in CS.

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CONTACTS:

Habibat A. Garuba, MD
hgaruba@ottawaheart.ca

Sharon Chih, MBBS, PhD
schih@ottawaheart.ca

University of Ottawa Heart Institute. 40 Ruskin Street, Ottawa, ON K1Y 4W7 Canada

The authors have no conflicts of interest to disclose.