



Editorial

The Current Concept and Role of Intensive Cardiovascular Care Units

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ABSTRACT

Since its first establishment in the early 1960s, intensive care for the critically ill cardiac patients had transformed substantially. From a unit designed only to monitor cardiac rhythm and administer electrical therapy to patients with myocardial infarction (MI), the Intensive Cardiovascular Care Units (ICVCU) now provide care for a wide array of patients with cardiovascular conditions needing close observation and hemodynamic support. This shift in role is accompanied with the development of cardiac critical care as an emerging subspecialty of cardiovascular medicine. Cardiac intensivists should have proper training in general cardiology, combined with additional competency in critical care, including mechanical ventilation, renal replacement therapy, mechanical circulatory support and general preventive measures for infections. A high-intensity medical staffing in a closed care system had shown to improve mortality in critically ill cardiac patients in the contemporary ICVCUs. As interventional cardiology, structural heart disease, electrophysiology, advanced heart failure and transplantation continue to offer new treatment options for complex high-risk patients, cardiac critical care is of utmost importance to provide collaborative care among these disciplines. .

Early development of Intensive Cardiovascular Care Units

Intensive Cardiovascular Care Unit (ICVCU) refers to a specialized system within a hospital which provide care for critically ill patients with underlying cardiac and vascular problems. The concept of ICVCU had developed rapidly from a unit exclusively administering care for patients with myocardial infarction (MI) toward an advanced management system able to provide care for not only severe cardiovascular conditions but also cardiac patients with acute non cardiac illnesses. In this modern era, ICVCUs are where patients with acute MI were treated, along with a significant number of other critically ill cardiac patients, ie. cardiogenic shock, mixed type shock, sepsis, respiratory failure needing ventilatory support and renal failure necessitating renal replacement therapy.^{1,2}

Historically, intensive care for cardiac patients was based on the recognition that arrhythmias accounted for up to 40% of deaths within the first few days after an episode of acute MI. Of these, about two thirds are due to ventricular fibrillation and one third to bradycardia, heart block and asystole.³ These arrhythmias were thought not caused by irreversible cardiac damage and responded well to prompt electrical therapy. Thus, the earliest Coronary Care Units (CCUs) were established to provide rapid identification and termination of these peri-infarction arrhythmias.

A pioneer in this field at that time was Desmond Julian, whose basic conception for CCU philosophy still remained relevant today; (1) Continuous electrocardiographic monitoring linked to arrhythmia alarms, (2) rapidly initiated cardiopulmonary resuscitation and defibrillation, (3) personnel trained to manage specialized equipment within a single unit, and (4) skilled nurses empowered to independently initiate resuscitation.⁴ Both Europe and the United States opened their first CCUs in 1962; aiming for continuous monitoring, cardioversion and resuscitation for patients with MI in a single unit staffed by specially trained personnel.¹

Adoption of this early model of CCU had been credited for significant temporal decrease in the in-hospital mortality rate after MI. Killip and Kimball described a 19% reduction in mortality rate over a period of two years. In the absence of cardiogenic shock, aggressive medical treatment in CCU reduced mortality from 26% to 7%. They noted this improvement was mainly due to segregation of patients in a closed unit, enabling immediate treatment of life-threatening arrhythmias through delegation of some medical authority to trained nurses to shorten response time.⁵ Their findings were supported by several other studies which reported overall mortality decline of MI patients from 30-40% in the 1950s to roughly 15-20% in the 1970s.¹ This led to an even more widespread implementation of dedicated CCUs worldwide.

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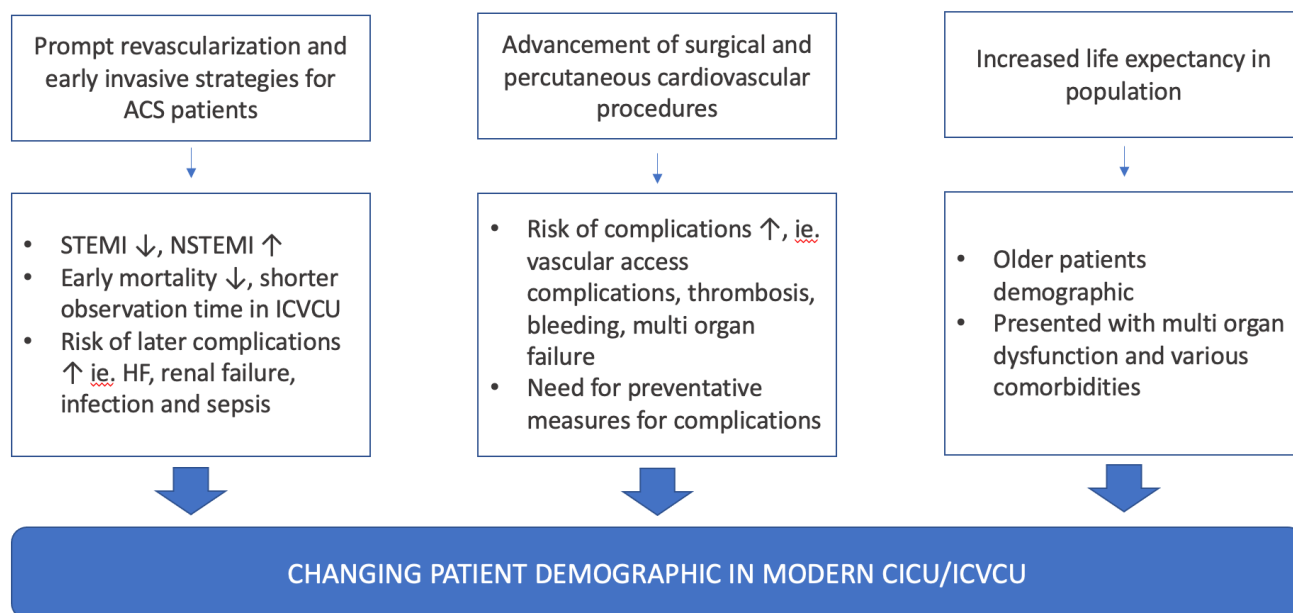


Figure 1. A shift of patient demographic in modern CICU/ICVCU

ACS: Acute Coronary Syndrome, STEMI: ST-elevation myocardial infarction, NSTEMI: Non ST-elevation myocardial infarction. HF: Heart Failure

Transformation of CCU to modern ICVCU

The scope of CCU in current era have evolved toward a wider concept of Cardiovascular Intensive Care Units (CICU), more commonly known as ICVCU in Indonesia. This transformation was not merely semantic, but a reflection of changing patient demographic profile. The introduction of an early invasive treatment strategy for acute coronary syndrome (ACS) had enabled early recuperation and shorter need for intensive care. On the other hand, patients admitted to ICVCU have become older and presented with more comorbidities. Advancements of invasive treatments in the catheterization lab providing procedures for multivessel diseases, complex lesions and reduced left ventricular function increased the risk of complications. Real world registries have observed a decreasing admission of MI patients, but a steady increase of cardiogenic shock, heart failure and primary non cardiac diagnoses. Sinha et al reported that in the United States, ACS declined as primary admitting diagnosis to CICU from 32.3% to 19% between 2003 and 2013. At the same period, primary non cardiac diagnoses increased from 38% to 51.7%.⁶ Critical Care Cardiology Trial Network (CCCTN) showed patients with concomitant distributive and cardiogenic shock who have higher Sequential Organ Failure Assessment (SOFA) score requiring more mechanical ventilation and renal replacement therapy, now account for a large fraction of CICU stays. This data reflects the complexity and challenges faced by medical personnel working in the CICU/ICVCU today (Figure 1).

In 2005, the European Society of Cardiology published an expert consensus document for the structure, organization and operation of intensive cardiac care units. It was among the first consensus which recommended a systematic critical care training of cardiologists and cardiac nurses.⁸ Subsequently, a 2012 scientific statement from the American Heart Association also highlighted the transformation of CICU/ICVCU and the emerging need for a standardized medical staffing/training model.¹ Both documents acknowledged cardiac critical care as a subspecialty of cardiovascular medicine. Physicians in CICU/ICVCU should have proper training in general cardiology combined with additional competency in critical care, encompassing mechanical ventilation, renal replacement therapy, mechanical circulatory support and general preventive measures for infections.

Special procedural skills and expertise are also needed, such as non-invasive and invasive hemodynamic monitoring, vascular access, extravascular procedures and airway techniques. The overlap between cardiology and critical care are shown in Figure 2 (adapted from 9).

Improving patient outcome through establishment of ICVCU

Delivering care to such complex and high-risk patients in an intensive care setting necessitating the presence of dedicated critical care providers. Since the establishment of high-intensity physician staffing model in the closed system Intensive Care Unit (ICU), observational studies consistently showed a decrease in general medical and surgical ICU mortality rate.² High-intensity staffing was defined as the presence of a dedicated critical care and mandatory intensivist consultation. Na et al in 2016 showed that in a closed system CICU in South Korea, the presence of a dedicated cardiac intensivist was associated with a reduction in CICU mortality rates in patients with cardiovascular disease who required critical care.¹⁰ Another observational study by Miller et al in 2021 also found an association between lower in-hospital and CICU mortality after the transition to a closed CICU.¹¹ These observations should provide a basis for the establishment of closed system CICU/ICVCU staffed by trained cardiac intensivists. Improvement of outcomes in this system are hypothesized due to increased use of evidence-based protocols, rapid recognition of life-threatening conditions, attention of patient safety, full attention and presence of critical care physicians and decreased overall infections.²

ICVCU in Indonesia

The development of cardiac critical care in Indonesia had generally been in accordance with global pathways. The first CCU in Indonesia was established in the early 1970s as an independent unit in a general hospital separate from the ICU, initially for early recognition and management of arrhythmias in MI. In 1985, a dedicated Intensive Cardiovascular Care Unit was founded in Harapan Kita Cardiac Center, Jakarta. This prototype unit provided care for coronary patients along with other patients with cardiovascular diseases who needed close monitoring and device support, such as mechanical ventilation and mechanical circulatory support.

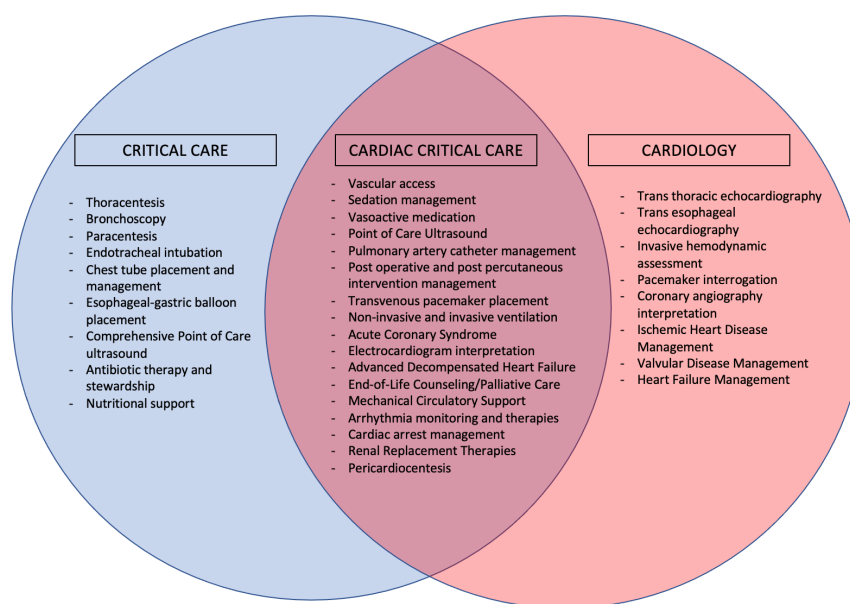


Figure 2. Overlap of knowledge and skills for critical care, cardiac critical care and cardiology. (Adapted from 9)

(Intra-Aortic Balloon Pump/IABP implantation was first performed in 1987). Initially co-managed by cardiologists and anesthesiologists, later development witnessed the evolution of critical care cardiologists as main medical staff in ICVCU.

The increasing complexity of patients admitted to ICVCU in Indonesia also had been observed. Registry of Acute and Intensive Cardiovascular Outcome (RAICOM study) in Harapan Kita Cardiac Center showed that although ACS still predominate as main admitting diagnosis, most of these patients presented with comorbidities and complications. Heart failure was the most frequent findings (38.9%), followed by renal failure (37.6%) and arrhythmias (24.4%).¹² Data from Sardjito Cardiovascular Intensive Care Registry (SCIENCE) in Yogyakarta showed that the main cause of admission was ACS (69.9%), followed by life threatening arrhythmia from any cause (14.1%) and acute decompensated heart failure (4.2%). In-hospital mortality rate was 9.2% and the use of mechanical ventilation was the main predicting factor.¹³

Indonesian Heart Association in 2021 had published a consensus document on the recommendation for ICVCU services; describing the general conditions and infrastructure of an ICVCU, classification of services into 3-tiered categorization (level 3 ICVCU caring for the most complex patients), indications for admission, training pathways for medical staff, referral system and governance.¹⁴ Currently, most level 3 ICVCUs in Indonesia are well equipped to manage ACS with 24/7 primary PCI capabilities, while also providing mechanical ventilation, mechanical circulatory support (IABP and ECMO/Extra Corporeal Membrane Oxygenation), targeted temperature management and renal replacement therapy (hemodialysis and CVVH/Continuous Veno-Venous Hemofiltration) for a wide array of cardiovascular patients. It is advocated that level 3 ICVCU is led by a certified critical care cardiologist, while level 1 ICVCU which provided basic intensive cardiac care could be led by a general cardiologist.

Future directions of ICVCU

Cardiovascular medicine is one of the branches of medicine that is rapidly expanding with new discoveries. Advances in medical care, technology, training and organization along with changes in population demographics have contributed to the changes we see today in modern ICVCU.

As interventional cardiology, structural heart disease, electrophysiology, advanced heart failure and transplantation continue to offer new treatment options which possibly alter patient outcome even further, cardiac critical care establishes itself as an emerging subspecialty of cardiovascular medicine who provide collaborative care among these disciplines.

Observational data so far had consistently showed us that the structure of ICVCU as an independent unit staffed by dedicated cardiac intensivists in a high-intensity closed system could decrease overall in-hospital mortality. To achieve this, professional organization should provide standardization of cardiac critical care training to encompasses specific skill sets in cardiology and general critical care. Considering that most of modern ICVCU patients consist of complex cases with multiple comorbidities, multidisciplinary care is also an important aspect of patient care. An amiable work environment between different disciplines should be agreed upon to ensure best practice.

Lastly, significant practice variation exists in ICVCU services across the globe, leading to different outcomes. Thus, there is a pressing need to identify quality measures and continuing effort to standardize care. Due to the complex nature of patients receiving care in ICVCU, traditional cardiovascular outcome measures such as readmission rates and post-MI mortality might not provide comprehensive assessment of quality of care. To overcome this, quality measures from other quality domains, such as patient engagement and experience, have been proposed as potentially relevant care markers in acute care cardiology, along with other disease-specific indicators.¹⁵

Conflict of Interest

There is no conflict of interest

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