

Special Article

Coronary Care Unit design, staffing and organization

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Introduction

Before the inception of coronary care units (CCU) myocardial infarction was treated with prolonged bed rest, digoxin and norepinephrine. Complications were frequent leading to a high mortality rate (25-30%).

Gunnar Biorck of Stockholm wrote:

"There are few diseases in the sphere of internal medicine where the average mortality during four to six weeks hospitalization is over 30%, and if the patients with shock are particularly considered, the figure is more than twice as large¹".

Beck and colleagues in 1947 had resuscitated, by electric shock, a 14 year old boy in whom ventricular fibrillation developed during operation^{2,3}.

Julian wrote on 5 May 1960, a 40 year old physician with a myocardial infarction collapsed on admission to the ward. A scalpel, which was poised to incise a cubital fossa in an adjacent catheterisation laboratory, was diverted to initiate a thoracotomy. After some minutes, help became available from the surgeons, who performed more effective cardiac massage until internal defibrillation could be carried out. The patient made an excellent cardiac recovery (he sustained some cerebral damage but survived for 23 years). By a curious quirk of fate he was an alumnus of Johns Hopkins Hospital, and shortly after his recovery he showed us an article in the hospital journal describing closed chest cardiopulmonary resuscitation, which had been developed there by Kouwenhoven, Jude and Knickerbocker⁴.

During the following year physicians in Edinburgh Royal Infirmary adopted the technique of closed chest cardiopulmonary resuscitation. In 1961 Julian and collaborators concluded that coronary patients can be treated better if they are grouped together in one place where dedicated equipment, trained physicians and nurses are made available. With the recognition of the importance of rhythm monitoring, closed cardiopulmonary resuscitation and defibrillation the treatment of coronary patients was revolutionized⁵. The era of modern CCU started.

The first purpose built CCU was opened by Hughes Day in Kansas City USA on May 20, 1962. Others quickly followed and by 1970 most of the major hospitals worldwide had their own CCUs⁶.

In Sudan the first CCU was opened in Al Shaab Hospital by Khalil, Ismaeel, Abbasher, Abu Saleh and Al Tayeb on August 21, 1985. It consisted of a converted nurse's room with 2 beds and 2 monitors and a defibrillator. Oxygen was delivered from large mobile cylinders. With WHO support we were able to send a group of sisters to Jordon for training at King Hussein Medical Center who returned to become the first trained CCU nurses. Sister Kawther who is now head of the CCU was one of that group. During one year of coronary care we admitted 93 cases of acute cardiovascular disease with mortality rate of 17%. Considering the resources available during those days and by today's measures that figure represents great success. In general CCUs have contributed immensely to the treatment of coronary patients and almost halved the mortality from that disease.

Functions

CCU provides a special area for the care and monitoring of patients with acute coronary syndrome, especially ST-segment elevation myocardial infarction, and other acute cardiac

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conditions by specially trained doctors and nurses, within a highly equipped and organized space.

CCU provides effective environment for detection of complications of acute coronary syndrome and treating them promptly.

It provides timely, effective and rapid cardiopulmonary resuscitation.

Design and layout

The design and layout is dictated by the hospital need and resources but the final shape is a compromise between desirability and the practical aspects of the project.

In general CCU must be adjacent to other critical care areas such as ICU, emergency reception, the cath lab and Echo lab. The building should be designed in consultation with cardiologists who must be able to specify their needs. Generally all installation like electric outlets, lighting, oxygen pipes, water lines and ventilation should be planned before starting the actual building.

For a catchment area with population of 250,000 – 500,000, eight to ten bedded CCU is required. The preferable layout is open bed CCU where patient can be constantly observed and their movement on bed seen. Other layout is the system of individual room which offers the advantage of privacy especially during the stressful time of cardiac arrest in the neighboring bed. Unfortunately there is a serious disadvantage to this system as it makes no room for direct observation.

The access door should be wide enough to allow movement of beds in and out of the CCU. Piped oxygen and suitable bed lights including special procedures light should be installed. Bed area should be wide enough to accommodate equipment and staff especially during resuscitation when all members of cardiac arrest team are present.

The recommended bed area is in the range of 8-10 square meters.

The provision of electric bed with all necessary controls and nurses call button is required. It should have collapsible side-rails and be easy to maneuver especially during cardiac arrest. Additionally it should be designed with adjustable height to allow

accommodation of image intensifier tube underneath it. Image intensifier is needed during insertion of pacemakers, cardiac paracentesis or Swan Ganz catheters procedures. One well equipped room should be reserved for special procedures such as pacing, paracentesis or Swan Ganz catherterization.

A special room for stocks and disposables should be allocated. Doctor's office and morning meeting room should also be made available.

It is also recommended that CCU should have its own stock of emergency medicines, IV infusions, thrombolytics and narcotics.

Equipments

Equipments should be securely fixed to the walls and monitors connected to the central console at the nurses observation area.

For each patient the following equipments should be provided: bed sided monitor, oxymeter, infusion pump, suction machine, oxygen delivery system e.g. nasal tubes or masks.

Monitors should at least show printable ECG strip with arrhythmia detection alarm, pulse, BP, respiratory rate, and oxygen saturation.

Additionally the following equipments should be available in the CCU: well prepared and daily maintained Crash Cart, 2 defibrillators with transcutaneous pacing facility, ECG machine, Holter recorder, image intensifier and at least 2 ventilators.

A temporary pacemaker device with properly functioning rechargeable battery should be available. It is recommended that intra-aortic balloon counter pulsation device be available in major hospitals with large turnover of critically ill cardiac patients. The device is useful for bridging in cases of intractable cardiogenic shock before intervention is available. It is available from Arrow or Data scope.

Staffing of CCU

One consultant should be appointed director of the CCU. Admitting consultants should perform daily morning round and also be available for emergencies. The attending specialist physicians or registrars should run

the day to day activity and at any time a medical registrar should be available. CCU residents (well trained senior house officers) do the routine work such as clerking, monitoring progress, investigations and discharge summaries. Trainee doctors should only perform under the strict control of the registrar or senior house officer.

Nursing staff should be at least 1.5 times that of general ward nurses. The acceptable rule is that the ratio of nurse to patient in CCU should be 1:1.

Trained CCU nurses should be well informed of advanced cardiac life support, know how to assist in cardiopulmonary resuscitation and have good knowledge on cardiac drugs.

Recently well trained nurses were given the clinical privilege to defibrillate, accept admission, request investigations and prescribe timely thrombolytic therapy.

The nurse is an important member of the CCU staff and success of treatment depends entirely on well trained dedicated nurses. A senior nurse should be appointed CCU in charge. Each shift should be headed by a staff nurse to act as shift leader and enough trained nurses to cover all patients according the ratio of 1:1.

Other members who are also an essential part of the CCU are the clinical pharmacist, the physiotherapist and the dietitian.

Auxiliary staff should include cleaners, porters and helpers. The floor of CCU should always be kept clean and linen frequently changed as condition of patients dictates. Helpers deal with patient personal needs such as toilets for which a commode should be available. Porters deal with stretchers and wheelchair supply and help in pushing stretchers in and out of CCU.

Organization of CCU

The mission of each CCU should be clearly stated. This is decided by the hospital authority and should state emphatically that the CCU provides intensive medical and nursing care to the critically ill cardiac patient.

A consultant should be appointed by the hospital board as director of the CCU. The appointed director has responsibility for quality

of patient care provided in the CCU. He is responsible for the smooth running of service provided by the unit. He should provide leadership and expertise to maintain the unit in a high professional standard. He should demonstrate leadership skills, ability to supervise, coordinating clinical staff and implementing and maintaining all policies and procedure of the unit. CCU director should assure that the quality, safety and appropriateness of patient care services are monitored and evaluated in a regular basis and that appropriate actions based on findings are taken. The supervision shall include day-to-day supervision of patient care, monthly morbidity and mortality conference, a multi-disciplinary conference (when appropriate), and any other quality assurance function deemed necessary.

CCU director should appoint a critical care Quality Assurance Committee (QA). The committee should meet with the house staff, doctors, nurses and auxiliary staff on a monthly basis to review the morbidities and mortalities of the month as well as professional or technical problems experienced during the month. Minutes of this meeting will be forwarded to the hospital Quality Assurance Committee and the director of the CCU.

The patient's attending physician (physician specialist or registrar) shall retain responsibility for the patient while in the special care unit. He should be readily available to deal with all eventualities. The attending physician is expected to make daily patient rounds, more frequent when indicated and to maintain patient coverage by a designated physician in his absence. The name of the designated physician covering for the physician on duty shall be written in the chart with the dates of coverage.

The attending physician is responsible for communicating with the patient and the patient's family regarding all aspects of patient management. He is also responsible for communicating with the patient's consultant or consultant on call regarding all admissions, treatment measures and if the need arises he should ask for immediate help.

The CCU resident should be a senior house officer (medical officer) who has received special training and gained experience in dealing with acute cardiac problems. He should develop complete data base on all assigned patients. The data base shall include a complete history, physical examination, appropriate laboratory studies, ECG, X-rays. The data base should be entered on the patient's file at the time of admission. He should also develop diagnostic and therapeutic management plan, after consultation with the attending physician and respond to acute changes in patient status.

The resident should perform daily assessment of patient's condition and enter a progress note on the chart. This progress note should show the status of all active patient problems and assessment measures and the consensus of opinion reached by the senior unit staff.

Following each working session or shift a resident doctor should endorse all assigned patients to the next doctor on duty. Both of them should sign the endorsement book and enter date and time.

Work should be divided into 3 eight hourly shifts or maximum 12 hourly shifts. This is important to avoid long working hours in stressful environment which is counterproductive.

Documentation is important both for future follow up and medico-legal aspects. All doctors including consultants should enter progress notes or new diagnosis and treatment on the patient's file. This should be dated timed and signed. Rubber stamp should be supplied to all doctors and should show the full name position and license number.

It is a prerequisite for a good CCU to have a good Emergency Reception Department (ER) staffed with trained doctors and nurses and with satisfactory ambulance service with well trained paramedics.

Chest pain patients should receive priority at ER and be dealt with immediately upon their arrival. It is recommended that busy hospitals have Rapid Axis Chest Pain Clinic or have a fast tract admission system for such cases.

Intermediate or step-down unit

The duration of stay in CCU is dictated by the patient condition and progress. Cases of acute myocardial infarction should remain in CCU if they develop post-infarction angina, heart failure, recurring life threatening ventricular arrhythmias, or if hemodynamically unstable. Other patients who have low risk of developing ventricular fibrillation are unlikely to die in hospital and can safely be transferred to the ward after 24 hours or maximum two days.

The provision of intermediate, step-down, coronary care unit can form a bridge between more intensive acute coronary care and management in the general ward and allows the more efficient use of high-dependency beds⁷. Staffing of these units by CCU trained nurses allows the patients to benefit from continuity of care as well as uniformity of approach.

Patients in intermediate care unit can also be connected to monitors or telemetry system and are usually linked to CCU observation console where abnormal rhythm can be spotted and treated.

Intermediate CCU plays important role in supervision of medication, risk stratification, patient education, lifestyle modification and rehabilitation. Discharge of patients can be planned and future plans such as stress-testing; and follow up are arranged.

Conclusion

Utilization of CCUs should be paralleled by efforts to improve public awareness to chest pain. This should be emphasized in hospital, referral clinics and through the media.

With rising rates of coronary artery disease in this country and worldwide the need for CCUs is overwhelming. The selection of hospitals that provide coronary care should be well thought of and the minimum number of CCUs which provide necessary service should be approved. Cost effectiveness should be a prime objective when considering budget and bed utilization, as building, staffing, provision of equipments and running costs of CCUs are exorbitant.

This paper is written to provide information on the design, planning, staffing and organization of CCU. I hope it fulfills the purpose for which it has been written.

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