Applying Roy Adaptation Model (RAM) in Assessing Health of Patient with Post-operative Coronary Artery Bypass Graft (CABG) Surgery

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Abstract
This paper describes a case study involving a process of theory integration into nursing care in a CABG postoperative care setting. This approach was guided by Roy’s adaptation model from the totality paradigm. Following a brief description of Roy’s Adaptation Model, a two-day assessment is conducted for a cardiac postoperative patient. Based on the two-day assessment, nursing diagnosis is established and nursing interventions are planned which aim to promote adaptation. Finally, the RAM will be discussed, the advantages and disadvantages of using RAM will be noted.

Keywords RAM, CABG Surgery, nursing care

Description of the Roy Adaptation Model
Roy adaptation model is used for the care of various clients in various settings¹⁻². It focuses on an individual as a biopsychosocial adaptive system. According to Roy nursing is a discipline that emphasizes strengthening, expanding, and improving upon the person’s coping abilities for the purpose of enhancing the patient’s health. RAM offers guidelines to us in application of nursing process logically³. The framework of RAM is assessment, problem identification, goal setting, nursing care planning, implementation and evaluation. According to Roy And Anddrew, RAM is includes five aspects:

Person
The person is defined as a bio-psycho-social being and person interact with a changing environment (stimuli). There are four mode of adaptation:

Physiological mode reflects how the physical needs responds to the stimuli. There are five physiological needs with oxygenation, nutrition, elimination, activity and rest, and protection. Four complex processes are senses, fluid and electrolytes, neurological function, and endocrine function.

Self-concept mode reflects the basic needs of the individual to psychic and spiritual integrity and the way in which an individual senses himself in the society.

Role function mode reflects the sociological role for an individual, in which consisting of a set of expectations of how a person behave in a particular position with the
underlying need of social integrity. It can be classified as primary, secondary and tertiary roles.

**Interdependence mode** reflects an individual's relational integrity and focuses on the giving and receiving love, respect, and value with the support system and their significant others.

**Environment**

Environment refers to the stimulating factors, it may affect the integrity of the person, and affect person's health. Stimulating factor is classified into two types; one is internal stimuli within the person, and external stimuli outside the person.

**Health**

Health is a state that indicates the person can adapt to the change of environment, even the environment equilibrium is disturbed.

**Goal of Nursing**

In order to help the person achieve adaptation to the change environment stimuli in each of the four adaptive modes, there are physiological, self-concept, role function and interdependence modes.

**Nursing activities**

It’s nursing process through a problem-solving approach. There are six steps to achieve:

1) **First level of assessment** is to identify individual's maladaptive and ineffective behavior relating to the four adaptive modes.
2) **Second level of assessment** is used to identify the stimuli that affect the adaptive or the maladaptive behavior.
3) **Problem identification** is identifying the patient's problem in relation to the four adaptive modes.
4) **Goal setting** is the aim to maintain and enhance individual adaptation, to change ineffective behaviors to adaptive behaviors.
5) **Nursing intervention** is a purposeful planning to change the stimuli and strengthening the coping process.
6) **Evaluation** is used to valuate the effectiveness of the nursing interventions.

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**Coronary Artery Disease**

**Definition & Pathology**

Coronary artery disease (CAD) is a condition that results from arteriosclerosis. The most frequent type of arteriosclerosis involves the accumulation of fat deposits inside the coronary arteries. This process usually occurs over many years and may not be detected until symptoms occur. These blockages decrease the flow of blood through the coronary arteries and diminish the amount of oxygen and nutrients the heart muscle receives. Therefore, the heart muscle is starved of the oxygen and food necessary to function properly. Development of coronary atherosclerosis or vasospasm may result in myocardial ischemia (MI).

**Clinical presentation**

Acute MI occurs as a result of prolonged myocardial ischemia that leads to irreversible injury and necrosis. Angina used to describe the chest-pain or discomfort associated with an MI usually lasts longer than 30 minutes and, although occasionally mild and ever absent. Angina is classified into stable angina and unstable angina. Stable angina patients may complain of chest tightness, heaviness, burning, fullness or sharp pain across the center of the chest. This discomfort may also travel to the arms, neck, jaw and back areas. It comes on varied activity or stress and may be relieved by resting and/or nitroglycerin pills. Unstable angina patients may increase in severity or duration, usually have onset at rest or at a low level of exertion, and are unrelieved by the amount of nitroglycerin of rest that had previously relieved the pain. The diagnosis of Acute MI is based on patient history, the presence of ST segment elevation, or Q waves on the 12-lead ECG and serial markers of myocardial necrosis.

**Investigation**

The diagnosis of CAD is based on patient's medical history, serial ECGs, and serum enzyme changes indicative of cardiac muscle necrosis. Tests used to diagnose CAD include: ECG, stress tests, cardiac catheterization (CC), imaging tests such as chest X-ray, echocardiography, or computed tomography (CT).
The resting ECG is a record of the electrical activity of the heart, and can demonstrate signs of oxygen starvation of the heart ischemia or heart attack. Exercise treadmill is a useful screening test for patients with a moderate likelihood of significant CAD and a normal resting ECG. Combining Echo with exercise stress testing is also a very accurate technique to detect CAD. CC with angiography is the most accurate test to detect coronary artery narrowing. Blood tests is to measure blood cholesterol, triglycerides, and other substances. If the above investigation shows positive result, CAD can be diagnosed and treatment is required.

**Treatment**

There is no medical or surgical cure for CAD. Risk factor modification may help control. Patients with CAD can improve their condition by making lifestyle changes such as quitting smoking, losing weight if they are overweight, eating healthy foods, reducing blood cholesterol, exercising regularly, and controlling diabetes and high blood pressure. They should be prescribed medications to treat their condition. The most common drugs are the aspirin, nitrates, beta-blockers and calcium channel blockers. If the patient continues to have angina or significant ischemia is noted while exercise testing, coronary angiography will usually be considered.

Percutaneous coronary intervention (PCI) will be considered for those patients with significant coronary artery narrowing or blockage. PCI is done when a balloon catheter is inflated at the site of coronary blockage, it’s followed by placement of stents to increase coronary artery blood flow.

CABG surgery is performed in patients who have failed medical therapy and they are not good candidates for PCI. CABG has been shown to improve long-term survival in patients with significant left main coronary artery narrow, and in patients with significant multiple arteries narrow, especially in those with decreased EF. Patients should stop aspirin and quit smoking for a period before the surgery.

A coronary artery bypass operation is the operative treatment for CAD. In traditional coronary artery bypass surgery, the surgeon makes a median sternotomy, and retracts the rib cage open to expose the heart. Heparin and high potassium cardioplegic solution were given while patient was put on bypass and myocardial protection. The patient is connected to a heart-lung bypass machine (cardiopulmonary bypass pump), that takes over for the heart and lungs to moves carbon dioxide from the blood and replaces it with oxygen, and allows the heart's beating to be stopped, so the surgeon can operate on a still heart. It takes about four hours. The aorta is clamped off for about 60 minutes and the body is supported by cardiopulmonary bypass for about 90 minutes.

One end of a segment of vein, usually removed from the leg, is anastomosed into the coronary artery below where the blockage occurs and the other end is attached into the aorta. The left internal mammary arteries (LIMA), located on either side of the breastbone, can be used to connected to the LAD artery and/or one of its major branches beyond the blockage. The major advantage of using LIMA is they tend to remain open longer than venous grafts. These grafts by-pass the blockage in the coronary artery and allow improved blood flow and oxygen supply to heart muscle.

CABG is not a cure for coronary artery disease. However, the improved blood supply to the heart muscle should help relieve angina, enable you to be more active and improve the heart’s ability to function as a pump.

**Nursing focus of post CABG care**

When the patient underwent cardiopulmonary bypass, various conditions would have changed. After the surgery, patient will be transferred to ICU for post-operative care, including closely monitoring patient's ECG rhythm, hemodynamic change (BP, HR, RR, SaO₂, body temperature, CVP), fluid balance, electrolytes balance, acid-base balance, coagulation (Hb, clotting, drainage, oozing of wounds) and pain control.
Case Study

Mr. C, a 67 year-old retired cook man, weight 88kg, is an ex-smoker, quitted for 40 years. He has history of hypertension, and gall stones (with history of cholangitis and cholecystectomy in 4/2007). He had inferior STEMI in 11/2007, thrombolytic therapy was given, reperfusion was done before 24 hours of myocardial infarction (MI). Transthoracic Echocardiogram (Echo) in 10/2008 showed satisfied left ventricle (LV) function, ejection fraction (EF) 44%, no regional wall motion abnormality (RWMA) and normal valves with mild mitral regurgitation (MR). Cardiac catheterization (CC) was done in 10/08, showed mid left anterior descending (LAD) occlude 99%, left circumflex (LCx) artery occlude 60~70%, retrograde from LCx to distal right coronary artery (dRCA), proximal right coronary artery (pRCA) occlude 90%, middle right coronary artery (mRCA) occlude 100%. Also thallium scan reported the viable myocardium noted at anteroseptal, septal and inferoseptal region. Moreover, carotid duplex had no significant extra-cranial carotid artery stenosis, no plaque was present. No aortic calcification was seen in chest X-ray. Mr. C stopped aspirin and finished blood tests of blood cholesterol, triglycerides, and other substances and satisfactory on 8/2009, therefor clinically admintted on 25/8/2009 for CABG on 26/8/2009.

Mr. C diagnosed with IHD, was admitted in ICU after CABG at 26/8/2009, CABG with median sternotomy and the endoscopic harvest of left long saphenous vein were done. The graft are LIMA to LAD, SVG to OM1, SVG to dRCA, and then chest closed over two chest drains and 1xA and 1xV pacing wires. The total bypass time was 75min, the cross clamp time was 44min. The first level assessment that was carried out on the arrival of Mr. C to the ICU allowed nurses to identify the patient’s problems in four adaptation modes. In view of Mr. C’s critical condition, nurses initially only focused on assessing Mr. C’s vital functions including oxygenation and neurological status. After stabilizing Mr. C’s cardio-respiratory function, the rest of the assessment continued. The second level assessment that was carried out within 8 hours upon Mr. C’s arrival, allowed nurses to find out the stimuli (factors) contributing to the identified problems. It should be noted that the patient’s problem can be due to one or more stimuli.

After performing the nursing assessment, a number of problems were identified. This included:

1. Pulmonary dysfunction
2. Hypotension
3. Hypothermia
4. Potential for dysrhythmias
5. Potential for bleeding
6. Limited physical mobility
7. Anxiety

Based on the findings of the nursing assessments, a nursing care plan was developed below.

Problem 1:

Pulmonary dysfunction was caused by the effects of anaesthesia, cardiopulmonary bypass, and surgical techniques.

Goal setting: To protect patient’s airway for ventilation and early extubate after off sedation.

Interventions:

1. Ensure and record the ventilator settings as prescribed.
Determined the ventilator effectiveness by monitoring saturation, tidal volume, and ABG result.
2. Provide adequate analgesic to promote increased activity without inducing respiratory depression. Maintain mechanical ventilation as needed until criteria for extubation are met.
3. Help Mr. C sit up, do suction as need to maintain air way, instruct he to do deep breath and effective cough, and arrange physiotherapist for recovery therapy.

**Evaluation:**
1. Mr. C was extubated after off sedation for 12 hours, and able to cough up moderate white phlegm.
2. Mr. C was stable with 8L O₂ mask after extubated.

**Problem 2:**
Hypotension related to cardiopulmonary bypass during operation.

**Goal setting:** To maintain normal BP and hemodynamic stable.

**Interventions:**
1. Monitor CVP, urine output and maintain preload with fluids as needed.
2. Monitor BP, MAP, heart rate, to detect durg effect and hypertension.
3. Administer TGN infusion as prescribed to reduce after load, decrease workload of the heart and maintain graft pateny.
4. Administer dopamin and adrenaline infusion to maintain BP, monitor the effect and side effect.
5. Carry out all prescribed treatment properly. (e.g. IV fluid infusion 1/2:1/2 + KCL20mg solution 80ml/hr.)

**Evaluation:**
1. Mr. C’s blood pressure was around at 140/65mmHg and MAP around 75mmHg.
2. Dopamine and Adrenaline IV infusion were Stopped after BP was stable at the midnight of 26/07.

**Problem 3:**
Hypothermia due to the effects of cardiopulmonary bypass and operation.

**Goal setting:** To maintain an normal body temperature.

**Interventions:**
1. Monitor body temperature closely.
2. Provide warm blankets.
3. Avoid overwarming.

**Evaluation:** Mr. C was warmed up at around 36.8~37°C.

**Problem 4:**
Potential for dysrhythmias can due to history of IHD, myocardial irritability during surgery, electrolyte imbalances.

**Goal setting:** Reduce the potential for dysrhythmias.

**Interventions:**
1. Closely monitor ECG wave form, including the elevation of ST segment, and peak T wave, detect pacer and dysrhythmias.
2. Attach epicardial pacing wires to pulse generator.
3. Closely monitor electrolyte, maintain electrolyte and I/O in balances.
4. Maintain graft patency by monitoring ST segment elevation or any premature ventricular complex, intravenous nitroglycerin and early administration of aspirin to inhibit platelet aggregation.
5. Administer prophylactic beta-blockers or other antiarrhythmic as ordered.

**Evaluation:**
1. Without any dysrhythmia occurrence, kept on monitoring. ECG showed T wave normal without ST segment elevation at 27/08.
2. I/O and Electrolyte were all in balance at 27/08. Urine output decreased from 2.28 ml/kg/hr to 0.56ml/kg/hr.
3. GTN was put on IV infusion around 0.5mg/hr to 1.0mg/hr.
4. Mr. C was administrated aspirin as prescribed in the morning of 27/08.

**Problem 5:**
Potential for bleeding.

**Goal setting:** To detect and reduce bleeding.

**Interventions:**
1. Keep the incision clean and dry, detect wound bleeding, and monitor the volume, color, and quality of the drainage.
2. Maintain patency of chest tubes, detect bleeding,
and cardiac tamponade.
3. The drains should be fixttured and placed well.
4. Administer transemin as ordered.
5. Monitor the Hct/Hb, aPTT, and platelets.

**Evaluation:**
1. Platelets, aPTT, haemoglobin, HCT are normal. PT was normal at 27/08. INR decreased from 1.25 to 1.19 at 27/08.
2. Trains are placed well and no fresh oozing, with minimal drainage.
3. Transemin IV infusion at 500mg/hr.

**Problem 6:**
Limited physical mobility due to wound pain and sedation.

**Goal setting:** Regain mobilization after off sedation and patient can have maximum self-care in bed.

**Interventions:**
1. Monitor Mr. C’s conscious level continuously.
2. Titrate off the sedation and as prescribed. Administer pain killer (IV morphine) if need. Monitor the effect and side effect.
3. Monitor Mr. C’s limbs power after off sedation.
4. Monitor the serum phosphate, administer sodium phosphate as
5. Give necessary assistance if need and encourage mobilization when awake.

**Evaluation:**
1. Mr. C claims pain can relief after morphine injection.
2. Mr. C can sit up in bed after operation for 12 hours.
3. Mr. C can feed himself after operation for 15 hours.
4. Mr. C’s serum phosphate increase to normal, after sodium phosphate infusion as prescribed.

**Problem 7:**
Anxiety related to Mr. C’s worry about the surgical treatment and disease prognosis.

**Goal setting:** Reduce the anxiety in two days.

**Interventions:**
2. Explain the procedures and reason of being in ICU by simple words and brief statements.
3. Arrange meeting with surgeon for patient and his family.
4. Maintain a clean and quiet place for rest, stay with patient if it appears necessary.

**Evaluation:**
Mr. C showed less anxiety and is less worried than before.

The plan included problem identification, goal setting, intervention, and evaluation. Based on the data collected during the 1st and 2nd level assessment, the patient’s nursing diagnosis could be identified. The RAM allowed nurses to use the NANDA, Roy’s typology, or just simply to state the problems. This made the documentation simply to state the problems. As for the goal setting, the RAM allowed nurse to set short-term goal might be more realistic, because the patient’s condition was changing all the time. So the master care plan should only serve as a guide to nursing care delivery, nurse should continue to assess the patient’s condition and evaluate the nursing care plan on shift-to-shift bases. Intervention was simply to carry out what had been planned; and evaluation would be carried out by assessing the patient’s outcome behaviors.

**Subsequent Patient Progress**

Health assessment and nursing care plan were carried out on the first day of ICU admission. The 1st level health assessment helped nurse to identify Mr. C’s physiological as well as psychosocial problems through the four adaptation modes. The 2nd level assessment helped nurses to differentiate the different factors that contributed to Mr. C’s problems. Seven problems were identified, and an initial nursing care plan was developed. The plan covered Mr. C’s problems, the nursing goal, intervention and evaluation. Health assessment served as a tool based on which Mr. C’s problems could be identified rapidly and systematically; whereas the nursing care plan served as a direction based on which nurses knew how to deliver specific care to meet the holistic needs of Mr. C.

It was noted that the health assessment and planning of nursing care should not be an one-off practice. It had to be
carried out continuously. Nurse needed to perform health assessments of Mr. C at regular intervals (say, in every nursing shift or whenever Mr. C’s condition changed). The nursing care plan was modified as needed. Before extubation, assessing the patient’s physiological function was not difficult, but assessing the psychological state of a ventilated patient did require some skills. Nurses had to use various means to communicate with the patient. Other than observing Mr. C’s body gestures, nurses needed to communicate with Mr. C by means of pencil and paper.

Mr. C stayed in the ICU for nearly 3 days. During his stay, Mr. C was provided with mechanical ventilation at the first of arrival to ICU, and also received mechanical ventilation after off sedation for 6 hours. He was put on sit-up position when the sedation was reduced gradually. After weaned off the ventilator, he was extubated with O₂ mask, and able to cough up moderate white phlegm. The vital signs, central venous pressure (CVP), urine output, air blood gas (ABG), blood clotting were monitored. Tramsmin was used to relieve pain. Nitroglycerin was administered as prescribed to reduce after load, decrease workload of the heart and maintain graft patency. Adrenaline and Dopamine were administered to maintain blood pressure (BP). ECG wave form and wound drainage were closely monitored. Finally, Mr. C’s clinical parameters were stable after stopped Dopamine and Adrenaline IV infusion (an improvement in SpO₂ with 2L O₂ mask, ABG, ECG, no fresh oozing with minimal drainage). Finally he was transferred to a cardiac ward for subsequent management and care.

## Using the Roy adaptation model to guide the health assessment of Mr. C

<table>
<thead>
<tr>
<th>Physiological Mode of Adaptation</th>
<th>1st level assessment</th>
<th>2nd level assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygenation</td>
<td>Mr. C is put on a ventilator with ASV mode and FiO₂ 1.0. PEEP at 5cmH₂O. Pulse oximeter shows SpO₂ at 99%. Cheek sound is clear. Heart sound dual, no murmur. JVP is not elevated. ECG monitor shows: heart rate 100bpm, regular rhythm, BP 98/50mmHg, and MAP at 62mmHg. Peak T wave with ST segment elevation 2 mm at V₂-V₃. Mr. C’s PT is prolonged (12.3seconds), with prolonged INR(1.25). Platelets, aPTT, hemoglobin, and HCT are normal. Mr. C is now put on Tramsmin IV infusion at 500mg/hr, GTN IV infusion at 0.5mg/hr, Dopamine IV infusion at12mg/hr, Adrenaline IV infusion at 15mg/hr.</td>
<td>Air way problem due to sedation and anesthetic effect which suppressed respiratory system. (F) Hypotension is cause by the anesthetic effect and also relate to the history of IHD. (F) Elevated ST segment can due to myocardial injured during operation. (F) Dysfunction of blood coagulation due to using of heparin during operation. (F)</td>
</tr>
<tr>
<td>Neurological Function</td>
<td>Low dose sedation is put on IV infusion. Mr. C’s GCS is E₁VTM₁; pupils equal and sluggishly react to light.</td>
<td>Due to the problem of anesthetic and sedation effect. (F)</td>
</tr>
<tr>
<td>Fluid &amp; electrolytes</td>
<td>Fluid balance is normal. Serum sodium and potassium are both normal.CVP: 3mmHg, Chest drain: drain-A is 110ml, drain-B is 40ml.</td>
<td>No significant problem was identified.</td>
</tr>
<tr>
<td>Nutrition</td>
<td>Mr. C cannot eat food orally. Serum phosphate is low (0.66mmol/L). Total Protein is normal. Blood test result of pre-operation showed serum lipids and lipoproteins were normal.</td>
<td>Decrease phosphate due to fluid shifts and fasting. (C)</td>
</tr>
</tbody>
</table>
Advantages and Disadvantages of RAM

The strength of RAM is a systematic and conceptual nursing theory for nurses to assess the patient in bio-psycho-social adaptive aspects. The physiological mode of adaptation can facilitate in assessment on patient who is critically ill, It guided the assessment systematically level of adaptation and facilitated the management the stimuli to promote patient’s adaptation. It allows different health care professionals to access and communicate efficiently.

Although this model is broad in scope, there’re still some limitations of the model. The limitations, include:
- The terms of RAM are quite complex, nurse need to be trained to use it.
- The judgment of behavior as adaptive or maladaptive will be influenced by the value system of the nurse assessing the client.
- The term “adaptation” generally does not convey a meaning of growth as intended in the model[^4].
Conclusion

The Roy Adaptation Model (RAM) is a systematic and conceptual nursing theory for nurses to assess the patient in bio-psycho-social adaptive aspects. By using a nursing model as a framework to guide the nursing practice will make the direction of care clearer. It enhances nursing care into very detail in ICU. According to this article, it describes how the RAM was used to form a holistic framework for assessing the health problems of a post-op CABG surgery in the ICU and to guide the development of a specific plan of care to meet his bio-psychosocial needs. The ability to perform health assessments to identify the problems of our patients is important characteristic of an advanced nursing practice. CABG Surgery is becoming more common; the requirement of the post-op care is getting higher too. Implementing this model in practice is perceived as having a positive impact on personal sense of nurses as well as on the image of nursing profession as a whole. Using RAM to guide the health assessment and care delivery in a technologically overwhelming unit may help nurses to deliver better care to the patients.

Reference