**MEDICAL REHABILITATION IN PATIENT WITH RIGHT HEMOPNEUMOTHORAX**

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**ABSTRACT** : Hemothorax refers to a collection of blood within the pleural cavity. By deﬁnition this bloody pleural effusion should contain a haematocrit value of at least 50% of the haematocrit of peripheral blood.1Pneumothorax is defined as the collapse of lung due to presence of air between parietal and visceral pleural cavity.This air pushes on the outside of the lung and makes it collapse. In most cases, only a portion of the lung collapses. Patients commonly have pleuritic chest pain, dyspnea, tachypnea, and tachycardia. Breath sounds may be diminished and the affected hemi thorax hyper was resonant to percussion-mainly with larger pneumothorax. Pneumothorax may be described as simple pneumothorax or tension pneumothorax. It can also be classified as open, closed and occult pneumothorax.2,3

Hemopneumothorax is the presence of both blood and air in the pleural cavity and may be caused by blunt or penetrating trauma.Stab wounds are the main cause of penetrating injuries.4,5 Early detection and treatment of hemopneumothorax is of most importance in prognosis of the patient. About 60% of polytraumas are associated with thoracic trauma. 150,000 Americans die due to trauma every year and it is the most common cause of death in the population 50% of patients dying immediately and less than 10-15% surviving until hospital admittance with critical vital signs.6

The traumatic hemopneumothorax is a result of blunt or penetrating trauma. Numerous factors affect the respiratory response. A trauma associated respiratory failure may occur directly or indirectly. An indirectly associated respiratory failure occurs because of pulmonary infection, fibrothorax as a late complication and trauma in a patient with underlying disease. Needle aspiration as a definitive treatment of a hemopneumothorax is an obsolute intervention. The adequate approach to a hemopneumothorax is a complete evacuation of retained clots either by tube thoracotomy. A chest tube is commonly sufficient to accomplish this goal.6

**ABSTRAK** : Hemotoraks mengacu pada kumpulan darah di dalam rongga pleura. Menurut definisi, efusi pleura ini harus mengandung nilai hematokrit minimal 50% dari hematokrit darah perifer.1Pneumotoraks didefinisikan sebagai kolapsnya paru-paru karena adanya udara antara rongga pleura parietal dan visceral. Udara ini mendorong bagian luar paru-paru dan membuatnya kolaps. Dalam kebanyakan kasus, hanya sebagian dari paru-paru yang kolaps. Pasien biasanya mengalami nyeri dada pleuritik, dispnea, takipnea, dan takikardia. Bunyi napas mungkin berkurang dan hemithorax yang terkena beresonansi dengan perkusi-terutama dengan pneumotoraks yang lebih besar. Pneumotoraks dapat digambarkan sebagai pneumotoraks sederhana atau tension pneumotoraks. Ini juga dapat diklasifikasikan sebagai pneumotoraks terbuka, tertutup, dan tersembunyi.2,3

Hemopneumotoraks adalah adanya darah dan udara dalam rongga pleura dan dapat disebabkan oleh trauma tumpul atau tembus. Luka tusuk merupakan penyebab utama luka tembus.4,5 Deteksi dini dan pengobatan hemopneumotoraks sangat penting dalam prognosis pasien. Sekitar 60% dari politrauma berhubungan dengan trauma toraks. 150.000 orang Amerika meninggal karena trauma setiap tahun dan itu adalah penyebab kematian paling umum dalam populasi 50% dari pasien meninggal segera dan kurang dari 10-15% bertahan sampai masuk rumah sakit dengan tanda-tanda vital kritis.6 Hemopneumothorax traumatis adalah akibat dari trauma tumpul atau tembus. Banyak faktor yang mempengaruhi respon pernafasan. Sebuah trauma terkait kegagalan pernapasan dapat terjadi secara langsung atau tidak langsung. Kegagalan pernapasan yang terkait secara tidak langsung terjadi karena infeksi paru, fibrotoraks sebagai komplikasi lanjut dan trauma pada pasien dengan penyakit yang mendasarinya. Aspirasi jarum sebagai pengobatan definitif dari hemopneumotoraks adalah intervensi mutlak. Pendekatan yang memadai untuk hemopneumotoraks adalah evakuasi lengkap bekuan darah baik dengan tabung torakotomi. Sebuah tabung dada biasanya cukup untuk mencapai tujuan ini.6

**INTRODUCTION**

 Hemothorax refers to a collection of blood within the pleural cavity. By deﬁnition this bloody pleural effusion should contain a haematocrit value of at least 50% of the haematocrit of peripheral blood.1Pneumothorax is defined as the collapse of lung due to presence of air between parietal and visceral pleural cavity.This air pushes on the outside of the lung and makes it collapse. In most cases, only a portion of the lung collapses. Patients commonly have pleuritic chest pain, dyspnea, tachypnea, and tachycardia. Breath sounds may be diminished and the affected hemi thorax hyper was resonant to percussion-mainly with larger pneumothorax. Pneumothorax may be described as simple pneumothorax or tension pneumothorax. It can also be classified as open, closed and occult pneumothorax.2,3

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Bed rest and immobilization were widely used in the management of trauma and acute and chronic illness, before the physiologic effects were well understood. It was generally assumed that rest fostered healing of the affected part of the body. What was not appreciated was that immobility and inactivity could be harmful to the unaffected parts of the body.7The dangers of immobilization have been understood for a long time. The often cited 4% to 5% loss of muscle strength for each week of bed rest was derived from studies that involved young healthy test individuals without underlying disease or musculoskeletal conditions. It is likely that the rate of deconditioning is even faster in older adult patients with multiple comorbidities, because ambu­latory function and ability to perform basic ADLs have been shown to decline in one third of hospitalized patients over the age of 70 years.Some of the complications of immobility include orthostatic intolerance, skeletal muscle changes, joint contractures, pulmonary atelectasis, urinary stasis, glucose intolerance, and pressure ulcers.8

In the hemopneumothorax patient is needed a good lung rehabilitation program.Pulmonary rehabilitation (PR) is defined as acomprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education, and behavior change.9

In this case report, 55 years old male diagnosed with hemopneumothorax dextra after water sealed drainage (WSD) procedure was consulted for rehabilitation.

**CASE REPORT**

**INITIAL PRESENTATION**

Male, 55 years old, live on Ratahan, has a major complaint of pain in the right chest due to sharp stabbing. Breathlessness since several hours before admission and patient is referred to the RSUP Prof Kandou. In the hospital patients directly installed WSD on the right chest wall. Currently the patient still feels pain in stab wounds and wounds on the installation of WSD. Due to the installation of WSD patients perform daily activities only in bed. Patient feel mild shortness of breath, especially when he take a breath.

On the physical examination, localic status at thorax looks asimetrical, slightly decrease on right chest, installed WSD and no udem on right thorax. On palpation there are tenderness around the wound, no crepitation on right thorax. On percussion there are normal sound (sonor) at all of lung field, and on the auscultation we found breath of soundare vesicular (+/+), decrease breathing sound on the right lung. no ronchi and no wheezing.Visual analoug scale is 5, in dynamic movement. Range of motion,limited on sholuder.

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**Functional Independence Measure (FIM) 13thDecember 2018 in hospital 1 days post WSD installed**

|  |  |  |
| --- | --- | --- |
| Self care |  | Score |
| 1. Eating
 | Complete independence | 7 |
| 1. Grooming
 | Complete independence  | 7 |
| 1. Bathing
 | Maximal assistance  | 2 |
| 1. Dressing (upper part)
 | Minimal assistance | 4 |
| 1. Dressing (lower part)
 | Minimal assistance  | 4 |
| 1. Toileting
 | Maximal assistance | 2 |
| Sphincters  |  |  |
| 1. Bladder management
 | Complete independence | 7 |
| 1. Bowel management
 | Minimal assistance  | 4 |
| Transfer  |  |  |
| 1. Transfer: chair/wheelchair
 | Supervision | 5 |
| 1. Transfer: toileting
 | Supervision | 5 |
| 1. Transfer: tub/shower
 | Supervision | 5 |
| Locomotion |  |  |
| 1. Locomotion: walk/wheelchair/crawl
 | Supervision | 5 |
| 1. Locomotion: stairs
 | Supervision | 5 |
| Communication  |  |  |
| 1. Comprehension
 | Complete independence | 7 |
| 1. Expression
 | Complete independence | 7 |
| Psychosocial |  |  |
| 1. Social interaction
 | Complete independence | 7 |
| Cognition  |  |  |
| 1. Problem solving
 | Complete independence | 7 |
| 1. Memory
 | Complete independence | 7 |
| Total |  | 97 |

**DIAGNOSIS**

In medical diagnosis, the clinical diagnosis is Hemopneumothorax on WSD, the topical diagnosis is right pleural cavity. Etiological diagnosis is chest trauma. Functional diagnosis is body function, body structure, activities, participation, enviromental factors, and personal factors. The short term goals : Decrease dyspnea and pain while breathing, Increase ROM of the right shoulders, Early mobilization to prevent deconditioning, Relieve anxiety The long term goals : Increase chest expansion / improve lung function, Increase aerobic capacity, Make the patient independent on ADL and vocational activity, Patient have motivation to do the exercises properly and regularly

**REHABILITATION TREATMENT PLAN**

1. Segmental breathing exercise
2. Active range of motion exercise (right and lefr shoulder)
3. Chest wall mobilization
4. Gradual mobilization (sitting, standing and walking)
5. Education to the patient and his family
6. Mental support to the patient and his family
7. Social medic : help in insurance (BPJS) registration

**DISCUSSION**

Hemopneumothorax is the presence of both blood and air in the pleural cavity and may be caused by blunt or penetrating trauma.Stab wounds are the main cause of penetrating injuries, early detection and treatment of hemopneumothorax is of most importance in prognosis of the patient. The respiratory complications of immobility are known to be life threatening. Initial pulmonary alterations result from restricted movement of the chest in the supine position and gravity-induced changes in the perfusion of blood through different parts of the lung. When venous and hydrostatic pressures that are due to gravity are increased in different parts of the lung, then perfusion is also increased.4,5

The balance between perfusion and ventilation is altered during recumbency. A change of position from upright to supine results in a 2% reduction in vital capacity, a 7% reduction of total lung capacity, a 19% reduction in residual volume, and a 30% reduction in functional residual capacity. Vital capacity and functional reserve capacity may be reduced by 25%to 50% after prolonged bed rest. Mechanisms responsible for this may include diminished diaphragmatic movement in the supine position, decreased chest excursion, progressive decrease in ROM of costovertebral and costochondral joints, and shallower breathing with a subsequent increase in respiratory rate.6,7

Regional changes in the ventilation-perfusion ratio in dependent areas occur when ventilation is reduced and perfusion is increased. This may lead to significant arteriovenous shunting with lowered arterial oxygenation. Atelectasis and hypostatic pneumonia may be the ultimate result of these alterations.7,8The intercostal and axillary respiratory muscles for deep breathing gradually lose their strength and overall endurance. Treatment or prevention involves early mobilization, frequent respiratory and frequent position changes. A patient in a recumbent position should be persuaded to perform regular pulmonary and deep breathing and exercises.7

A-55 years old man stabbed on right chest on December 12nd 2018. He started to feels shortness of breath and pain at right chest, he went to emergency room. In a chest X-ray, hemopneumothorax was noted his right pleural cavity and was diagnosed with hemopneumothorax dextra. He was immediattely treated with WSD ( Water Seal Drainage) on right side of chest by surgery department.

In this patient, pain around wound that became the main complaint of the patient. In addition to the pain in wound puncture and WSD installed, the patient also feels worried about the WSD is interested when about to move (standing or walking), so in doing ADL like toileting.





Chest tube application is a surgical procedure so that should be performed in sterile conditions. Insertion point of tube to thoracic thoracic cavity is where the fifth or the sixth intercostal space intersects the posterior axillary line.After insertion of the chest tube, its localization is confirmed by re-performing thechest x-ray to confirmed adequate drainage of pleural air, to shows that the treatment is sufficient, which is the result in 60-90% of the patients.15 Observation of the chest tube include the fluctuation (tidaling) of the fluid level in the water-seal chamber recorded as positive undulation that shows the system is patent and working properly. Constant or intermittent bubbling in the water-seal chamber indicates leaks in the drainage system.14 This patient’s chest tube has undulation and no bubble at the day of examination until the chest tube has been removed, indicates that the chest tube was patent and no air leaks.

To decrease pain and prevent complications, we suggest patient to do some rehabilitation program. Medical rehabilitation programs provided are:9,10

- Segmental breathing exercise

* Chest wall mobilization
* Active range of motion exercise
* Gradual immobilization
* Education to the patient and his family
* Mental support to the patient and his family

In segmental breathing exercise,the patient is asked to inspire and applies pressure to the thoracic cage to resist respiratory excursion in a segment of the lung. When the patient feels the local expansion, the hand resistance is decreased to allow inhalation.This facilitates expansion of adjacent regions in the thoracic cavity that may have decreased ventilation.9.Insertion of WSD in this patient alters his chest wall compliance due to pain on the wound (VAS 5), indicated by reduction of chest expansion to 2 cm at the first day of examination. Therefore we give segmental breathing exercise as a specialize technique to emphasize this specific lung problem. There are 3 segmental expansion that commonly used, which are apical, laterocostal and posterior basal expansion. Each technique uses manual counter pressure to encourage the expansion of a specific part of the lung and restrict the abnormal part of the lung.9 In this patient the counter pressure was applied at the right lateral costal segment of the lung, specifically at the WSD insertion side to restrict that area from expanding during deep inhalation. This technique aims to reduce pain while breathing and encourage expansion of other segments of the lung which not affected by tube insertion wound. On the first, second and third follow up, pain while breathing decreased (VAS 5 → VAS 0) and the chest expansion increased (2 cm → 5cm) indicate that segmental breathing technique was success for this patient.

For breathing exercises, the patient is asked to perform a series of deep breaths under the supervision of the same physiotherapist. The patient is instructed to breathe as deep as possible, slowly. Anchoring during inspiration is not performed during breathing exercises. The patient performs five or six deep breathing exercises, the physiotherapist encourages the patient to perform deeper breathing from the previous exercise. After a period of rest (breathing normally), the cycle is repeated five times. Respiratory pattern measurements lasted for the last two cycles. The whole treatment lasts about five or six minutes. The breathing exercises are performed by the patient in an upright sitting position either on the side of the bed or on the chair.11 This patient was immobile for around 4 days after WSD insertion on right chest and had limitation of right shoulders motion due to pain and fear tube misplacement. Strong emphasize is placed on gradual mobilization and shoulder active range of motion exercise of this patient to restore loss of motion, prevent muscle atrophy and deconditioning syndrome.

To assess the patient's cardiorespiratory fitness progress before and after being given an exercise using spirometry incentives, the 6-minute walking test (6MWT) procedure was performed.The 6MWT is a practical simple test that requires a 100-fthallway but no exercise equipment or advanced training fortechnicians. This test measures the distancethat a patient can quickly walk on a flat, hard surface in aperiod of 6 minutes (the 6MWT). It evaluates the global and integratedresponses of all the systems involved during exercise,including the pulmonary and cardiovascular systems, systemiccirculation, peripheral circulation, blood, neuromuscular units,and muscle metabolism. It does not provide specific informationon the function of each of the different organs and systemsinvolved in exercise or the mechanism of exercise limitation, asis possible with maximal cardiopulmonary exercise testing. Theself-paced 6MWT assesses the submaximal level of functionalcapacity. Most patients do not achieve maximal exercise capacityduring the 6MWT; instead, they choose their own intensityof exercise and are allowed to stop and rest during the test.However, because most activities of daily living are performedat submaximal levels of exertion, the 6MWD may better reflectthe functional exercise level for daily physical activities.18

On the 4thday of treatment, WSD installed on the right chest has been removed and on the 10th day of treatment, the 6MWT are performed. In preliminary assessment T: 110/60 mmHg, HR: 85 x / m RR: 22 x / m, SpO2: 96%. Final assessment after 6MWT. T: 110/60 mmHg, HR: 92x / m, RR: 24 x / m, SpO2: 97%. Obtained a distance of 348 meters which means his aerobic capacity was 3,407 Mets., no complaints of shortness of breath, dizziness or pain in the chest.This patient was given list of activities which are safe to do according to his Mets level and was prescribed low to moderate intensity (Borg RPE 12-13) aerobic exercise such as walking, bicycling for 15-20 minutes duration, with frequency 3-5 times / week. The aerobic exercise was increased in duration from 15 – 20 minute to 20-30 minutes as recommended by American College of Sports Medicine (ACSM).19

An exercise training program is best designed to meet individual health and physical fitness goals. A variety of exercises to improve the components of physical fitness is recommendedfor all adults. The health-related components of physical fitnessinclude cardiovascular (aerobic) fitness, muscular strength and endurance, flexibility,and body composition. When choosing the exercise modalities to be included in an exercise program,the individual’s goals, physical ability, health status, and available equipment should be considered. The principle of exercise program is frequency, intensity, time, and type (FITT)20

Chest wall mobilization exercises are all exercises that combine the active movement of the trunk or limb with deep breathing. The exercise is designed to maintain or improve the mobility of the chest wall, trunk, and shoulder bracelet as it affects postural ventilation or alignment.Chest wall mobilization exercises are also used to strengthen or emphasize the depth of inspiration or controlled expiration. The patient can strengthen expiration, for example, by leaning forward on both flanks or bending the spine while he is expiratory. This pushes the viscera towards the superior toward the diaphragm.21

Chest wall mobilization exercises can be done in 3 types of movement, tailored to the needs and tolerance of the patient. The exercises are: Dean, E: Cardiopulmonary physiology.21

1. Mobilize One Side of the Chest

* + While sitting, allow the patient to bend away from the tight side to extend the hypomobile structure and develop the chest during inspiration
	+ Then, allow the patient to push the clenched hands to the lateral aspect of the chest, bend to the tight side, and expiratory
	+ Continue by allowing the patient to raise his arm over his head to the tight chest and to bend his body away from the tight side. This provides additional stretching of the hypomobile network

2. Mobilizing Upper Chest and Stretching Pectoralis Muscles

* + When the patient is sitting in a chair with both hands locked behind the head, allow him to horizontally abduct both arms (pectoralis major stalling) during inspiration in
	+ Then instruct the patient to unite both elbows and lean forward during expiration

3. Mobilize Upper Chest and Shoulder

* While sitting in a chair, allow the patient to reach with both arms above the head (180° flexion of bilateral shoulder and light abduction) during inspiration and then lean forward on the pelvis and touch the floor during expiration.

This patient had limited joint movement, especially in the right upper limb because of pain. To maintain the ROM upper right extremity, especially the shoulder area, we use active ROM exercises. The ROM examination is a basic technique used for motion checking and is used as a basis for evaluation of movement while in a therapy program. The movement required to complete a functional activity can be assessed. The full movement of the joint segment is called the scope of joint motion (ROM). When moving the body segment through its ROM, all structures in the region are affected: muscles, joint surfaces, capsules, ligaments, fascia, blood vessels, and nerves. To describe the scope of joint motion, use terms such as flexion, extension, abduction, adduction, and rotation. The range of available joint motion is usually measured by a goniometer and recorded in degrees

Indication of active ROM training:22

1. Active ROM is used when the patient can perform muscle contractions and move the segment without the need to be assisted.
2. If the patient is unable to move the segment until it reaches the full ROM, then ROM active practice is assisted in order to achieve full ROM. When the patient is able to achieve full ROM, exercise is performed by providing resistance to the movement of the ROM until the patient can achieve functional movement well
3. If one segment of the body can not be moved, active ROM exercises are used on the lower and upper segments of the body to maintain the condition of the area.
4. Active ROM exercises can use an aerobic exercise program and this exercise can restore posture for the better.

In these patients, there are limitations on the right shoulder ROM. In the patient's first examination, there were limitations to all ROM movements, from extension-flexion, abduction-adduction and external-internal rotation. After a few days of regular ROM exercise, shoulder wheel and dart board, there is improvement with marked improvement in ROM.

In this case, the patient experiences immobility because of difficulty breathing and pain and the inclusion of WSD in his rightchest. Patients feel weak and not strong enough to stand for a while. The program that can be given to patients is to provide a gradual mobilization exercise. Resilience sitting and standing exercises is the main program.

Mobilization of inpatients has a positive effect on the quality of life of patients. Tyedin et al. (2010) emphasizes that patients tend to have a lower quality of life after a stroke and suggest early mobilization to restore it. The study stated that the group who received the mobilization exercise showed significantly improved physical function, compared with the control group. Behnke et al. (2003) also stated improvements in the quality of life of patients with chronic obstructive pulmonary disease. Mobilization has a positive effect on anxiety, depression mood and symptoms of distress. Chang et al. (2008) studied the effects of exercise programs on cancer patients, and found increased mood and symptoms of distress.23

Mental and educational support is mainly given to parents and their families. Low levels of parent and family education affect the success of patient rehabilitation, either during treatment or after outpatient care.

In this case, we provide mental education and support to the patient to practice the deep breathing exercise and chest wall mobilization exercise, and educate to his family to keep the patient diligent in doing the exercises. We also recommends patients to control the surgical polyclinic and medical rehabilitation.

**DAFTAR PUSTAKA**

1. Boersma W G, Stigt J A, Smith H J M.Treatment of Haemothorax. 2010
2. Zarogoulidis P, et al**.** Pneumothorax: from definition to diagnosis and treatment. *Thorac Dis* 2014;6(S4):S372-S376.
3. Metin B, et al. Comparison of different respiratory exercise methods in patients with chest tubes for spontaneous pneumothorax. Turk Gogus Kalp Dama 2016;24(4):717-721
4. Mahmut T, Mehmet E, Mustafa D, Muhammed S, Huseyin A. Approach to Pneumothorax in Emergency Department. Med J of Islamic World Academy of Sciences (Internet). 2015 (cited 2017 Feb 2); 23(3): 98-107. Available from : [*www.journalagent.com.pdf*](http://www.journalagent.com.pdf)
5. © 2015 Trauma.Org. Haemothorax (Chest Trauma Haemothorax). Available at [www.trauma.org](http://www.trauma.org) download February 5, 2018.
6. Mahoozi H R, Volmerig J, Hecker E. Modern Management of Traumatic Hemothorax. Department of Thoracic Surgery, Evangelisches Krankenhaus, Herne, Germany. 2016
7. Halar E M, Bell K R. Phiysical Inactivity: Physiological and functional impairments and their treatment. In: De Lisa’s Physical Medicine and Rehabilitation. Principles and practice. 5thEd. P 1249-72
8. Bartels M, Prince D Z. Acute Medical Conditions. In: Braddom’s Physical Medicine and Rehabilitation. 5th Ed. Chapter 27. P 571-95
9. Nusdwinuringtyas N. Kumpulan Makalah Rehabilitasi Respirasi Ed II. Jakarta: Departemen Rehabilitasi Medik RSCM; 2012
10. Gonzalez P, MelilloN G, MacBruceD K, CuccurulloS J. Pulmonary, Cardiac Rehabilitation. In: Physical Medicine and Rehabilitation Board Review.3rd Ed. Edited by Sara J. Cuccurullo, MD. P668
11. Orfanosl P, Ellis E, Johnston C.Effects of deep breathing exercises and ambulation on pattern of ventilation in post-operative patients.IThe University a/Sydney, Westmead Hospital.
12. Incentive Spirometry. Available from: <http://www.ceu.org/cecourses/981130/ch7.htm>. [Cited: 23rd August 2017]
13. AARC Clinical Practice Guideline. Incentive Spirometry. Available from: [www.rejournal.com](http://www.rejournal.com). [Cited: 23rd August 2017]
14. How to use insentive spirometry. Available from: <https://my.clevelandclinic.org/health/articles/how-to-use-an-incentive-spirometer>. March 2017. [Cited: 23rd August 2017]
15. Insentive Spirometry Chart. Available from: <http://emupdates.com/2009/11/25/incentive-spirometer/untitled/>. [Cited 25th August 2017]
16. Guidelines for the six-minute walk test. American Thoracic Society. RespirCrit Care Med Vol 166. pp 111–117, 2002
17. Exercise Training in Pulmonary Rehabilitation. Available from: <https://www.researchgate.net/publication/261565726_Exercise_Training_in_Pulmonary_Rehabilitation>. [Cited: Sep 7, 2017]
18. Guidelines for the six-minute walk test. American Thoracic Society. RespirCrit Care Med Vol 166. pp 111–117, 2002
19. Tulaar ABM, Wahyuni LK, Wirawan RP, Aliwarga J. Layanan Kedokteran Fisik Dan Rehabilitasi. Perdosri; 2013.
20. General principles of exercise prescription. In: Thompson WR, Gordon NF, Pescatello LS, editors. ACSM’s Guidelines for Exercise Testing and Prescription. 8th Edition. Philadephia: Lippincott Williams & Wilkins; 2010: 152-155.
21. Dean, E: Mobilization and exercise. In Frownfelter, D, Dean, E (eds) Cardiovascular and Pulmonary Physical Therapy: Evidence and Practice, ed 4. Mosby, St. Louis, 2006, pp 263–306
22. Kisner Carolyn, Colby Lynn. Range of Motion. In: Therapeutic Exercise. 6th edition. 2012. Chapter 3. P51-71
23. Kalisch B J, Lee S, Dabney B W. Outcomes of inpatient mobilization: a literature review. 2013