**MEDICAL REHABILITATION IN PATIENT POST AVR AND PDA LIGATION**

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**Abstract:**

Patent ductus arteriosus (PDA), in which there is a persistent communication between the descending thoracic aorta and the pulmonary artery that results from failure of normal physiologic closure of the fetal ductus, is one of the more common congenital heart defects.1 PDA frequently diagnosed in infants, the discovery of this condition may be delayed until childhood or even adulthood.2 Anatomic abnormalities can vary widely and are common in conjunction with complex aortic arch anomalies.3 PDA is sometimes idiopathic (unknown cause). Known risk factors include: Preterm birth, Congenital rubella syndrome, Chromosomal abnormalities (e.g., Down syndrome), Genetic conditions such as Loeys-Dietz syndrome.The estimated incidence of patent ductus arteriosus (PDA) is 1 in 2000 in full-term infants and consists 5 to 10% of all congenital heart disease in children, in US children born at term is between 0.02% and 0.006% of live births.4,5 Patients after heart valve surgery may experience a decrease in physical activity and functional capacity for several years, worsening of bed rest after surgery, difficulty returning to daily life activities, impaired quality of life, depression symptoms, anxiety, and postoperative stress, resulting in this group of patients experiencing an inadequate fitness condition when discharged from the hospital and requires medical rehabilitation, as well as the transition to daily life activities into physical, mental and social challenges.6,7 Exercise is the core program for rehabilitation after heart valve surgery.8

**Key Words:** Heart valve surgery, patent ductus arteriosus, rehabilitation.

**Abstrak:**

Patent ductus arteriosus (PDA),ditandai dengan adanya hubungan persisten antara descending thoracic aorta dan arteri pulmonalis yang diakibatkan oleh kegagalan penutupan fisiologis normal dari duktus janin, adalah salah satu kelainan jantung bawaan yang lebih umum.1 PDA sering didiagnosis pada bayi, penemuan kondisi ini mungkin tertunda hingga masa kanak-kanak atau bahkan dewasa.2 Kelainan anatomi dapat sangat bervariasi dan sering terjadi sehubungan dengan anomali lengkung aorta kompleks. PDA terkadang idiopatik (penyebab tidak diketahui). Faktor risiko yang diketahui meliputi: Kelahiran prematur, sindrom rubella kongenital, kelainan kromosom (misalnya, sindrom Down), kondisi genetik seperti sindrom Loeys-Dietz.Perkiraan kejadian patent ductus arteriosus (PDA) adalah 1 pada 2000 pada bayi cukup bulan dan terdiri dari 5 sampai 10% dari semua penyakit jantung bawaan pada anak-anak, di AS anak yang lahir aterm adalah antara 0,02% dan 0,006% dari kelahiran hidup.4,5Pasien setelah operasi katup jantung dapat mengalami penurunan aktivitas fisik dan kapasitas fungsional selama beberapa tahun, memburuknya tirah baring setelah operasi, kesulitan kembali ke aktivitas kehidupan sehari-hari, gangguan kualitas hidup, gejala depresi, kecemasan, dan stres pasca operasi, yang mengakibatkan sekelompok pasien yang mengalami kondisi kebugaran yang tidak memadai saat keluar dari rumah sakit dan membutuhkan rehabilitasi medis, serta transisi ke aktivitas kehidupan sehari-hari menjadi tantangan fisik, mental dan sosial.6,7 Latihan adalah program inti untuk rehabilitasi setelah operasi katup jantung.8

**Kata Kunci:** Operasi katup jantung, paten ductus arteriosus, rehabilitasi.

**INTRODUCTION**

Patent ductus arteriosus (PDA), in which there is a persistent communication between the descending thoracic aorta and the pulmonary artery that results from failure of normal physiologic closure of the fetal ductus (Picture 1), is one of the more common congenital heart defects. PDA frequently diagnosed in infants, the discovery of this condition may be delayed until childhood or even adulthood. Anatomic abnormalities can vary widely and are common in conjunction with complex aortic arch anomalies.

PDA is sometimes idiopathic (unknown cause). Known risk factors include: Preterm birth, Congenital rubella syndrome, Chromosomal abnormalities (e.g., Down syndrome), Genetic conditions such as Loeys-Dietz syndrome.

The estimated incidence of patent ductus arteriosus (PDA) is 1 in 2000 in full-term infants and consists 5 to 10% of all congenital heart disease in children, in US children born at term is between 0.02% and 0.006% of live births. PDA is found twice as often in females than in males.1 In adulthood a PDA is not often encountered since it is usually discovered and treated during childhood. The mortality of untreated PDA in adults (without correction for the size of the PDA) is estimated to be 1.8% per year. The PDA in adults is usually a coincidental finding during physical examination or echocardiography screening.

Clinically, a PDA has a typical continuous murmur which can be heard at the higher left sternal edge. The other symptoms are: [tachycardia](https://en.wikipedia.org/wiki/Tachycardia) (a heart rate exceeding the normal resting rate), respiratory problems, [dyspnea](https://en.wikipedia.org/wiki/Dyspnea) (shortness of breath), continuous "machine-like" (also described as "rolling-thunder" and "to-and-fro") [heart murmur](https://en.wikipedia.org/wiki/Heart_murmur) (usually from aorta to pulmonary artery, with higher flow during [systole](https://en.wikipedia.org/wiki/Systole) and lower flow during [diastole](https://en.wikipedia.org/wiki/Diastole)), [cardiomegaly](https://en.wikipedia.org/wiki/Cardiomegaly) (enlarged heart, reflecting [ventricular dilation](https://en.wikipedia.org/wiki/Ventricular_dilation) and [volume overload](https://en.wikipedia.org/wiki/Volume_overload)), left subclavicular thrill, [bounding pulse](https://en.wikipedia.org/wiki/Bounding_pulse), widened [pulse pressure](https://en.wikipedia.org/wiki/Pulse_pressure), increased [cardiac output](https://en.wikipedia.org/wiki/Cardiac_output), increased [systolic pressure](https://en.wikipedia.org/wiki/Systolic_pressure), [poor growth](https://en.wikipedia.org/wiki/Failure_to_thrive), differential [cyanosis](https://en.wikipedia.org/wiki/Cyanosis), i.e. cyanosis of the lower extremities but not of the upper body. Patients typically present in good health, with normal respirations and heart rate.

Pulse oximetry/[arterial blood gas (ABG)](http://emedicine.medscape.com/article/1982163-overview) analysis usually demonstrate normal saturation because of pulmonary overcirculation. The echocardiographic findings are typically diagnostic for patent ductus arteriosus (PDA). Findings on chest radiographs range from normal to those consistent for congestive heart failure (CHF). With a small patent ductus arteriosus (PDA), the electrocardiographic (ECG) findings. Cardiac catheterization and angiography is not indicated for the uncomplicated patent ductus arteriosus (PDA).



All patent ductus arteriosus (PDA) should be closed because of the risk of bacterial endocarditis associated with the open structure. Surgical ligation or surgical ligation and division remain the standard treatment of large patent ductus arteriosus (PDA) that require treatment in infancy (see the following image). This is a particularly successful, low-risk procedure. indications for surgical treatment include the following: failure of indomethacin treatment, contraindications to medical therapy (eg, thrombocytopenia, renal insufficiency), signs and symptoms of congestive heart failure (CHF), patent ductus arteriosus (PDA) found in an older infant, Infants found to have an asymptomatic patent ductus arteriosus (PDA) after the neonatal period should undergo surgical ligation preferably before the age of 1 year to prevent future complications of a patent ductus arteriosus (PDA), ductal closure is indicated for cardiovascular compromise (ie, pulmonary complications) and for reduction of the risk of infective endocarditis (subacute bacterial endocarditis).

Aortic regurgitation (AR) is the diastolic flow of blood from the aorta into the left ventricle (LV) as we can see in picture 2. Regurgitation is due to incompetence of the aortic valve or any disturbance of the valvular apparatus. Congenital causes - Bicuspid aortic valve is the most common congenital cause

Acquired causes: rheumatic fever, Infective endocarditis, Collagen vascular diseases, Degenerative aortic valve disease,Traumatic, Postsurgical (including post-transcatheter aortic valve replacement). Abnormalities of the ascending aorta, in the absence of valve pathology, may also cause AR.

Most often, aortic valve regurgitation develops gradually, and your heart compensates for the problem. You may have no signs or symptoms for years, and you may even be unaware that you have the condition. However, as aortic valve regurgitation worsens, signs and symptoms may include: fatigue and weakness, especially when you increase your activity level, shortness of breath with exercise or when you lie down, swollen ankles and feet, chest pain (angina), discomfort or tightness, often increasing during exercise, lightheadedness or fainting, irregular pulse (arrhythmia), heart murmur, sensations of a rapid, fluttering heartbeat (palpitations). The 2014 AHA/ACC guidelines classify progression of chronic aortic regurgitation (AR) into 4 stages (A to D) as follows:Stage A: At Risk of AR,Stage B: Asymptoma-

tic with progressive AR (mild to moderate), Stage C: Asymptomatic with severe AR, Stage D: Symptomatic with severe AR.

Important echocardiographic findings in AR include the following: aortic valve structure and morphology-Bileaflet versus trileaflet, flail, thickening,severity of AR, regurgitant volume, fraction, and orifice area.

Severe acute aortic regurgitation (AR), surgical intervention is usually indicated. Surgical treatment of AR usually requires replacement of the diseased valve with a prosthetic valve, although valve-sparing repair is increasingly possible with advances in surgical technique and technology.

Patients after heart valve surgery may experience a decrease in physical activity and functional capacity for several years, worsening of bed rest after surgery, difficulty returning to daily life activities, impaired quality of life, depression symptoms, anxiety, and postoperative stress, resulting in this group of patients experiencing an inadequate fitness condition when discharged from the hospital and requires medical rehabilitation, as well as the transition to daily life activities into physical, mental and social challenges. Exercise is the core program for rehabilitation after heart valve surgery.

**CASE REPORT**

A 47 years old woman,a housewife,come to outpatient clinic with Chest pain, shortness of breath and limitation in actitivity of daily living, vocational and social activity. Shortness of breath was experienced often by the patient from birth, but lately she felt it more often, shortness of breath appeared especially when she started doing heavy activities. She had been countroled in cardiologist and diagnosed with AR and MR Severe. Since then, the cardiologist advised not to do heavy activities both at school and at home and she did not experience complaints of shortness of breath and chest pain after that, but around February 2017, she got high fever accompanied by chest pain, shortness of breath and coughing.The patient was finally scheduled for surgery on 10 March 2017. Before surgery, he was referred to a dentist and physiatrist and ophtalmologist. Since age 12 year she already diagnosed with a cardiac valve disease.Had stroke at July, 20th 2016, inpatient for 3 weeks, weakness at right side of the body. The patient felt normal (no sequelle) after discharge from hospital.

 On physical examination, BP: Vital signs in normal limit, BMI: 18,73 kg/m2. Neuromuscular Examination in normal limit, MMSE: score 30, mental state: There were anxiety. Motor Control and Balance are adequate. Musculoskeletal in normal limit. Functional status all independent. Echocardiography on 02/03/2017 : AR Severe, Calsification all Cuspis, MR Moderate-Severe, LA and LV Dilatation, Sistolik function LV Global normal, EF 59%. Laboratorium : anemia & lekositosis, trombositopenia. X-foto thorax: Cardiomegaly and EKG : sinus tachicardia. Spirometric exam : Severe restriction. Post valve heart surgery exercises are believed to improve physical and functional capacity, improve quality of life and exercise tolerance. The exercise starts as soon as possible, starting from early mobilization after a stable medical condition has been started since at CCU then continued on the ward. The purpose of early mobilization is to prevent orthostatic hypotension and thromboembolism, increase lung ventilation, functional ability and psychological support. Physical training programs should be given individually according to individual program goals.

Education is an important factor for secondary prevention and adherence to the overall program. Today, patient was totally independent, routinly enjoying social and community activity that covers by his METs. Nowdays the patient is still undergoing therapy and has done the usual activities at home and school.The rehabilitation for this patient to reduce pain, to reduce anxiety,to maintain functional,to educate the patient about rehabilitation program after the operation procedure.



Figure 2. Electrocardiography



Figure 1. Radiologic examination AP chest x-ray



Figure 3. Spirometric Examination

**DISCUSSION**

In this case report, we report a 42 years old female patient, with chief complaints chest pain, shortness of breath. Patients had congenital heart disease since childhood. According to the pediatrician the patient suffered Patent Ductus Arteriosus. Patients can not exercise heavily and exhausted. Since then the shortness of breath is rarely felt by the patient and never bluish lips or cyanosis. In February the patient had a high fever accompanied by chest pain, shortness of breath and coughing. Finally the patient is treated in the heart care room in CVBC and after being treated that the patient suffers from infective endocarditis.

In these patients experienced A since childhood and rarely complained of shortness of breath. is a condition whereby there is a hole between the two pumping chambers of the heart. The defect can be small or large. Patent ductus arteriosus (PDA), in which there is a persistent communication between the descending thoracic aorta and the pulmonary artery that results from failure of normal physiologic closure of the fetal ductus. Infective endocarditis is a major infection and can be life-threatning condition. Gems attack the heart valve and may cause the valve to leak.8

This patient also had Aortic Regurgitation. Aortic regurgitation (AR) is the diastolic flow of blood from the aorta into the left ventricle (LV). Regurgitation is due to incompetence of the aortic valve or any disturbance of the valvular apparatus. Congenital causes - Bicuspid aortic valve is the most common congenital cause[1] Most often, aortic valve regurgitation develops gradually, and your heart compensates for the problem. You may have no signs or symptoms for years, and you may even be unaware that you have the condition. However, as aortic valve regurgitation worsens, signs and symptoms may include: fatigue and weakness, especially when you increase your activity level, shortness of breath with exercise or when you lie down, swollen ankles and feet, chest pain (angina), discomfort or tightness, often increasing during exercise, lightheadedness or fainting, irregular pulse (arrhythmia), heart murmur, sensations of a rapid, fluttering heartbeat (palpitations).

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The Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation provides advice on exercise guidelines after heart valve surgery:14exercise begins at the beginning of hospital treatment,the training program lasts 2-4 weeks for still being treated in hospital or up to 12 weeks in outpatients,the upper body exercises begin when the sternal wound is stableexercise is individualized based on the clinical condition, the basic exercise capacity, ventricular function and type of valve operation (after repair / replacement of mitral valve lower exercise tolerance than the repair / replacement of the aortic valve, if there is no residual pulmonary hypertension).

Exercise can not be given (contraindicated) on condition there is still a surgical wound infections, harvesting of the saphenous vein or radial artery and infectious respiratory secondary to sternotomy, unstable angina pectoris (UAP), endomiokarditis acute arterial embolism pulmonary or phlebothrombosis, arrhythmia due to hemodynamic disturbances, acute obstruction of the left ventricular flow.14

Hemodynamic improvement after valve operation depends on the degree of impairments before surgery and valve lesions. In patients with aortic stenosis and impaired left ventricular function before surgery, hemodynamic ability significantly improved at rest and during exercise after valve surgery. Conversely, patients with mitral valve replacement have lower exercise tolerance.15

A good candidate for exercise training is a patient with aortic valve replacement surgery with good left ventricular function. Patients should first get a submaximal exercise test 2 weeks after surgery to get a recommended exercise guide baseline.16 Dynamic, aerobic and road-like exercises, jogging is preferred over isometric exercise. Although, in the elderly there are problems of muscle weakness, high intensity reinforcement exercises to increase muscle strength and coordination are quite useful.Prescribing exercises includes aerobic exercise and resistance training, and should be determined by intensity, duration, frequency and modalities.14

Upper body exercise should be limited to range of motion and light repetitive or rhythmic type activities until 8 weeks after surgery when sternal wound healing has occurred. Physical activities such as volley ball and swimming can place stress on the sternal wound and should be avoided for 12 weeks. During heart valve surgery, the chest and shoulder muscles become irritated. It is important to improve the flexibility and prevent stiffness during the wound healing process. Exercise done 2 times a day.18

Recovery back to good functional level in patients after heart valve surgery is not as fast as in post-CABG patients, maximal recovery takes 3-6 months after surgery. Exercise training improved gradually throughout life.19

One of the training programs conducted by Kirstine Laerum Sibilitz et al (2013), in 210 patients who undergo heart valve surgery with the following exercise program guide:30

Other sternal precaution for patient to help protect patients after median sternotomy that must follow for 6 weeks

Patient in this case report start ambulation in the roomcare on the day he transfer from CCU, with low grade ambulation, in the morning and afternoon, sitting on the chair, do ADL (toileting) with minimal assistance, practice a save mobilization and transfer from chair due to sternal precaution, and on the next day, patient do walking on hospital corridor with assistance, for several minute, to increase his activity level. The duration of walking in the roomcare and corridor increased from day to day, and for the walking speed, we allow the patient to make his own pace without effort.

Surgical site integrity and pain initially limit upper body exercise after heart surgery. Inappropriate transfer techniques or forceful upper body exercises can cause sternal dehiscence. By 6 weeks, postoperative sternal knitting is complete, and upper body exercise can be liberalized.23

On Day 12, 2 days before patient discharge from hospital, we continue the rehabilitation program and do 6MWT with telemetric guidance, and in 6 minute, patient achieve 285 meters. Base on this test, we calculate patient metabolic equivalent of task (METs) = (0,06 x distance – 0,104 x weight + 0,059 x age + 2,9 ) : 3,5 = 4,67 METs. We give some activity recomendation for this patient due to his functional level based on his METs, include slow walking and basic ADL.

On Day 14, patient discharge from the hospitals (entering the transitional period). We give recomendation to control regularly to the hospital, repeat the activity recomendation and precaution, eat healthy food and arrange a schedule for the cardiac rehabilitation phase II.

After the patient is discharged from the hospital, an exercise program that has been scheduled, there are several times can not be implemented because the patient 3 days had bleeding gums after brushing teeth. Patients also complained limp and looked pale so the exercise program postponed. As long as the patient is treated in CCU or in the ward, we should monitor vital / hemodynamic signs such as blood pressure response, heart rate response, respiratory response. As well as when the patient is discharged from the hospital, there are 2 program sessions that are delayed because the patient's blood pressure is very low, systolic pressure < 90 mmhg. When exercising by walking or cycling, before and after exercise should be checked blood pressure, pulse, and breathing in addition to signs and symptoms of intolerance such as chest pain, very pale, tired, weak pulse and not palpable. Blood pressure should be stable where systolic blood pressure does not drop 10 mmhg or more and diastolic blood pressure rises more than 20 mmhg or above 110-120 mmHg, no shortness of breath and heart rate <130 x / min.15 Exercise can be started at low intensity (heart rate <100x / min) after 2 weeks of heart valve surgery. Increased training is given slowly.

 Goals in transisional periode include reintegration into full community activities and preparation for outpatient CR. The transition period allows for complete wound healing, medical stabilization, and continued functional gains. Patients transition from hospitalization to community independence. Unmonitored aerobic exercise is discouraged at this time. The length of the transition period varies depending on medical and functional recovery. 24

In this transitional period, regular daily activities are resumed. Patients do not participate in any aerobic exercise during this period. Patient take rest at home for 1 week and entering the cardiac rehabilitation phase II on 3th april 2017. Goals in outpatient rehabilitation phase include progressive aerobic conditioning, education, lifestyle modification, and return to vocational and avocational practices.24

 We performed 6MWT on the first visit as an exercise testing, in an effort to adjust the exercise and the patient's functional capacity. The 6MWT test is a simple test, does not require expensive equipment or sophisticated training, usually used in heart failure patients, to test permitted exercise, therapeutic effects and prognosis, as well as in post surgical cardiac patients. This test is conducted upon entering the program and completing the program to evaluate the results of the exercise. 25

Exercise testing is a key component of the initial patient assessment performed when a patient enrolls in a cardiac rehabilitation program, and change in functional capacity has become a common clinical outcome in cardiac rehabilitation programs. Submaximal exercise testing using the 6-min walk test is now used by many cardiac rehabilitation programs both for initial assessment and to document functional outcomes after completion of the cardiac rehabilitation program. The 6-min walk test has excellent patient acceptance because exercise levels during the test closely resemble usual patient activities, and costs of administration are low.26

Walking is regarded as one of the most common and utilitarian activities of everyday life. Rehabilitation programs developed on the basis of this form of activity often constitute the primary method of rehabilitating patients after heart surgery. Walking is considered to be the most utilitarian and the most common of everyday activities. Rehabilitation programs based on this form of movement are effective in cardiac patients, including those after heart valve replacement. 27

This modality does not impose excessive orthopedic stress and walking is the most common type of activity. Stationary-cycle exercise may be advantageous for those with limited tolerance for weight-bearing activity. 28

In addition to the distance walked, ratings of perceived exertion (RPE) and presence and severity of angina and dyspnea are recorded. Blood pressure and heart rate are measured before and after testing.26 Aerobic exercise include warm up and cooling down, and after completing aerobic exercise, patient performed stretching exercise. The warm up prepares the body for more intense aerobic exercise, and might help prevent development of exercise-induced ventricular arrhythmias. The cool down minimizes post exercise hypotension. Gentle muscle and joint stretching before and after exercise minimizes post exercise soreness and improves flexibility. 24

 On the third visite (phase II), we prescribe cycling exercise as additional regiment to increase functional or cardiopulmonar capacity, 3 times a week, intensity 11 – 12 BORG scale for 15 minute, which include warming up 5 minute in 20 RPM; 5 minute in 40 RPM; 5 minute cooling down in 20 RPM. The duration and RPM in cycling will be increased in every visite by adding 5 minute for every visite, untill reach maximal 30 minute in duration and 60 – 80 RPM in speed.

 We give additional ROM exercise for shoulder in full motion after the patient pass the sternal precaution periode, on May 2sd 2017 (8 weeks post op). Surgical site integrity and pain initially limit upper body exercise after heart valve replacement. Inappropriate transfer techniques or forceful upper body exercises can cause sternal dehiscence. By 6 weeks, postoperative sternal knitting is complete, and upper body exercise can be liberalized. Wound breakdown is less of a concern with minimally invasive surgical approaches. Inpatient Cardiac Rehabilitation after heart valve replacement is well tolerated, and attendance at outpatient sessions is greater than 80%. More intense programs are associated with a more rapid achievement of functional goals and greater patient satisfaction.23

 On may 2sd 2017, we evaluate patient improvement in functional capacity by 6MWT and we found that there is improvement in functional capacity (FIM) and exercise tolerance from 285 meters to 294 meters, 315 meters and 365 meters in the end of phase II. Increases in self-reported physical activity level and improved functional capacity through exercise training are reflected in better walk performance at graduation from cardiac rehabilitation. 26

After completing outpatient rehabilitation phase, patient will entering the maintenance phase. To maintain achieved gains, exercise must continue at least twice a week. Exercise three to five times a week is needed to continue the training process.24

The two methods that are typically used to guide intensity in patients with clinically manifest disease are heart rate and ratings of perceived exertion (RPE). The relationship between heart rate and exercise intensity (i.e., power output or peak oxygen consumption, VO2max) is generally quite linear in healthy people and those with cardiovascular disease; therefore, it is appropriate to train an individual at a target rate or within a target heart rate range that will elicit the necessary overload stimulus on the cardiorespiratory system. It involves asking the patient to rate their over-all (not just legs or breathing) body exertion or fatigue, using a scale of 6–20. A value of 6 corresponds to sitting in a chair, and a value of 20 is described as all-out maximal effort to exhaustion. Relative to exercise training intensity, an RPE of 11–12 is equivalent to light to moderate work and a heart rate approximating 50–60% of peak. Training within an RPE range of 12–14 is common among patients with stable cardiovascular disease, in that it is both safe and sufficient to induce improvement in peak VO2 and health.

Post valve heart surgery exercises are believed to improve physical and functional capacity, improve quality of life and exercise tolerance. The exercise starts as soon as possible, starting from early mobilization after a stable medical condition has been started since at CCU then continued on the ward. The purpose of early mobilization is to prevent orthostatic hypotension and thromboembolism, increase lung ventilation, functional ability and psychological support. Physical training programs should be given individually according to individual program goals. Education is an important factor for secondary prevention and adherence to the overall program. Today, patient was totally independent, routinly enjoying social and community activity that covers by his METs. Nowdays the patient is still undergoing therapy and has done the usual activities at home and school.

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