

## Appendix 1

### Key techniques for perioperative pulmonary rehabilitation training (PPRT)

Diaphragmatic breathing: According to the patient's tolerance, he or she should assume a standing position, sitting position, or half-lying position, and relax the muscles of the whole body. The patient or therapist should place their hands on the chest and upper abdomen (the upper edge of the hand should be under the xiphoid process of the sternum) and encourage the patient to expand this area when he/she inhales deeply through the nose. When inhaling deeply, the thorax and upper abdomen (diaphragm position) will rise at the same time. It is important that the patient does not shrug when inhaling. Once the patient has inhaled to the maximum lung volume, he/she should hold their breath for 2–3 seconds. When exhaling, the chest and upper abdomen should contract inwards and downwards. The ratio of suction and exhalation is 1:3, or at least 1:2. In our study, 45 breaths were performed each time, in 3 sets of 15 repeats, with a 1–2-minute rest in between each set.

- (1) Bilateral lower thorax expansion: According to the patient's tolerance, assume a standing position, sitting position, or half-lying position, and relax the muscles of the whole body. The patient or therapist should place their hands on the front and outer side of the 6th–10th quarter rib area, and the patient should be encouraged to expand this area when inhaling deeply through nose. It is important that the patient does not shrug when inhaling. Once the patient has reached the maximum lung volume, the patient should hold his/her breath for 2–3 seconds. When exhaling, the chest and upper abdomen should contract inwards and downwards. The ratio of suction and exhalation is 1:3, or at least 1:2. In our study, 45 breaths were performed each time in 3 sets of 15 repeats, with a 1–2-minute rest in between each set.
- (2) Lung local expansion breathing: According to the patient's tolerance, he/she should assume a standing, sitting, or half-lying position, and relax the muscles of the whole body. The patient or therapist should place their hands on the surface projection of the surgical lung tissue, and the patient should be encouraged to expand this area while inhaling deeply through the nose. It is important that the patient does not shrug when inhaling. Once the patient has reached the maximum lung volume, the patient should hold his/her breath for 2–3 seconds. When exhaling, the surface projection of the surgical lung tissue and the upper abdomen should contract inwards and downwards. The ratio of inhalation to exhalation is 1:3, or at least 1:2. In our study, 45 breaths were performed each time, in 3 sets of 15 repeats, with a 1–2-minute rest in between each set.
- (3) Effective cough training: According to the patient's tolerance, he or she should assume a standing, sitting, or half-lying position. However, if possible, the patient should assume a forward-sitting position when coughing. The patient should relax all muscles in the body. The patient or therapist should place their hands on the chest and upper abdomen (the upper edge of the hand should be under the xiphoid process of the sternum) and encourage the patient to expand this area when inhaling deeply. Once maximum lung capacity is reached, the patient should hold their breath for 2–3 seconds, then suddenly contract the abdominal muscles inward, open the glottis, inhale deeply, and cough. When coughing after the operation, pay attention to protecting the mouth of the drainage tube with the hands to prevent pain and subcutaneous emphysema caused by excessive pressure. In this study, 3 sets of 10 repeats were performed over a 3–5-minute period. The patients were instructed to lie down every 3 hours, especially after a long session.
- (4) Respiratory training device training: To use the incentive spirometer, the patient should assume a standing, sitting, or half-lying position depending on their tolerance. Patients should relax the muscles of the whole body. The mouthpiece should be placed in the mouth and the patient should inhale through the mouthpiece in a manner similar to the diaphragm breathing technique. According to the buoy visual inspection, low flow rate, and extended inspiratory time, the patient should aim to reach the age and gender target volume. Each session was divided into 3 sets of 10 repeats over a 2–3-minute period.
- (5) Stair climbing training: Some patients were accompanied by medical staff. Patients were asked to adjust their breathing rhythm during exercise, such as breathe by shrinking the lips, exhale when exerting, avoid closing up. If there is obvious dyspnea, the patient should take a short rest and continue to exercise as soon as they feel ready. This was performed once a day, for 15–30 minutes.
- (6) Aerobic walking: Under the monitoring of the pulse oximeter, the patient walks at a subjective and slightly faster pace than usual. In the event of chest distress, shortness of breath, etc., patients should slow down, take a proper rest, or stop walking depending on the monitoring situation. Prior to the operation, the target is to walk 400–500 m for 10 minutes each time, and the termination target is to walk 20–30 minutes each time. After the operation, the sessions

should start with 10 minutes of walking each time, and gradually transition to 20–30 minutes each time.

- (7) Ankle pump movement: I. Ankle flexion and extension movement: The patient lies flat or sits on the bed, with the lower limbs extended, the thighs relaxed, and the toes slowly hooked inside so as to face themselves as much as possible. Patients are asked to hold this position for 5–10 seconds, and then the toes will be stretched straight and pressed down to the maximum. Again, patients hold this position for 5–10 seconds, and relax. Patients should practice this 5–8 times every day for about 10 minutes. This can be carried out when the patient is awake, lying in bed, or having an infusion. II. Rotation of the ankle joint: The patient lies on his back or sits on the bed, stretches his legs, relaxes his thighs, centers on the ankle joint, and circles his toes 360 degrees, trying to maintain the maximum range of motion. Patients should practice this 5–8 times every day for about 10 minutes. This can be carried out when the patient is awake, lying in bed, or having an infusion.