

## Health Professional Info

### Lung Volume Recruitment with Manual Resuscitation Bag (LVR bag)

#### What is the LVR bag?

The LVR bag is a modified manual resuscitation bag with an extension and a one-way valve. It assists with breath-stacking, beyond that which an individual can achieve on their own, up to maximum insufflation capacity (MIC). The LVR bag is commercially available as a pre-assembled custom Lung Volume Recruitment Kit (Trudell Medical Marketing Ltd, London Canada).

The LVR bag is NOT an emergency resuscitation device. If used for resuscitation in a closed circuit environment, the LVR bag one-way valve will not allow the individual to exhale and may cause a tension pneumothorax.

The LVR bag consists of:

- + One manual resuscitation bag;
- + One 50 cc corrugated tube;
- + One one-way valve closest to the bag;
- + One screen connector closest to the individual;
- + One mouthpiece;
- + Nose clips (optional); and
- + Caution indicator.

#### Who benefits from LVR bag?

Individuals with weak inspiratory and expiratory muscles and decreased lung volume usually benefit from routine use of a lung volume recruitment (LVR) bag. Weak inspiratory and expiratory muscles are associated with neuromuscular diseases (e.g., amyotrophic lateral sclerosis, muscular dystrophy, post-polio syndrome), spinal cord injury or muscular skeletal conditions (e.g., kyphoscoliosis). The LVR bag is particularly important when the spontaneous peak cough flow (PCF) is < 270 L/min. The individual must be alert, cooperative and able to communicate.

#### Why would you perform LVR bag?

Effective use of the LVR bag may:

- + Increase lung volume;
- + Improve cough effectiveness and secretion clearance;
- + Increase mechanical compliance and thoracic range of motion;
- + Decrease atelectasis; and
- + Increase speech volume.

Cost of the LVR bag is minimal. The LVR bag is the easiest method to initiate lung volume recruitment. LVR bag therapy usually results in an immediate increase in lung volume and improved cough.

## WHEN do you perform LVR bag?

In the absence of contraindications, the LVR bag should be introduced when the PCF is < 270 L/min. In progressive disorders such as amyotrophic lateral sclerosis, the LVR bag may be initiated earlier in the course of the disease when a sudden decrease in vital capacity is noted despite adequate cough.

The LVR bag should be used routinely as part of daily living: at least 2-3 times per day with 3-5 maximum insufflations (lung stretches) per session. It should also be performed as often as required to clear secretions, while ensuring hyperventilation is avoided. The LVR bag, if combined with manually assisted cough (MAC), is best performed before meals and at bedtime to minimize risk of refluxed gastric contents.

## When should you NOT perform LVR bag?

Use of the LVR bag is not recommended in the presence of hemoptysis, recent or current barotrauma, bullous emphysema, severe obstructive pulmonary diseases, significant hypotension and previous adverse experience with LVR bag.

Do NOT use the LVR bag if the individual has an inflated tracheostomy cuff or endotracheal tube. The LVR bag one-way valve will not allow the individual to exhale and may cause a tension pneumothorax. Alternative noninvasive LVR and secretion clearance techniques (e.g., mechanical insufflation-exsufflation) are more appropriate for individuals who are unable to tolerate cuff deflation with an artificial airway

## When do you perform LVR bag with caution?

Caution is advised with use of the LVR bag if the individual has a history of obstructive lung disease or pneumothorax. These individuals should undergo a medical assessment to establish if treatment with the LVR bag is appropriate. Informed consent is necessary if LVR is deemed appropriate despite medical history. If the LVR bag is used for individuals with combined lung disease and either neuromuscular disease or spinal cord injury, a maximum pressure of 40 cmH<sub>2</sub>O is recommended to minimize maximal insufflation pressures and potential barotrauma.

## Where can you perform LVR bag?

The LVR bag can be used in any clinical or home setting with an alert and cooperative individual.

## How do you perform LVR bag?

1. Assess the need for appropriate personal protective equipment. The LVR bag technique may generate droplets increasing exposure to respiratory pathogens.
2. The LVR bag technique is best performed in the sitting position however, can be performed in supine position. The cervical spine must be stable with head and neck well supported if combined with MAC.
3. Establish an individual signal that will identify when MIC has been reached e.g., blinking.
4. With nose clips in place (optional), instruct the individual to take a deep breath and hold.
5. Instruct the individual to place their lips tightly around the mouthpiece to prevent air from escaping.
6. Gently squeeze the LVR bag, coordinating the movement with inspiration. Pay attention for possible leaks between the mouthpiece and the mouth. Squeeze the bag 2-5 times until the lungs are full or when the individual signals that MIC is reached. The individual may feel a gentle stretch in the chest.
7. Once the individual's lungs are full: a) take the mouthpiece out of the mouth; b) instruct the individual to hold the maximum insufflation for 3 to 5 seconds; and c) allow the individual to exhale gently.
8. If secretions are present, instruct the individual to produce a strong cough WHEN AT MAXIMUM INSUFFLATION (instead of gently letting the air out). Combine with MAC when indicated.

9. Repeat steps 4-8, 3 to 5 times.

## Clinical Considerations

- + Nose clips will not be necessary once control of the soft palate is achieved, preventing air from escaping through the nose.
- + Always coordinate gentle LVR bag compression with individual inspiratory effort.
- + Ensure there are no leaks.
- + The LVR bag should be used with an individual initiated spontaneous maximal inspiration, however starting from a more relaxed lung volume such as functional residual capacity (FRC), or end of normal exhalation is sometimes easier when the individual is first learning the technique.
- + Encourage the individual to accept as much air as possible; the added volume should not cause dizziness.
- + Some individuals experience lung and slight chest wall discomfort with the LVR bag technique due to over stretching of soft tissues, this is normal.
- + During the MIC breath-hold period, an individual with tetraplegia and diminished sympathetic tone may develop symptomatic hypotension particularly if upright in a chair. An abdominal binder may be helpful to prevent this. Some individuals may need to be treated in a more recumbent position. The abdominal binder may also increase the effect on the chest wall (thoracic range of motion) by limiting diaphragm descent.
- + Change the interface when mouth leak persists. However, if using a full-face mask, LVR bag therapy becomes a closed system; the LVR bag one-way valve will not allow the individual to exhale and may cause a tension pneumothorax; be attentive to the individual signal that will identify when MIC has been reached.
- + When possible, the individual should be provided the tools to perform the LVR bag technique independently e.g., extend the LVR bag corrugated tubing to allow for more flexibility.
- + Individuals must clearly understand that in most instances, once the LVR bag is prescribed, it should be performed for the rest of their lives even if other forms of LVR and secretions clearance techniques are being used.

## How do you perform the LVR bag with a tracheostomy?

Use of the LVR bag is possible with a cuffless or cuff deflated tracheostomy provided there is adequate patency around the tracheostomy and the stoma is tight to the tracheostomy tube shaft. It is best to cork the tracheostomy and introduce the technique by mouth. The LVR bag may be introduced directly through the cuffless or cuff deflated tracheostomy tube if the vocal cords are functional and the individual is able to hold the augmented lung volume.

## How do you perform the LVR bag post tracheostomy decannulation?

LVR bag therapy is encouraged post decannulation to facilitate secretion clearance. Apply moderate pressure to the stoma site using a skin dressing to control leak through the stoma.

## How do you monitor LVR bag efficacy?

Measure and compare spontaneous Forced Vital Capacity (FVC) and PCF with and without LVR bag. The PCF may further improve with MAC.

## Glossary

FRC	Functional Residual Capacity
FVC	Forced Vital Capacity
LVR	Lung Volume Recruitment
LVR bag	Lung Volume Recruitment with resuscitation bag
MAC	Manually Assisted Cough
MIC	Maximum Insufflation Capacity
PCF	Peak Cough Flow