

Esophageal balloon catheter

Advanced filling volume approach

Esophageal pressure measurement is available on the HAMILTON-G5/S1 and the HAMILTON-C6 ventilators. This User Guide refers to the use of NutriVent and Cooper Surgical esophageal balloon catheters. Instructions vary depending on the catheter type.

While the information contained herein is believed to be accurate, it does not represent an official recommendation from Hamilton Medical, nor may it substitute an opinion, assessment or instructions provided by a trained healthcare professional.

Before proceeding with this advanced approach, see the *Esophageal Balloon Catheter Quick Reference Card* (PN 10067119) for insertion and correct placement.

Step 1: Before you start

1. Actively deflate the balloon with the syringe.
2. During deflation, a negative pressure on the Pes tracing will ensure that the balloon is completely deflated.
3. To equalize the system to the ambient pressure, remove the syringe, and open the stopcock to the ventilator and balloon.
4. Check the ventilator display and make sure the esophageal pressure waveform shows $Pes = 0 \pm 0.5$ cmH₂O to avoid a technical misreading of the value.



To avoid a negative and highly variable pressure in the catheter, avoid filling the balloon during the inspiratory phase.



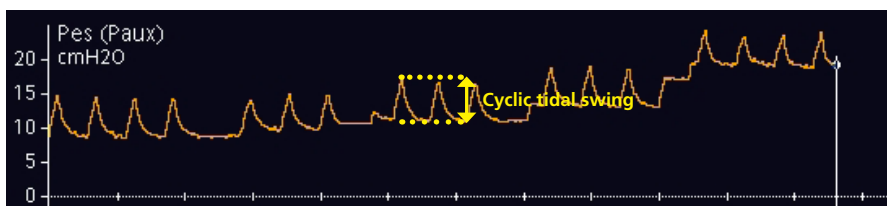
With spontaneously breathing patients, disconnect the syringe during the expiratory phase.

Step 2: Inflate the balloon

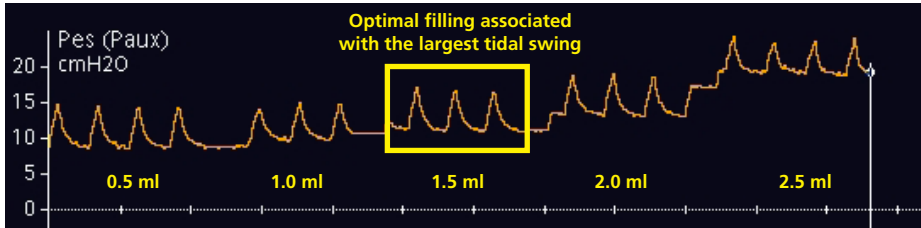
NOTE. Change the timescale of the real-time waveforms to 60 seconds resolution (66 seconds on HAMILTON-C6).

1. Before inflating the balloon and to avoid folds, inject a volume close to its nominal volume into the catheter, and then deflate the balloon to the desired level:
 - a. *NutriVent*: Inflate the balloon with 8.0 ml, then remove 7.0 ml. **1.0 ml remains.**
 - b. *Cooper*: Inflate the balloon with 2.0 ml, then remove 1.5 ml. **0.5 ml remains.**
2. Progressively fill the catheter every 5 to 10 seconds with steps of 0.5 to 1.0 ml.
 - a. *NutriVent*: 1 ml steps from 1.0 to 8.0 ml.
 - b. *Cooper*: 0.5 ml steps from 0.5 to 2.0 ml.
3. Freeze the waveform (using **Freeze** button) before it reaches the end of the time axis.
4. Measure the cyclic tidal swing of Pes at the end of each filling volume step.

NOTE. If excessive cardiac oscillations prevent reliable measurements, pull the catheter back slightly and move it to mid-esophagus to effectively reduce artifacts. Repeat steps 2 to 4.



The optimal filling volume is the lowest volume inside the balloon associated with the largest tidal swing of Pes during mechanical ventilation with constant tidal volumes.



Step 3: Validate the measurement

Once the esophageal balloon is properly placed in the mid-lower third of the esophagus and it is optimally filled, perform a validation test. See the *Esophageal Balloon Catheter Quick Reference Card* (PN 10067119).

Step 4: Catheter attachment

1. Affix the catheter to the patient's nose with medical tape.
2. *NutriVent*: Carefully remove the guide wire and close the cover caps of the gastric line.
Cooper:
 - a. Deflate the esophageal balloon.
 - b. Carefully remove the guide wire and the Y-piece.
 - c. Reconnect the 3-way stopcock, and inflate the balloon with 2.0 ml, then deflate to the optimal filling volume.
 - d. Close the stopcock to the syringe.



Avoid overfilling the balloon. Stop filling the balloon as soon as a sudden and significant increase of the baseline pressure (> 3 to 5 cmH₂O) is detected while approaching the nominal volume of the balloon.



Periodically check the optimal filling volume, at least whenever the intrathoracic pressure is likely to be significantly changed due to changed PEEP setting, patient position, intra-abdominal pressure, and the like.

References

Mojoli F, Torriglia F, Orlando A, Bianchi I, Arisi E, Pozzi M. Technical aspects of bedside respiratory monitoring of transpulmonary pressure. *Ann Transl Med* 2018; 6(19):377. doi: 10.21037/atm. 2018.08.37

Mojoli F, Torriglia F, Giannantonio M, et al. In vivo calibration of the esophageal balloon catheter: a simplified procedure. *Intensive Care Med Experimental* 2016; 4:534.