

## Small manometers improve bag and mask ventilation: a manikin study

Vincent Rigo, Nathalie Kreins, Sandra Eiras da Silva, Tania Marini, Masendu Kalenga

Neonatology division, CHU de Liège, CHR de la Citadelle, University of Liège, Belgium.

---

### INTRODUCTION:

Self-inflating bags (SIB) remain widely used for neonatal resuscitation. Insufflation pressures from SIB are difficult to assess and can be inadequate. Ventilation monitoring improves pressure control, but is not accessible to most resuscitators. Small spring manometer or a pressure line to a needle and dial manometer can be connected through a side port on the SIB. Those devices are cheap and easily available, but their efficacy needs to be assessed. Observation of the manometer could also be considered as a distraction, with increased risk of leak or inadequate insufflation rate. We therefore aimed to evaluate the effect of mechanical manometers on the quality of insufflations with a SIB.

---

### MATERIALS AND METHODS:

Participants to the Belgian Pediatric Society meeting were invited to ventilate a manikin with a 300 ml SIB. The leak-free manikin was modified with a flow-meter at tracheal level connected to a neonatal test lung. Participants had to aim for a 25 mbar pressure and a rate of 40-60 during 3 sequences of 45 seconds. A spring (S), a dial (D) manometer or nothing (N) was added to the SIB in random sequence. Pressure data from the SIB and flow data from the manikin were obtained through a ventilation monitor. Peak pressure (PIP), tidal volume (VTi), and insufflations rate (RR) were calculated for each breath. Theoretical leak was evaluated by subtracting real from theoretical volumes derived from a leak free calibration (taped facemask). Data were analyzed with ANOVA and posthoc Bonferroni.

---

### RESULTS

Five neonatologists (Neo), 15 pediatricians (Ped) and 11 residents ventilated the manikin for a total of 5279 insufflations. Manometer use was associated with an increase in PIP (N:  $17 \pm 6$  mbar; S:  $18 \pm 4$  mbar\*; D:  $19 \pm 4$  mbar\*#) [ $*p < .05$  vs N; # $p < .05$  vs S]. Changes in VTi (N:  $3 \pm 1$  ml; S:  $3.1 \pm 1$  ml\*; D:  $3.2 \pm 1$  ml\*) and RR (77-82 bpm) were small. Leak did not increase. The effect of manometer use on PIP, VTi and leak was more important with Neo (PIP-N:  $16 \pm 7$  mbar; S and D:  $20 \pm 4$  mbar\*) and Ped. With residents, no change occurred in PIP ( $\sim 17$  mbar), Vti (2.9 ml) or leak (31-35%). However, for first sequences of ventilation, manometer use was associated with higher PIP (N:  $12 \pm 4$  mbar; S:  $16 \pm 3$  mbar\*; D:  $20 \pm 4$  mbar\*#), VTi (N:  $2 \pm 1$  ml; S:  $3 \pm 0.8$  ml\*; D:  $3.3 \pm 1$  ml\*#) and lower leaks (N:  $38 \pm 16\%$ ; S:  $27 \pm 12\%*$ ; D:  $34 \pm 13\%*#$ ). This observation for first sequences was found in all 3 categories of providers.

---

### CONCLUSIONS

Bag and mask ventilation remains difficult. In this model, the addition of a manometer is associated with improved pressures and VTi, and with decreased theoretical leak. This effect is predominant for initial (“naïve”) ventilation with a dial manometer, and is also related to operator experience. Small, inexpensive manometers have the potential to improve SIB ventilation of newborn infants.