Heart-lung Interaction in Infants with Heart Insufficiency after Cardiac Surgery

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Introduction:
Heart-lung-interaction, particularly important in heart failure patients, is discussed on the basis of the existing literature and our own studies on infants after heart surgery.

Materials and methods:
We investigated respiratory and circulatory conditions after extubation (1st study, n=60), under post extubational non invasive ventilation (NIV) (2nd study, n=48) and the effects of chest physiotherapy with expiratory flow acceleration (EFA) in ventilated patients (3rd study, n=51). Parameters measured: respiratory: tidal volume (TV), inspiratory pressure (PIP), positive endexpiratory pressure (PEEP), lung compliance (C), airway resistance (R), functional residual capacity (FRC), circulatory: stroke volume (SV), cardiac output (CO), ventricular contractility (ICON), all measured by electrical velocimetry (EV), mitral velocity time integral (MVTI) measured by Doppler ultrasound, blood pressure, urine output, biological: Lactate, base excess (BE), brain natriuretic peptide (BNP), a hormonal marker for ventricular afterload.

Results:
1st study: BNP rises from 554 to 1165 pg/ml (p<0.001), SV decreases from 5.2 to 4.7 ml (p = 0.006), pH moves from 7.41 to 7.38 (p<0.001) with BE from 1.5 to – 0.05 mmo/l (p=0.005), indicating increased afterload, reduced SV and thus impact on metabolism. BNP cut off 379 pg/ml for negativation of BE and of SV 354 pg/ml.

2nd study: 6 h after extubation (patients<5 kg): BNP increases from 716 to 1350 pg/ml (p<0.001) without and from 867 to 1030 (p=ns) with NIV, cardiac output decreases from 0.70 to 0.54 l/min (p<0.05) without NIV and remains stable at 0.7 l/min in the NIV group, indicating hemodynamic stability of extubated patients under post extubational NIV.

3rd study: BNP increases from 305 to 358 pg/ml (p=0.001) without and decreases from 391 to 358 pg/ml (p<0.001) with physiotherapy. SV remains at 5 ml without physiotherapy whereas it rises from 5 to 6 ml (p=0.001) corresponding to a significantly better left ventricular filling measured by MVTI. Respiratory parameters: significant amelioration of C, R and alveolar recruitment (FRC augmentation), correlating well with the hemodynamic parameters, suggesting a positive influence of chest physiotherapy on heart-lung-interaction.

Conclusion:
Infants with postsurgical heart failure present with distinct heart-lung-interaction features that can be positively influenced by post extubational NIV and respiratory physiotherapy.