No long-term complaints in survivors with CPR-related chest wall injuries- despite decreased lung function and a few cases of non-unions.

Monika Fagevik Olsén[1,2], Rauni Rossi Norrlund[2,3], Micheline al Nouh[1], Eva-Corina Caragounis[1,2].

[1]Sahlgrenska University Hospital/Surgery, [2] Sahlgrenska Academy at Gothenburg University, Gothenburg, Sweden [3]Sahlgrenska University Hospital/ Radiology,

Background:

During manual and/or mechanical cardio-pulmonary resuscitation (CPR) a blunt force is applied to the thorax which may damage the chest wall resulting in fractured ribs and sternum, as well as causing intrathoracic and intraabdominal injuries.

Previous non-CPR-related thoracic trauma research has found several consequences of trauma with rib-fractures such as pain, impaired lung function and impaired physical function.

However, there is a lack of studies focusing on long-term chest function after chest wall injury due to cardiopulmonary resuscitation.

Objective:

To investigate long-term chest wall pain, lung function, physical function, and fracture healing after manual or mechanical CPR and in patients with and without flail chest.

Methods

Patients experiencing out-of-hospital cardiac arrest between 2013–2020 and transported to Sahlgrenska University Hospital were identified. Survivors who had undergone a computed tomography (CT) showing chest wall injury were contacted.

Thirty-five patients were included in the study and answered questionnaires regarding pain, physical function, and quality of life. Twenty-five patients also attended a clinical examination to measure respiratory and physical functions. In addition, 22 patients underwent an additional CT-scan to evaluate fracture healing. The patients were divided into groups based on the mechanism of injury (manual vs manual and mechanical CPR) and injury pattern (with and without flail chest).

The CT-scans were examined by one specialised thorax radiologist and the presence of rib fractures and sternal fractures were recorded as well as injuries in the lung parenchyma, mediastinum and upper abdomen.

Pain was examined by questions regarding remaining chest wall pain at rest or during deep breathing, local discomfort, and breathlessness.

Lung function was tested by Forced Vital Capacity (FVC), Forced Expiratory Volume 1 sec (FEV1) and Peak Expiratory Flow (PEF) and respiratory muscle strength by maximal inspiratory and expiratory muscle pressure (MIP / MEP).

Breathing movements were tested by Respiratory Movement Measuring Instrument, RMMI®

Figure 1. Respiratory Movement Measuring Instrument

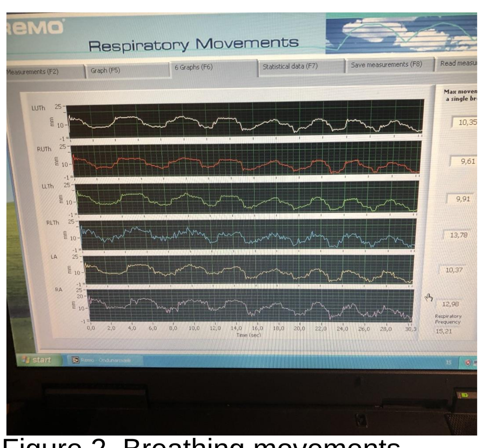

Figure 2. Breathing movements

Thoracic expansion was measured at the level of the 4th costa, and at the xiphoid process. The range of motion in the thorax was examined by thoracic flexion, extension, and lateral flexion and the range of motion in the shoulder by the Boström Index.

Results:

Of the 35 patients who participated 29 were men and the mean age at the time of cardiac arrest was 62 years, ranging between 32 and 83 years. The mean BMI was 26.6 (±4.2) kg/m². Seven patients had lung diseases/conditions, 3 were current smokers and 11 were previous smokers. Eighteen patients had received only manual CPR and 17 patients a combination of manual and mechanical CPR.

The initial CT showed bilateral rib fractures in all but one patient with a mean of 8.5 (SD 3.6) fractured ribs and sternum fracture in 69%. Flail chest was seen in six patients and tended to be more common in the group experiencing manual and mechanical CPR. Apart from lung contusions being more common in the manual CPR patients (72 vs. 57%, $p=0.045$), there was no significant difference in the incidence of thoracic and abdominal injuries

At the time of the follow-up three of the patients had remaining unhealed injuries

None of the patients had persistent pain, however, two patients (6%) experienced local discomfort in the chest wall.

Lung function and thoracic expansion were significantly lower compared to normal/reference values ($p<0.05$). Respiratory muscle strength was within normal values in most of the patients, but eight patients had a MIP and four a MEP below 80% of the predicted. No clinically significant differences were seen between manual and mechanical CPR and in patients with and without flail chest.

Figure 3 shows the results of breathing movements.

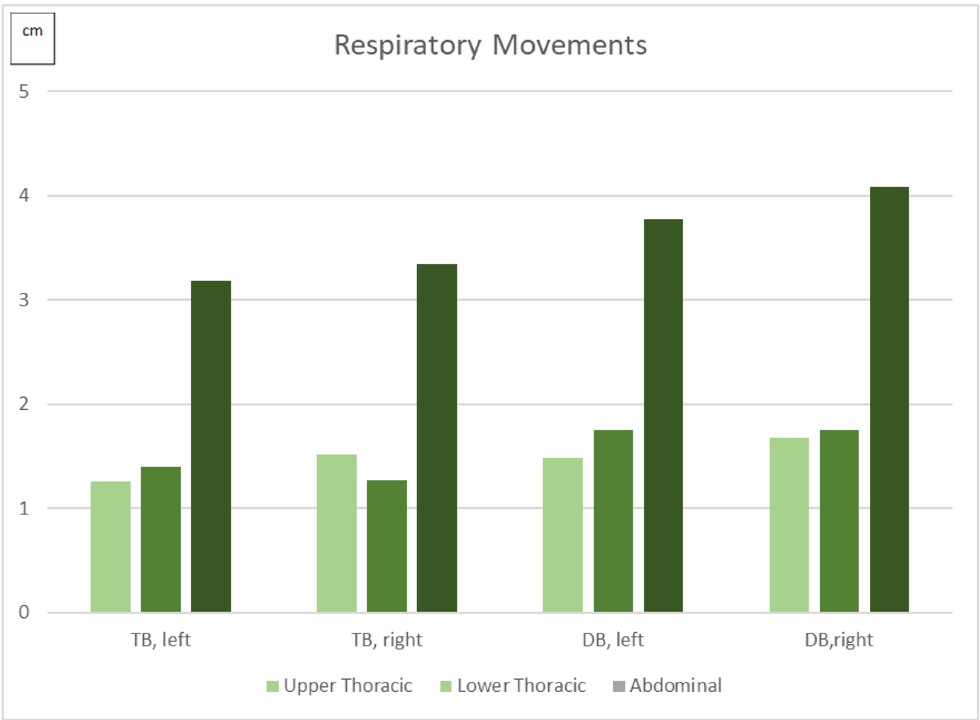

Figure 3, Breathing movements (in mm) in tidal volume breathng and deep breathing)

The predicted lower thoracic excursion was significantly decreased (63.4%; $p<0.001$) but the range of motion in the thorax was normal compared to reference values (92 – 102 %; $p>0.05$).

The mean range of motion in the shoulder was normal compared to reference values. There were no significant differences between those with or without flail chest and between manual or +mechanical CPR (data not shown).

Conclusion:

None of the survivors had persistent pain after the CPR. Despite decreased lower lung function and thoracic expansion, most patients had no limitations in physical mobility. Only minor differences were seen after manual vs. mechanical CPR and with and without flail chest.

The Sahlgrenska Academy

For further information, contact:
Monika Fagevik Olsén
monika.fagevik-olsen@vgregion.se

Region Västra Götaland
Sahlgrenska University Hospital

University of Gothenburg