Title: EFFECTS OF HALOTHANE ON ELECTRICAL ACTIVITY OF RESPIRATORY MUSCLES IN RATS

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Introduction. Halothane induces alterations of the breathing pattern which are related to a decrease in the recruitement of the rib cage, whereas diaphragmatic contribution to breathing process becomes much more predominant.[1] In addition, it has been suggested that a decrease in respiratory muscle tone could account for the reduction in functional residual capacity observed following induction of anesthesia.[2] However, no data are available so far regarding the effects of halothane on intercostal muscle tone, and reports concerning the diaphragm are conflicting.[2] This study was designed to assess the effects of halothane on diaphragmatic, intercostal and abdominal muscle electrical activity in an animal model.

Methods. Ten rats weighing 400-450 gm were studied. The animal preparation was first performed under light halothane anesthesia. The animals were tracheostomized. Electromyographic (EMG) activity of the muscles was recorded from silver fish hooks electrodes surgically inserted in the costal (Dia_{cost}) and crural (Dia_{cru}) parts of the diaphragm, in the parasternal muscle of the third intercostal space (IC) and in the external oblique muscle (Ab). The abdomen was closed and the wires externalized through the incision. EMG signals were filtered between 100 and 600 Hz, amplified (DISA 15G01) and integrated (time constant 100 ms). Both raw and integrated signals were recorded. Tonic activity of the muscles was assessed by the width of the baseline of the raw expiratory EMG signal recorded after high amplification. Phasic activity was assessed by measuring the amplitude of the inspiratory peak, recorded from the integrated signal. The animals were immobilized using a plaster cast which did not impair thoracoabdominal motion and they were allowed to recover from anesthesia. Three hours elapsed before awake measurements were performed. Then, halothane at a concentration of 2% was vaporized with compressed air and oxygène as the carrier gas. After 5 min of halothane exposure, all the rats failed to move in response to tail clamping and a second set of measurements was then performed. Values from EMG signals during halothane are expressed as percent of awake values and given as mean ± SD. Statistical analysis was performed using the paired t test.

Results. The effects of halothane on the electrical activity of diaphragm, intercostal, and abdominal muscle are summarized in the table. Under halothane anesthesia, phasic activity of the crural and costal parts of the diaphragm was significantly reduced whereas no significant change in tonic activity was observed when compared to the control value. By contrast, both phasic and tonic intercostal activity were reduced under halothane anesthesia. No phasic activity was recorded from the abdominal muscles during either the awake or halothane periods. Under halothane, abdominal
muscle tone decreased significantly.

Discussion. The main findings of this study are that halothane depresses only slightly the phasical activity of the diaphragm whereas it markedly reduces both phasic and tonic electrical activity of the intercostal muscles. The discrepancy between diaphragm and parasternal muscles regarding halothane effects may result from a quantitative difference in muscle spindles between these different respiratory muscles. Indeed, intercostal muscles contain far more muscle spindles than does the diaphragm and a strict parallelism exists between tonic activity of a muscle and the number of spindles contained in that muscle. Therefore, cephalad displacement of the diaphragm could be the consequence rather than the cause of the reduced FRC observed under halothane anesthesia.

Table. Results are given as percent of awake values.

	Dia_{cost}	Dia_{cru}	IC	Ab
Phasic activity	74±7*	80±4.5*	35±10.5*	-
Tonic activity	86±10	89±11	27±10**	28±7**

* $p < 0.05$, ** $p < 0.01$ vs control

References

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