SPONTANEOUS BREATH VOLUME AND INTRA-ABDOMINAL PRESSURE DEVELOPMENT WERE RELATED WITH MAGNITUDE OF ISOMETRIC LIFTING EFFORT

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INTRODUCTION

Intra-abdominal pressure (IAP) linearly increases with increased lifting effort to stabilize lumbar spine during lifting [1, 2]. It is known that IAP development was influenced by breath volume, for instance, IAP development was highly elevated as a voluntary respiratory action in inhaling, then, breath holding prior to lift-off [3]. However, it is unknown whether changes in spontaneous breath and IAP development are coupled with lifting effort. The purpose of the present study was to examine changes in spontaneous breath and IAP development with increased isometric lifting effort.

METHODS

Eleven men (22±2years) performed isometric lifting tasks with straight arms and legs, with gripped handle at 2.5cm proximal to the patella, using a lifting device attached load cell at 30%, 45%, 60%, 75%, 90%, 100% of maximal lifting effort, three times for each, in a random order. Subjects practiced the required lifting effort before data collection. IAP was measured with pressure transducer placed intra-rectally, 15cm from the anus [4]. Breath volume was measured by using a pneumotachometer from a face mask. The volume of one inspiratory before just lifting and expiratory volume for a period of 2 s just after the start of lifting were normalized by tidal volume at rest. The change of IAP development was calculated from at rest up to peak during lifting. The subjects were blinded so as not to bias their respiratory behavior. Independent variable was lifting effort. Dependent variables included the respiratory volume parameters and IAP development. Repeated measures ANOVAs were performed to assess statistical significance. Dunnet post hoc performed to assess the significant change compared to tidal volume on these respiratory dependent variables.

RESULTS AND DISCUSSION

A lifting effort had a main effect of the all dependent variables ($p<0.05$). At 30%-100% of maximal lifting effort, the normalized inspiratory volume was increased to 111.7±16.6%, 143.5±15.5%, 161.1±15.4%, 191.9±19.6%, 206.8±15.2% and 235.7±20.8%, by contrast, the normalized expiratory volume was decreased to 50.7±12.7%, 27.6±9.9%, 18.2±7.7%, 13.2±6.3%, 7.2±2.1% and 5.1±1.3%, respectively (mean±SE) (Figure 1). Based on the Dunnet test, the inspiratory volume significantly increased and the expiratory volume significantly decreased compared to tidal volume at lifting effort above 45% and 30% of maximal lifting effort, respectively. The IAP development significantly increased to 18.6±3.2, 35.9±5.6, 49.3±6.3, 72.1±8.8, 95.7±12.4 and 109.6±13.9 (mmHg) respectively. These results suggested that the natural respiratory coupled with lifting effort would be controlled to carry out in efficient manner [5]. Also, both increasing inhalation and avoiding excessive exhalation would be necessary to obtain an effective respiratory mechanism for IAP development [3].

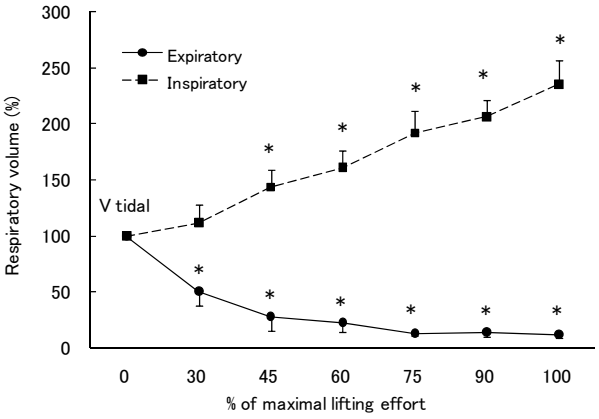

Figure 1: Changes in spontaneous respiratory volume normalized by the tidal volume. Asterisk indicates significant differences from the tidal volume for $p < 0.05$.

CONCLUSIONS

Natural IAP development and respiratory volume are tightly associated with isometric lifting effort.

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