THE BREATHING PATTERNS IN CHINESE AND INDIAN ADULT MALES IN THE SUPINE POSTURE

J C H Yap, Y T Wang, S C Poh

ABSTRACT

The breathing patterns in the supine posture during inspiration from functional residual capacity (simulating the "liver palpation"manoeuvre) were studied in two groups of young adult male Chinese and Indians with each group comprising 30 subjects. Both groups were matched for age, height and weight. Although the findings did not reach a statistically significant level, Indian subjects were found to breathe more with their abdomen compared to the Chinese during the manoeuvre. The two groups behaved similarly when they breathed with increasing amplitude from their resting tidal volume to full inspiratory capacity. There was also no difference between the two groups when they performed the total lung capacity manoeuvre.

Keywords : Breathing patterns, Chinese/Indian males, supine.

SINGAPORE MED J 1990; Vol 31: 225 - 227

INTRODUCTION

Ventilation is brought about by a change in the dimensions of the chest wall which comprises the rib cage (RC), diaphragm and abdomen (AB). In 1967, Konno and Mead (1) showed that the chest wall behaved like a system that moved with two degrees of freedom. When the airway was occluded, the respiratory system then possessed only a single degree of freedom. The movement of one part could only occur when there was reciprocal movement of the other part. Based on this, deflections representing volume change in the two components (RC and AB) can be made to indicate equivalent volumes. This can be accomplished by the isovolume manoeuvre. After this calibration using respiratory inductive phlethysmography (RIP), the displacement can be used to study breathing patterns.

In our clinical practice, liver palpation in Indian patients appears to be easier than in Chinese patients. We felt that Indians breathe more with their abdomen during this manoeuvre. The study by Cheong et al (2) found no significant difference in the breathing pattern between the two ethnic groups when they breathed from function residual capacity (FRC) to total lung capacity (TLC) in the supine position. However the number of subjects studied was small. We have therefore set up a larger study to re-examine the breathing patterns of the two groups in the supine posture.

Department of Medicine III
Tan Tock Seng Hospital
Moulmein Road
Singapore 1130

J C H Yap, MBBS, M Med (Int Med)(S'pore)
Registrar

Y T Wang, MBBS, M Med (Int Med), AM (S,pore), MRCP (UK)
Consultant

S C Poh, MBBS (Mal), AM (S'pore), FRCP (Edin)
Senior Physician & Head

Correspondence to : Dr Yap

PATIENTS AND METHODS

Respiratory inductive phlethysmography (RIP) was used to measure chest wall displacement during various respiratory manoeuvres. The chest wall displacement was partitioned into RC and AB displacements. The breathing loops obtained were displayed on a Philips Digital Storage Oscilloscope PM 3310. RC movements were represented on the Y axis and AB on the X axis. The images were captured on polaroid for later analysis.

The subjects were young male adult Chinese (n = 30) and Indians (n = 30) who were matched for age, height and weight (Table I). All subjects were in good general health and had no history of any respiratory disease. All were non-smokers. Their chest radiographs were normal.

Table I
Characteristics of Subjects

	Chinese		Indian	
	Range	**Mean±SD**	**Range**	**Mean±SD**
Age(yr)	21-32	26.2±3.1	20-32	26.1±3.5
Height(cm)	163-180	170.7±5.3	154-183	170.0±6.3
Weight(kg)	52-77	63.9±8.1	53-78	63.5±8.7

The subjects were studied in the supine position using RIP with thoracic and abdominal belts. All constricting garments were loosened during the study. The calibration of the RIP was achieved using the isovolume manoeuvre at FRC. The subjects then performed the following manoeuvres:breathing during 'liver palpation', breathing with increasing amplitude from resting tidal volume to full inspiratory capacity and breathing from FRC to TLC then back to FRC.

All manoeuvres were done repeatedly until performance was consistent and one example of each manoeuvre was photographed. In the 'liver palpation' manoeuvre, the patients were first instructed with actual abdominal palpation, then abdominal examination was simulated without the examiner's hand on the abdomen.

The patterns of RC and AB displacements during the liver palpation and TLC manoeuvres were analysed by assessing the peak to trough (PT) angle, the percentage contribution of RC and AB, the presence or absence of looping and whether the loop was clockwise or anti-clockwise. The PT angle was obtained by estimating the slope of a line joining the points of "zero flow' i.e. end-inspiratory and end-expiratory, 0^0 meaning sole AB displacement, 90^0 meaning sole RC displacement. The percentage contribution of RC was obtained by dividing the vertical (RC) deflection by the sum of horizontal (AB) and RC deflections and then multiplying by 100. The contribution of AB was obtained by subtracting RC% contribution from 100%. The presence or absence of looping was determined by eyeballing and was used to indicate phase-lag. In the increasing tidal volume manoeuvre, the percentage of the different variety of AB and RC motions were compared between the two groups. The direction of the inspiratory loop as well as any change in direction during the manoeuvre were also analysed.

Comparisons of means were done using unpaired Student's T test with a two-tailed analysis. Percentages were compared using chi-square tests with continuity correction and where appropriate, the Fisher's Exact Test.

RESULTS AND DISCUSSION

Isovolume Manoeuvre

Calibration of the RIP in both Indian and Chinese subjects was reliably performed as evidence by a mean (± SD) angle of 44.6^0 (± 1.3^0) in Indian and 45^0 (± 0.4^0) in Chinese.

'Liver Palpation' Manoeuvre

The mean PT angle in the Chinese (47.8^0) did not differ significantly from that found in the Indians (37.0^0) ($p = 0.09$) (Table II). The Indians tended to have more abdominal displacement (i.e. PT angle < 45^0). Their abdominal contribution to this procedure was 58.6% compared to the Chinese of 47% ($p = 0.07$). The Chinese also had less 'looping'. This means that there was more phase-lag between the RC and AB displacements in the Indians. This difference was not significant. The looping in the Indians were generally in the counter-clockwise direction i.e. the initial part of the inspiratory limb was almost horizontal indicating predominantly abdominal displacement (Fig 1).

Increasing Tidal Volume Manoeuvre

The variety of AB and RC motions involved in increasing the tidal volume are shown in Fig 2. The percentages of subjects showing the different patterns were compared. There was no significant difference between the two groups. As a whole, our subjects behaved similarly to those found in Sharp's study (3) in the supine posture.

Table II
Liver Palpation Manoeuvre Findings

Measurement	Chinese	Indian
PT angle(°)	47.8±23.8	37.0±24.7
RC contribution(%)	53.0±24.3	41.4±25.0
AB contribution(%)	47.0±24.3	58.6±25.0
Looping(%)	23.3	36.7
Direction(%)		
clockwise	46.7	33.3
anti-clockwise	53.3	66.7

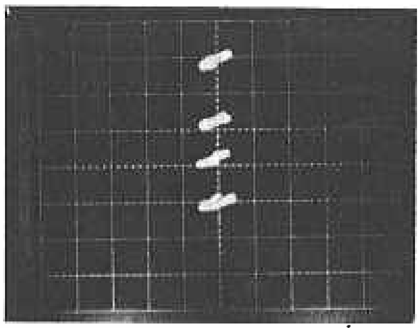


Fig 1
Photograph showing a typical loop of an Indian in the supine position during the "liver palpation" manoeuvre.

Patterns A and B were characterized by an increasing participation of the rib cage with increasing tidal volume. This resulted in a progressively increasing slope of tidal loops as their volume were increased. Pattern B showed an increased abdominal participation at the peak of the breath. As a result, there was a succession of sickle shaped loops with concavities facing the right. Both patterns were commonly found in the two groups (83.4% in Chinese vs 90% in Indians).

Fig 2
Diagram showing the various patterns in increasing tidal volume manoeuvre.

PATTERN	CHINESE	INDIAN	SHARP STUDY
A 	16.7%	30.0%	61.0%
B 	66.7%	60.0%	
C 	6.7%	0%	18.0%
D 	10.0%	6.7%	13.0%
E	0%	3.3%	-
Miscellaneous	-	-	8.0%

In the third pattern, C, inspirations at all volumes began with abdominal predominance. As tidal volume increased further the abdominal volume increase was limited and nearly all further volume increase was accomplished by RC motion. Here the tidal loops took the form of a series of increasingly elongated crescentic loops, partially superimposed and with concavity facing upward and to the left. This pattern was not found in the Indians.

Patterns D was characterized by an unchanging slope of the tidal loops indicating the same relative proportions of rib cage and abdominal displacement at all tidal volumes. This was found in 10% of the Chinese and 6.7% of the Indians.

Lastly, pattern E, which was found in one of the Indians, showed only abdominal displacement throughout the manoeuvre. His PT angle during the liver palpation procedure was zero, while that during the TLC was 10°. He was probably consciously using abdominal muscles during the three manoeuvres.

43.3% of the Indians performed the manoeuvre with initial abdominal displacement in the inspiratory limb as compared with 20% of the Chinese. Looping in the clockwise direction (i.e. RC leading the AB) was seen in 60% of Chinese and 43.3% of Indians. There was also a change from counterwise to clockwise direction of the loops in 20% of Chinese and 13.3% of Indians during the procedure. None of these results showed any significant difference between the two groups.

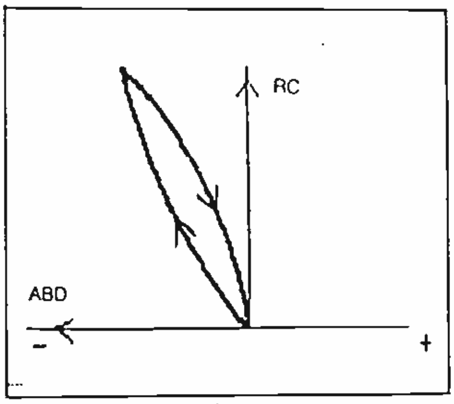
TLC Manoeuvre

The mean PT angle had increased in both the Chinese and Indian subjects to a value of 67.9° and 58.2° respectively (Table III). The result of the Chinese was comparable to that in an earlier study by Cheong et al (2). They found a mean PT angle of 70° during this procedure. However the mean PT angle of their Indians was 72° as compared to ours of 58.2°. The rib cage contribution of both groups was significantly different from that during the 'liver palpation' manoeuvre ($p<0.01$). When comparison was made between the two groups, there was no significant difference. There was also significantly more looping in both groups during this manoeuvre. The rib cage also showed a greater predominance in the inspiratory limb. Paradox breathing was observed in 2 of the Chinese and 3 of the Indians (Fig 3). The RC dominance was so great that the PT angles were > 90° i.e. RC displacement was solely responsible for ventilation, with AB displacement being negative. One Chinese had a PT angle of 90° i.e. vertical loop. This need not mean that the diaphragm was inactive or ineffective. It could be that the abdomen was contracted (thus reducing the AB displacement or even having negative displacement) to give the diaphragm a geometric advantage in displacing the RC through its anterior fibres.

Table III
TLC Manoeuvre Findings

Measurement	Chinese	Indian
PT angle(°)	67.9±18.8	58.2±26.5
RC contribution(%)	72.6±20.4	63.8±27.6
AB contribution(%)	27.4±20.4	36.2±27.6
Looping(%)	70.0	86.7
Direction(%)		
clockwise	86.7	66.7
anti-clockwise	13.3	33.3

Fig 3
Diagram showing loop of paradoxical breathing during TLC manoeuvre.



CONCLUSION

Although the findings showed no significant difference between the two groups, the Indians had a higher abdominal contribution during the "liver palpation" manoeuvre. They also tended to lead more with the abdomen as indicated by more counter-clockwise loops. This could account for our impression that Indian patients are more often abdominal breathers than Chinese patients during the "liver palpation" manoeuvre.

ACKNOWLEDGEMENT

We thank Miss Tan Bee Yian, from the Department of Research and Evaluation, for her help in the statistical analysis.

REFERENCES

1. Konno K, Mead J. Measurements Of The Separate Volume Changes Of Rib Cage And Abdomen During Breathing. J Appl Physiol 1967; 22:407 - 22.
2. Cheong TH, Chan ALW, Koh DR, Wang YT, Poh SC. Breathing Patterns In Young Male Adult Chinese And Indians. Singapore Med J 1988; 29:570 - 4.
3. Sharp JT, Goldberg NB, Druz WS, Danon J. Relative Contributions Of Rib Cage And Abdomen To Breathing In Normal Subjects. J Appl Physiol 1975; 39:608 - 18.
4. Tobin MJ, Chadha TS, Jenour G, Birch SJ, Gazeroglu HB, Sackner MA. Breathing Patterns In Normal Subjects. Chest 1983; 84:202 5.
5. Goldman MP, Mead J. Mechanised Interaction Between The Diaphragm And Rib Cage. J Appl Physiol 1973: 35:197 - 204.