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THE CARDIO-OESOPHAGEAL ANGLE – A QUANTITATIVE RADIOLOGICAL ASSESSMENT

Gurmit Singh,
M.B., B.S.(S'pore), F.R.A.C.S.,
Lecturer,
Department of Anatomy and Histology,
University of Adelaide,
ADELAIDE. 5001.
South Australia.

Joginder Singh,
M.B., B.S. (Bombay), D.M.R.D. (England),
Associate Professor and Head,
Department of Radiology,
University of Malaya.

INTRODUCTION

A MULTIPLICITY OF factors are believed to play a part in the prevention of gastro-oesophageal reflux. However, the actual mechanism is still uncertain. The diaphragmatic crura have been noted to provide an anti-reflux mechanism by narrowing the oesophageal hiatus by means of a "pinch-cock" mechanism. The right crus of the diaphragm splits to encircle the lower oesophagus, and reinforces the circularly-arranged muscle fibres in the oesophagus and the stomach, but others have recorded evidence against this view (Atkinson *et al.*, 1957a). Another factor of some importance is the phreno-oesophageal ligament, which is a condensation of extra-peritoneal connective tissue inserted into the supra-cardiac portion of the oesophagus. This "ligament" merges with the oesophageal musculature and helps to maintain the intra-abdominal position of the cardio-oesophageal junction. The mucosa of this junctional area exhibits folds and together with a hypothetical lower oesophageal sphincter could form a barrier against reflux, (Fyke *et al.*, 1956). The acute angle of entry of the oesophagus into the stomach, is now being recognised as being of major importance since it can provide a flap-like mechanism to resist gastric reflux. This study was designed to quantitate this angle in a representative sample of our patient population.

MATERIALS AND METHODS

A prospective study was undertaken of one hundred patients undergoing Barium meal examination at the University Hospital, Kuala Lumpur, for some gastro-intestinal disorder. They were carefully screened to exclude patients with hiatus hernia and those with symptoms of gastro-oesophageal reflux. An erect, antero-posterior radiograph was taken, and the cardio-oesophageal angle was measured by dropping a perpendicular line through the lower oesophagus, and a tangential line from the convex fundic area of the stomach which meets the oesophagus.

Of the one hundred cases studied, 16 were Malays (9 males, 7 females), 51 were Chinese (29 males, 22 females), and 33 were Indians (22 males, 11 females). This forms a rough cross-section of the total number of patients seen in the Radiology Department of our hospital.

RESULTS

The total number of cases studied was 100 (60 males and 40 females). It was found that the mean (average) cardio-oesophageal angle was 63.8°, with a standard deviation of 10.6°, and a range (85° – 33°) of 52° (Fig. 1).

The mean cardio-oesophageal angle amongst males and females was 65.3° and 61.5° respectively. Although the angle appears to be smaller in females, statistical analysis reveals that there is no significant difference in the cardio-oesophageal angle between males and females.

The mean cardio-oesophageal angle among the 16 Malays, 51 Chinese and 33 Indians examined were 62.9°, 64.0° and 63.9° respectively. It is interesting to note that statistical analysis indicates that the cardio-oesophageal angle shows no significant difference in the three major racial groups in Malaysia. It would be worthwhile to pursue this

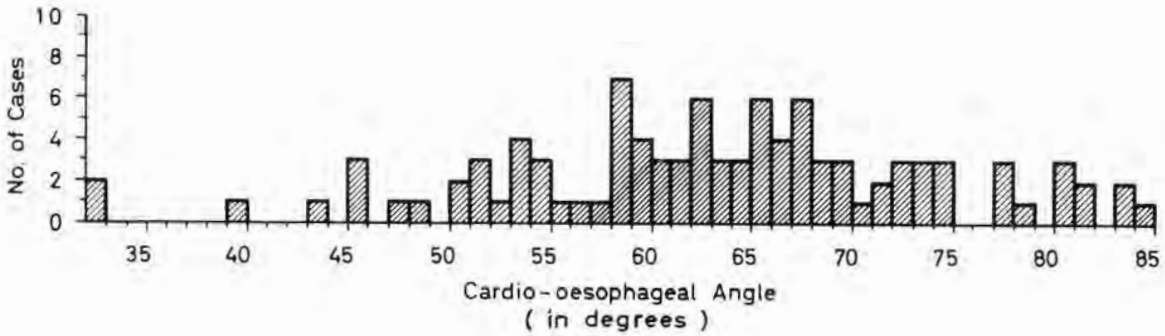

Fig. 1. Distribution of cardio-oesophageal angles in 100 cases examined radiologically.

matter further and relate the incidence of hiatus hernia in the various ethnic groups with the magnitude of this angle.

If the level of significance is set at $p = 0.05$, there is no significant difference in the cardio-oesophageal between Malay and Chinese males and females. However, it is found that a significant difference exists in the Indian population where the females tend to have a smaller angle when compared to males (Table 1).

DISCUSSION

The problem of gastro-oesophageal reflux is one which continually faces the physician, though it is our impression that this problem is relatively rare in Malaysia. It was an attempt to define what constitute the normal cardio-oesophageal angle in our population, and in the two sexes, and various ethnic groups that prompted us to embark upon this study. The angle at which the oesophagus enters the stomach is known as the angle of His, and seems to be of great importance. The acuity of this angle could provide a flap-valve mechanism adapted to resist gastric reflux. There are variations in this angle as seen in radiological examination, and our study showed that it could range from 33 degrees to 85 degrees. Where this angle is obtuse or non-existent, as in infants, and in some types of hiatus hernia, reflux commonly occurs.

However, it must never be forgotten that other factors may also play an important role in providing a barrier against reflux. The existence of a cardio-oesophageal sphincter has been a subject of considerable controversy. Though it has not been demonstrated anatomically, sufficient evidence has accumulated by means of radiology and manometric measurements to confirm the existence of a function sphincter in this area. It is felt that the sphincter maintains a higher pressure in the distal oesophagus than in the gastric fundus, provided that the distal oesophagus remains in an intra-abdominal position. Atkinson *et al.* (1957b) first noted the correlation of low sphincter pressure with gastric reflux, although other studies failed to demonstrate any relationship (Hammond and Daramen, 1962). Edwards (1967) believed that the anatomical disposition of the oesophagus at its passage through the diaphragm is of the nature of a flutter-valve which can be opened

Table I

Mean cardio-oesophageal angle in the various ethnic groups by sex distribution

Malays n = 16		Statistical Analysis	Chinese n = 51		Statistical Analysis	Indians n = 33		Statistical Analysis
Males n = 9	Females n = 7		Males n = 29	Females n = 22		Males n = 22	Females n = 11	
61.1°	65.1°	$t = 1.08$ $p > 0.1$	65.6°	61.9°	$t = 1.20$ $p > 0.1$	66.6°	58.4°	$t = 2.21$ $0.05 > p > 0.02$

easily from above, but the flaps of which close with increase in intra-abdominal pressure. Other authors feel that the lower oesophageal sphincter plays an active part in maintaining a normal cardio-oesophageal angle.

Our study shows that the mean cardio-oesophageal angle is 63.8 degrees, and that there is no significant variation between males and females of Malay and Chinese origin. However, it is seen that this angle is significantly smaller in Indian females compared to Indian males. It would be interesting to see how our figures compare with studies from other centres. It is also suggested that the cardio-oesophageal angle be routinely measured at Barium meal examinations in radiographs taken in the antero-posterior position – a practice not usually undertaken at present. It is felt that a cardio-oesophageal angle which is obtuse or greater than ninety degrees would be more compatible with a diagnosis of gastro-oesophageal reflux than an angle which is acute. In the repair of hiatus hernia, associated with reflux, it would be appropriate for the surgeon to attempt to restore the acuity of this angle.

SUMMARY

The cardio-oesophageal angle was measured, from Barium meals, in a prospective study involving 100 subjects. The results were analysed to obtain the average angle in all subjects and in the two sexes. Further analysis was done to measure the angle in the various ethnic groups in Malaysia, and also in the sexes of the ethnic groups. The average angle were found to be 63.8 degrees. No significant difference was noted in the cardio-oesophageal angle, between males and females, and between the major ethnic groups of Malays, Chinese and Indians. There was also no significant difference between males and females of Malay and Chinese origin, but a significant difference was noted between Indian males and females.

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