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Original Article

Normal Weight of the Heart in Nepalese Adults and its Relation to Body Length: A Postmortem Study

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ABSTRACT:

Background and Objectives: Cardiac enlargement is an independent risk factor for sudden cardiac death. Definitive criteria for cardiac enlargement are not formulated yet in Nepalese adult population as we do not have reference of normal cardiac weight because of lack of study. There is also dearth of data on correlation of heart weight with body length. Hence this study was conducted.

Methods: A cross sectional descriptive study was undertaken at forensic medicine department at Patan hospital for a period of 3 years. The heart was weighed from selected bodies by Mini electronic kitchen scale. Lengths of the deceased were also measured. Cases with natural death, history of medical illness and attempted cardio version and pathological heart were excluded. The data was analyzed by Pearson correlation coefficient to determine correlation. P values less than 0.05 were considered to be statistically significant

Results: Out of 250 cases, there were 173 (69.2%) males with male to female ratio of 7:3. The range of ages in the study is 20 to 58 years in males and 20 to 60 years in females. Range of body lengths in the study are 58 to 68 inches in females and 62 to 73 inches in males. The heart weights ranged from 188 to 575 g with an average of 331 g with an SD of 56.7 g. The heart weighs 252+/- 36 gram in females and 265+/-41 grams in male. In males there was a positive statistical correlation of heart weight with respective body length at p value 0.01.

Conclusion: Males' heart was statistically correlated with body length but same was not seen in females. Males' organs were heavier than that of females'. The heart weights were found to be smaller compared to that of western countries. These results can be taken as a reference of a standard heart weights to differentiate pathological from normal variants in adult Nepalese population

Key Words: autopsy, body length, heart weight, Nepalese adult.

INTRODUCTION:

In an autopsy, the internal organ weight is regularly used as a criterion to differentiate the normal from pathological conditions. It is one of the important indicators of possible organ diseases in forensic pathology as well as in clinical medicine [1-4]. The changes in organ weights compared to the body weight and body length are well recognized in many diseases[5,7].Any decrease or increase in organ weights is suggestive of presence of some underlying disease thus it also helps in determination of exact cause of death in many of the cases[8-19]. The change in the weight of heart can be used to interpret the opinion concerning the cause of death during an autopsy. For example, the increased weight of the heart may be the only evidence to myocardial hypertrophy that is often difficult to recognize macroscopically and microscopically [20-22].The measurement and establishment of normal values of organ weights are not only essential in comparison with the natural diseases but also have significance in determining the effects on the organ weights due to the other manner of deaths such as suicide, accidents and homicide where deaths occurred due to drowning and asphyxiation [9, 23-25] . Likewise the studies are also conducted to analyze the variation that occurs during the human aging process in terms of organ weights[8] .The only method to measure internal organs were used to be autopsies, now with advanced technologies, the researches to standardize internal organ weights are carried

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out with non-invasive methods like CT scans, ultrasonography. However, there are both positive and negative aspects of each method. With aid of these methods not only pathological condition and its progression can be determined but also estimation of segmental volumes of specific organs for transplantation can be done[10].

Increment in organ weights in critically ill patients' performed autopsies after death imply the changes brought by volume resuscitations leading to edema of organs and subsequent changes from ideal organ weights which may contribute to the dysfunction of the organs and slow recovery from the illness. Therefore studies have been made in critically ill children and adults who expired in ICU and their changes in organ weights comparing to the established ideal weights in the respective age groups [27] .Studies and calculations of lethal doses with relation to the affects in organ weights have led to make more accurate doses that can be tolerated by human organs with least adverse effects. For instance in cases of radiotherapy, the radiation tolerance of normal human organs respective to their weights are assessed so as to overcome the negative effects[28-32] .Pharmacological effects on organs and their respective changes in their weights and gross morphology are one of the important analyses done with the concerns of the benefits as well as adverse effects of any drugs in human beings. Such analyses are observed in many species. Effects of the mean lethal dose on the organ weights have been appreciated as changes in doses of a drugs are made, they bring the subsequent changes in organ weights as well[33] .The weight of internal organs can be good diagnostic criteria for interpreting autopsy information if the weights of internal organs are compared to the appropriate reference weights [6, 34].

This means that normality for the weight of heart in a given population should be accurately defined. One of the ways to define this data is to generate reference tables for that population, meaning the average weight to be used as reference information should be generated from the people of that population. Another method that can be used to normalize the information is correlation of heart weights to body length. We often use references of normal adult heart weights from Western countries but many studies have showed that in both sexes of Asian population, weight of heart was lower than that of Western population[4, 5, and 12]. Human heart weight is not only dependable on race, age, gender but also were reported to be dependent on environment, socioeconomic conditions, dietary habits and genetic factors [1, 2, 3, 5] .Therefore the references that are taken from other countries are not applicable to the Nepalese population. These established references should be updated frequently so as to increase their effectiveness and accuracy. No data exists about the standard dimensions of the normal heart in Nepalese populations. Hence, the objective of this study was to evaluate the standard size of the normal heart among Nepalese population and correlate the weight of heart with body length.

MATERIALS AND METHOD:

The cross sectional observational study was undertaken at forensic medicine department at Patan hospital. The heart was weighed from selected bodies that satisfied the criteria for inclusion in the study. The bodies were selected from postmortem cases brought to the department of forensic medicine for a period of 3 years. During this period 250 cases were sampled, and all the autopsies that were used in the study were done by the faculty at forensic medicine department at patan hospital. In the study, subjects who died due to natural causes were not included; this was because the organs in patients may have a variety of morbid anatomical lesions or disease process was considered to be pathological. The assumption was that the ideal subjects for establishing the weight of internal organs would for those dying from accidental and violent deaths are presumed to be healthy[35]. For the purposes of this study, normal heart was defined as the heart from a person who did not have any evidence of any type of disease or infection that would damage that organ: the gross appearance of the organs had to be without any evidence of any type of damage and or pathology. Cases were excluded if there was any known history of medical illness including illicit drug use and if prolonged medical treatment was performed. Cases were also excluded if the individual underwent medical procedures, other than attempted cardio version or intravascular line placement; if there was a prolonged period between sustaining the injuries and death (92 hours); or if accurate measurements of height were not possible. Heart was excluded from analysis if there was significant injury or disruption that could potentially result in an increase or decrease in weight of heart (ie, parenchyma loss, intraparenchymal hemorrhage).

All autopsies were performed within 24 hours of death. The length of the bodies of those individuals who met the criteria for inclusion in the study was measured without shoes. The decedents were measured in supine position from heel to vertex by a measuring tape in inches. All autopsies were conducted in the same manner. The hearts were eviscerated by transecting the inferior and superior vena cavas and the pulmonary veins at the respective cardiac insertions and the pulmonary artery and the aorta just distal to the valves[26]. The hearts were evacuated of all retained blood and blood clot before being weighed on an Mini electronic kitchen scale WH B07 digital scale with a capacity of 3000 g, with corresponding division 0.5g & 0.1g. Heart weights included any epicardial fat present. Any hearts with evidence of pathology, including trauma, were excluded from the study, and any cases where systemic disease was found in another organ (infection) were excluded.

RESULT:

Out of 250 cases, there were 173 (69.2%) males with male to female ratio of 7:3. The decedents ranged from are 20 to 60 years in which 20-58 years in males and 20 to 60 years in females (figure 2). Range of body lengths in the study are 58 to 68 inches in females and 62 to 73 inches in males. Overall, the heart weights ranged from 188 to 575 g with an average of

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331 g and an SD of 56.7 g for entire population. The heart weighs 252+/- 36 gram in females and 265+/-41 grams in males. In male population there was a positive statistical correlation between heart weight and body length at p value 0.01(table 2, figure 1). But same was not seen in females. The regression equation derived for males, heart weight = 4.834 x (body length)-52.667 with R^2 of 0.04. The mean heart weight with its standard deviation for all the study population as well as for males and females is shown in Table 1.

	Heart weight in gram	Heart weight female	Heart weight in male
N	250	77	173
Mean	261.3960	252.2987	265.4451
Std. Deviation	40.05377	36.37454	41.04073

Table 1: Descriptive statistics of heart weights showing mean and standard deviation for entire sample population.

Correlations

		Length	Heart
Length	Pearson Correlation	1	.209**
	Sig. (2-tailed)		.001
	N	250	250
Heart	Pearson Correlation	.209**	1
	Sig. (2-tailed)	.001	

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2: Correlation between heart weight and body length of studied population.

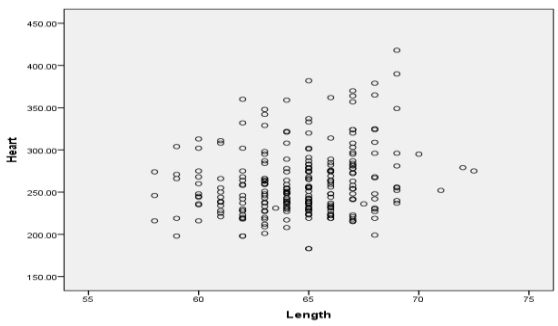

Figure 1: Heart weight-Body length of male population

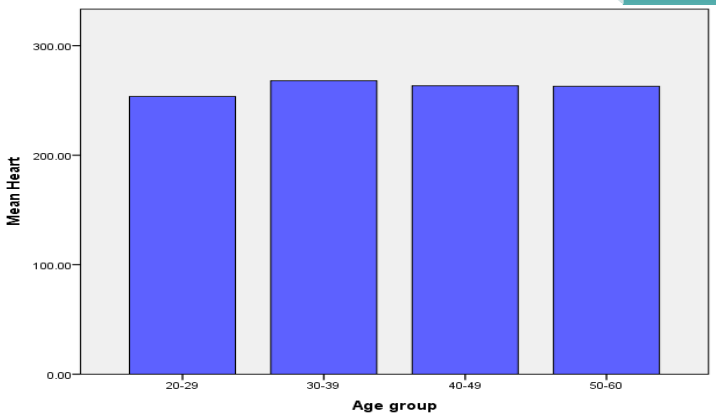

Figure 2: Bar chart showing mean heart weight among different age groups

DISCUSSION:

The heart weight is very important because an abnormal heart weight can be only the indicator of pathology of heart, but there is always a big question that how one defines abnormal. Historical textbooks cite the normal weight of a human heart in adult men to average 280 to 312 g with ranges from 250 to 346 g.[42-45] The Robbins and Cotran Pathologic Basis of Disease states that the normal heart weight for men ranges from 300 to 350 g but varies by length and weight.[46] In addition, several studies have been performed to address this issue and reported the average weight of the heart to range between 236 and 412 g with a full range of 90 to 672 g.[19,34,35] but in this study, we found the average heart weight of 331 g and 252+/- 36 gram in females and 265+/-41 grams in males which is comparatively smaller in our population.

When comparing the previous studies, it can be seen that the average heart weight varies widely and is dependent on the population studied[1,2,3,5]. The definition and criteria of normality poses a lot of hindrances and challenges since it varies from respective authors' views and perception. Establishing a normal group when faced with variations caused by pathophysiological conditions and processes can be very difficult [36].

Therefore non-hospitalized cases were taken in this study as far as possible because in our context every forensic cases, histology is not performed and it is highly dependable upon gross examination, if the deceased was hospitalized for some disease condition then it could be missed in autopsy and may lead to wrong judgment leading to use of incorrect tables. Therefore a non- hospitalized deceased cases subjected to an autopsy would consequently provide controlled material because the heart` in hospitalized cases for autopsies will more probably have disease processes and other morbid anatomical lesions which cannot be considered normal for standardization of norms [6].Such control autopsy cases are easily available in a Department of Forensic medicine especially from cases of unnatural death. With regards to the entire studied population weight of heart was significantly correlated to the body length. Mean organ weight with standard deviation was tabulated and comparison between

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males and females showed that males' heart weight was heavier than females'. The heart weight in this studied population was 261.39+40.05 gm., in males it was 265.44+41.04 gm. and 252.29+36.37 gm. in females. In distribution according to the age groups the heart weight attained its maximum weight in 30 to 39 years of age group. Several authors have argued that it is possible to predict the weight of the heart using biometric measurements of height. Zeek[11]concluded that a person's height is a more stable measurement than body weight and is less affected by pathologic or temporary conditions (such as weight gain, disease processes, etc), and thus, height would be a better indicator of heart weight than body weight: as the body weight is not stable. Many disease processes may lead to variation in body weight. In our studied population there was significant positive correlation between the heart weight and body length in mlales which contradicts with the studies of Zschoch H and Klemm PG [14], Hanzlick and Rydzewski [38], Chirachariyavej et al[5].The female groups didn't show relationship with body length which was consistent with other studies [5,39,40,41].

CONCLUSION:

The weight of heart in male population was positively correlated with body length and in females there was no correlation between heart weights and body length. Males' hearts were found to be heavier than that of females'. When compared with other countries studies with the present, the average heart weights of present study were smaller than that of western countries.

These results can be taken as a reference of a standard heart weights to differentiate pathological from normal variants. However, this study further emphasizes on the need of regular update on standardization of heart weight among Nepalese population with a larger sample size for more qualitative and reliable references. Although, an attempt was made to create a reliable control group by limiting it to the non- hospitalized cases, there were still not confirmatory techniques such as histological examination of the heart, but was only based upon gross examination which can lead to inclusion of heart with any pathological conditions which can be not visualized in gross examination. In this study, an attempt was made to carefully evaluate heart and exclude if apparently affected by pathological processes.

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DECLARATION: I declare that this article has not been published elesewhere.

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