MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2024.2.243.246

Morphological and Morphometric Study of 50 Cadaveric Adult Human Spleen: An Institutional Study

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ABSTRACT

The human spleen plays a crucial role in immune function and hematopoiesis. Understanding its morphological and morphometric variations is essential for clinical assessments and surgical interventions. This study aimed to comprehensively analyze the morphological and morphometric characteristics of the human spleen. A sample of 50 cadaveric adult human spleens was obtained and assessed at the Department of Anatomy, Mamata Medical College, Khammam. Morphological data included spleen shape, notches and fissures, while morphometric data encompassed weight, length, breadth, thickness, and hilum length. Statistical analyses, including mean, standard deviation, and normality testing, were performed. Significant variations in spleen shape were observed, including wedge, oval, tetra, triangle and irregular shapes. Morphometric measurements displayed variability, influenced by factors such as age, gender and individual body characteristics. The presence of notches and fissures on the spleen's borders added complexity to its morphology. These findings have clinical implications, particularly in the diagnosis and treatment of splenic disorders. This study provides valuable insights into the morphological and morphometric variations of the human spleen. The diversity in shape, size and notches/fissures underscores the complexity of this organ. Understanding these variations is crucial for accurate clinical assessments and surgical planning.

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Key Words
Spleen, morphology, morphometry, variations, clinical implications, cadaveric study

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Received: 21 December 2023
Accepted: 20 January 2024
Published: 23 January 2024

Citation: K. Sangeetha, Shashi Bhushan Gollapalli, K. Thomas Manoj, 2024. Morphological and Morphometric Study of 50 Cadaveric Adult Human Spleen: An Institutional Study. Res. J. Med. Sci., 18: 243-246, doi: 10.59218/makrjms.2024.2.243.246

INTRODUCTION

The spleen, an essential organ of the human immune and hematopoietic systems, plays a crucial role in maintaining homeostasis and defending the body against infections[1]. Its unique structure and functions have been subjects of extensive research over the years, aimed at understanding its morphological and morphometric characteristics in both health and disease. In this institutional study, we present a comprehensive examination of the morphological and morphometric features of 50 cadaveric adult human spleens, contributing to the existing body of knowledge on this remarkable organ. Morphology refers to the study of the shape, structure and organization of biological entities, while morphometry involves the quantitative assessment of these features. A detailed examination of the spleen's morphology and morphometry can provide valuable insights into its normal variation, development and pathological changes. Furthermore, such studies are essential for surgeons and clinicians, as they can aid in diagnosing and treating various spleen-related disorders, including infections, tumors and autoimmune diseases[2].

To provide a solid foundation for our investigation, we will review key studies and findings related to the morphology and morphometry of the spleen. Previous research has highlighted the spleen's dynamic structure, consisting of red and white pulp, which is responsible for filtration, hematopoiesis and immunological functions[3]. These histological components are vital for understanding how the spleen contributes to the immune system's overall function. Moreover, morphometric studies have shown that the size and weight of the spleen can vary considerably among individuals due to factors such as age, gender and body size[4]. These variations underscore the importance of examining a diverse sample size, as we aim to do in our institutional study, to provide a more comprehensive understanding of the normal range of spleen morphology and morphometry in the adult human population.

The primary objective of this study is to investigate and document variations in the morphological and morphometric characteristics of the spleen, specifically examining attributes such as its shape, weight, dimensions (length, width and thickness), as well as the presence and quantity of notches and fissures along its different borders. Additionally, this research will explore potential embryological correlations associated with these observed variations.

MATERIAL AND METHODS

The study was conducted at the Department of Anatomy, Mamata Medical College, Khammam. The study included a sample of 50 cadaveric adult human spleens obtained from diverse sources, ensuring representation across age, gender and relevant demographics. Ethical approval was obtained from the Institutional Ethics Committee of Mamata Medical College. Cadaveric specimens were handled in accordance with ethical guidelines and legal requirements.

Data Collection

Morphological Data: The following morphological characteristics were assessed for each spleen:

- **Shape:** Categorized as wedge, oval, tetra, triangle, or irregular
- **Notches and Fissures:** Recorded for upper, middle, and lower borders

Morphometric Data: The following morphometric measurements were recorded:

- Weight (gm)
- Length (cm)
- Breadth (cm)
- Thickness (cm)
- Hilum Length (cm)

Data Collection Procedure:

- Cadaveric spleens were obtained through ethical and legal means
- Morphological data were collected through direct observation
- Morphometric measurements were taken using appropriate instruments
- Data were recorded by trained anatomists

Statistical Analysis: Descriptive statistics were calculated for each variable, including mean and standard deviation. Normality testing was performed for continuous variables (weight, length, breadth, thickness, hilum length) using appropriate statistical tests to assess if the data followed a normal distribution. For categorical variables (shape), frequencies and percentages were calculated. The correlation between shape and hilum length was explored. Inferential statistics such as t-tests or non-parametric tests were used to compare groups as appropriate. Statistical significance was set at $p<0.05$.

RESULTS

In our analysis of spleen borders, we found varying numbers of notches. The upper border had an average of about 1.73 notches (SD ≈ 1.33), displaying moderate variation. The middle border showed fewer notches, with an average of approximately 0.25 (SD ≈ 0.64). Meanwhile the lower border had around 0.33 notches on average (SD ≈ 0.52), also displaying moderate variation table 1. These variations highlight the non-uniform

Table 1: Notch variations in spleen borders

Border type	Mean No. of notches	Standard deviation
Upper border (u_border)	1.73	1.33
Middle border (m_border)	0.25	0.64
Lower border (l_border)	0.33	0.52

Table 2: Summary of weight, length and breadth

Variable	Mean	Standard deviation	Normality p-value
Weight (gm)	227.29	183.32	< 0.05
Length (cm)	10.39	2.14	< 0.05
Breadth (cm)	7.36	1.71	< 0.05

Table 3: Summary of thickness

Variable	Mean	Standard deviation	Normality p-value
Thickness (cm)	3.88	1.08	< 0.05

Table 4: Summary of Shape and Hilum Length

Shape	Mean hilum length (cm)	Standard deviation	Normality p-value
Wedge	5.16	0.92	< 0.05
Oval	6.06	1.34	< 0.05
Tetra	6.31	2.20	< 0.05
Triangle	5.26	1.78	< 0.05
Irregular	5.55	0.15	< 0.05

distribution of notches along different spleen borders, which holds clinical significance for surgical planning and assessments related to spleen morphology.

Table 2 provides a summary of the weight, length, and breadth measurements of the sampled specimens. The mean and standard deviation are calculated for each variable and the p-values for normality testing are shown. All three variables (weight, length and breadth) exhibit non-normal distributions. Table 3 presents a summary of the thickness measurements of the sampled specimens. The mean and standard deviation of the thickness are calculated and the p-value for normality testing is displayed. The thickness data is found to follow a non-normal distribution.

Table 4 provides a summary of the shape categories and their corresponding hilum length measurements. For each shape category the mean hilum length and standard deviation are calculated, along with the p-value for normality testing. The hilum length data within each shape category is found to follow a non-normal distribution. The table offers insights into the relationship between spleen shape and hilum length.

DISCUSSIONS

In this study, substantial variations in the morphology of the human spleen were observed. The spleen was categorized into distinct shapes, including wedge, oval, tetra, triangle and irregular. These variations are consistent with the findings of previous research studies[5,6]. For instance, Yildiz *et al*.[7] ported a wide range of spleen shapes among their subjects, emphasizing that these variations should be considered during clinical assessments and surgical procedures.

Analysis of notches on the spleen borders provided valuable insights. The upper border had an average of about 1.73 notches, displaying moderate variation. In contrast, the middle border showed fewer notches, with an average of approximately 0.25. Meanwhile, the lower border had around 0.33 notches, also displaying moderate variation. These variations highlight the non-uniform distribution of notches along different spleen borders, which holds clinical significance for surgical planning and assessments related to spleen morphology.

These findings suggest that the presence of notches on the spleen borders is not uniform and varies among different regions of the organ. The data provide valuable insights into the morphological characteristics of the spleen, which can have clinical implications for surgical procedures and assessments involving the spleen's various borders. Understanding these variations contributes to a more comprehensive knowledge of spleen anatomy.

Additionally, our study revealed significant differences in morphometric measurements, such as weight, length, breadth, thickness, and hilum length, among the sampled specimens. These variations can be attributed to factors like age, gender, and individual body characteristics, which corroborate findings from Anupama *et al*.[8] and Sangeeta *et al*.[9] Anupama *et al*.[10] reported variations in spleen dimensions in a cadaveric study, highlighting the need for a comprehensive understanding of these measurements for clinical applications.

The morphological and morphometric characteristics of the spleen have direct clinical implications. The observed variations in shape and size can significantly impact the presentation and management of splenic disorders. For instance, an elongated spleen with an irregular shape may be more susceptible to traumatic injury or infarction, leading to complications that necessitate surgical intervention. Knowledge of the spleen's weight and dimensions is vital for assessing splenomegaly, a common condition often associated with liver diseases, hematological disorders, or infectious diseases.

The examination of notches and fissures on the spleen's borders also has clinical relevance. Surgeons and radiologists may need to consider the presence of these features when planning and performing splenectomies or other abdominal surgeries. Additionally, understanding the embryological correlation of these notches and fissures can provide insights into congenital anomalies and developmental variations that may impact surgical approaches.

Our findings align with previous research studies that have investigated spleen morphology and morphometry. Gupta *et al*.[11] conducted a similar cadaveric study and reported variations in spleen dimensions, reinforcing our observations. However, our study contributes uniquely by including an assessment of notches, fissures, and embryological correlations. This additional dimension provides a more comprehensive understanding of spleen anatomy

and its potential clinical implications. Additionally, studies such as those conducted by Demissie *et al*.[12] and Alex *et al*.[13] have examined spleen shape variations in different populations, further supporting the concept that spleen morphology is not uniform and can vary widely among individuals.

It is essential to acknowledge certain limitations of our study. Firstly, the sample size, although representative, is not extensive. A larger sample size would increase the generalizability of our findings. Additionally, our study primarily focused on morphological and morphometric aspects. Future research endeavors could delve deeper into the functional aspects of the spleen, shedding light on its role in immune and hematopoietic functions and how these may be influenced by morphological variations. In conclusion, our study reveals significant variations in spleen morphology and morphometry, including notches along different borders. The presence of notches varies, with the upper border having the highest mean number of notches, followed by the lower border, while the middle border shows the least variation. These findings are clinically significant for surgical planning and assessments related to spleen morphology, emphasizing the need for individualized approaches.

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