

RESEARCH ARTICLE

A STUDY OF TOTAL LEUKOCYTE
COUNT IN DIFFERENT PHASES OF
MENSTRUAL CYCLEShilpa Nandi¹, Reshma Rani²¹ Department of Physiology, Khaja Banda Nawaz Institute of Medical Sciences
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Key Words

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Background: The naturally occurring fluctuations in the levels of sex steroid hormones during the menstrual cycle provide a convenient basis for analyzing the interactions between sex steroid hormones and immune mechanisms. The study estimated total leukocyte count (TLC) in different phases of menstrual cycle.

Aims and Objective: The aim was to study the variations in TLC in three phases of menstrual cycle.

Materials and Methods: The study comprises 100 girls aged between 18 and 25 years. Venous blood sample (2 ml) was collected under aseptic precautions during a single cycle in three phases of their menstrual cycle: on 2nd day, 11th day, and 21st day. Assessment of TLC was done using an automated hematology analyzer.

Results: Significant changes were observed in TLC, during the three phases of menstrual cycle and more so during the secretory phase of menstrual cycle, which is probably due to the hormonal changes during the luteal phase.

Conclusion: The study on changes in leukocyte counts during the menstrual cycle has indicated that there are cyclical fluctuations in the TLC over the course of the menstrual cycle, and the immune response is influenced by changes in hormone status.

INTRODUCTION

The term *menstruation* is derived from the Latin word *menstruus*, meaning monthly. Menstruation is a phenomenon that has appeared very late in evolution and is confined to us and our closest cousins, the primates such as monkey and apes. It is a repetitive phenomenon occurring during the reproductive life of a female that involves structural, functional, and hormonal changes in the reproductive life.^[1] The menstrual cycle alternates between two major phases, the follicular phase, which typically persist for 12–16 days and is characterized by the presence of maturing follicles, and the luteal phase, which most commonly persists for 10–16 days and is characterized by the presence of the corpus luteum in the ovary.^[2] There are three phases of menstrual cycle namely; menstrual phase (MP), proliferative phase (PP), and the secretory phase (SP). The regular cyclic changes may be explained as a phenomenon for periodic preparations for fertilization and pregnancy.^[3] The first menstruation occurs between 11 and 15 years with a mean age of 13 years, and the time of first

menstrual cycle is called menarche. It is more closely related to bone age rather than chronological age. The duration of menstrual cycle is between 21 and 35 days, with a mean of 28 days.^[4] It is suggested that a woman's immune responses are influenced by hormones, and since hormone levels change throughout the menstrual cycle, one would expect her immune responses to also change.^[2] It has long been known that the sex hormones influence or are interrelated with the immune response. Research in the field of immune–endocrine interactions has been ongoing for some time and has provided significant evidence for the role of sex hormones in the immune response such as the differences in immune responses between men and women, the knowledge that gonadectomy and hormone replacement alter the immune response, the observation that the immune response is altered during pregnancy, and the presence of sex hormone receptors on cells of various arms of the immune system.^[5] Numerous studies have been undertaken to examine the changes in various types of blood cell counts and hormonal profile in different phases of menstrual cycle, but results have often been variable and

contradictory.^[6] Hence this study was carried out to assess the variations of the total leukocytes (TLC) in the peripheral blood during different phases of menstrual cycle.

MATERIALS AND METHODS

The study comprised 100 girls aged between 18 and 25 years pursuing MBBS (first year) and BDS (first year) from Navodaya Education Trust, Raichur. Venous blood sample (2 ml) was collected under aseptic precautions during a single cycle in three phases, that is, on 2nd day, 11th day, and 21st day of their menstrual cycle, MP, PP, and SP, respectively, and TLC was estimated using a Sysmex KX-21 automated hematology analyzer. Informed consent was obtained from the students who fulfilled the criteria for the study, and the study was approved by the ethics clearance committee of NMCH and RC, Raichur.

Inclusion Criteria: (i) Women in the age group of 18–25 years; (ii) Women with regular cycles; (iii) Unmarried

Exclusion Criteria: (i) Women with irregular cycles; (ii) Presence of anemia; (iii) History of any gynecological or endocrinal disorder; (iv) Presence of infection

RESULTS

Using the automated analyzer, we calculated TLC and the obtained data and baseline parameters such as age, height, weight, and BMI were tabulated. 95% CI for the mean TLC is shown in Figure 1. A two-tailed p -value <0.05 was considered as statistically significant. The significance of difference among the groups was assessed by repeated-measures analysis of variance (ANOVA).

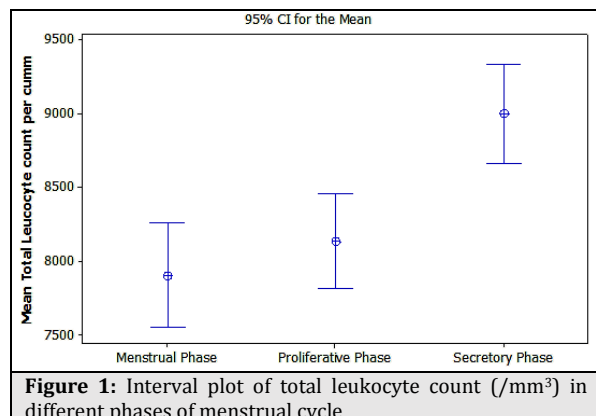


Table 1: Anthropometric measurements of the subjects (n = 100)

Parameters	Minimum	Maximum	Mean ± SD
Age (years)	18	19	18.03 ± 0.171
Height (meters)	1	2	1.52 ± 0.018
Weight (kg)	40	70	51.69 ± 5.462
BMI	18	30	22.39 ± 2.13

Table 2: Repeated-measures ANOVA with post hoc test of results for various leukocyte counts during different phases of menstrual cycle

Parameters	Menstrual phase	Proliferative phase	Secretory phase	F-value	p-value
Total leukocyte count (per cumm)	7908 ± 1784.7	8140 ± 1614.9	9002 ± 1714.5	21.025	<0.0001

Post hoc test: MP vs. PF, $q = 1.845$, $p > 0.05$; MP vs. SP, $q = 8.702$, $p < 0.001$; PF vs. SP, $q = 6.857$, $p < 0.001$

Total Leukocyte Count

The mean ± SD values of TLC were found to be 7908±1784.7, 8140±1614.9, and 9002±1714.5 in MP, PP, and SP, respectively. The TLC increased in PP and SP when compared to MP, and the rise in SP was statistically significant ($p < 0.001$) when compared with PP and MP.

DISCUSSION

The study was carried out to assess the changes in TLC during three phases of regular menstrual cycle. The TLC was estimated during the MP, PP, and SP of regular menstrual cycle in 100 female students.

The TLC was 7908 ± 1784.7, 8140 ± 1614.9, and 9002 ± 1714.5 in MP, PP, and SP, respectively. Significant changes were observed in TLC during three phases of menstrual cycle. Neuroendocrine regulation of immune responses is suggested during an ovarian cycle, which may be critical for embryonic implantation and pregnancy. In our study, the observed percent change in TLC in the SP corroborated by earlier studies and is due to an increase in all subpopulations (lymphocytes, monocytes, and granulocytes). Estrogen seems to enhance proliferation of granulocyte *in vitro*.^[6]

Reproductive processes such as ovulation and menstruation are influenced by the immune system. This results in a sexual dimorphism in the immune response in humans.^[7] A significant increase in granulocyte numbers was found during pregnancy and in the luteal phase when compared to the follicular phase of the normal ovarian cycle, which suggests a role of progesterone and estrogen in increasing the number of granulocyte from the bone

marrow.^[8] It has been shown that progesterone enhances chemotactic activity of neutrophils, whereas estrogens decreases the activity.^[9] Diseases mediated by excessive antibody production such as systemic lupus erythematosus tend to get worse during pregnancy^[10] and in the luteal phase of menstrual cycle.^[11] The reason may be that both the luteal phase and pregnancy are associated with a type 2 immune response, shifting immunity away from the cell-mediated immunity response. Several studies have shown that the levels of inflammatory markers in healthy women are influenced by menstrual cycle changes, but one study conducted during menstrual cycle did not show any significant differences in the inflammatory markers in women with appendicitis, and it seems that day-to-day variations in sex hormones during the cycle have led to very different conclusions about the inflammatory markers in different phases of menstrual cycle.^[12] In our study, a significant change was observed in the TLC during different phases of menstrual cycle.

CONCLUSION

The study of changes in leukocyte counts during the menstrual cycle has indicated that there are cyclical fluctuations in the TLC over the course of the menstrual cycle, and that the immune response is influenced by changes in hormone status.

It points to the need for determining the role that variation in immune cell levels may have in women's immune response and might lead to therapeutic

implications in autoimmune diseases.

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