The Effect Of Neon Light In The Clinical Laboratory On Bilirubin Levels

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ABSTRACT

The average number of patients served by the Grogol Health Center in the general polyclinic is 40 to 45 patients every day. Based on these data, there is a buildup of 7-10 patients, with an average service time of 10 minutes per patient. From the results of further observations, there is a buildup of patients in the general polyclinic of the Grogol Health Center. This study aims to solve the queue problem with the line balancing method and develop an online registration application at the Grogol Health Center that can increase the efficiency of the patient registration process and reduce waiting time. Line Balancing is a method for solving queue system problems. So that the results of this study are the creation of an integrated application and online registration that can reduce waiting time

KEYWORDS

Bilirubin, Neon Light, Clinical Laboratory, Light Exposure, t-test.

INTRODUCTION

Bilirubin is a yellow pigment formed from the breakdown of hemoglobin in red blood cells and plays an important role in the body's metabolism, particularly related to liver function and the bile ducts (1,2,10). Bilirubin is divided into two main types: unconjugated (indirect) bilirubin and conjugated (direct) bilirubin. Monitoring bilirubin levels in the blood is crucial for the diagnosis and management of various health conditions, such as jaundice, liver disorders, and hemolytic anemia (3,4,5,9).

However, one characteristic of bilirubin that needs to be considered in laboratory testing is its sensitivity to light. Bilirubin, especially unconjugated bilirubin, can undergo photodegradation when exposed to light, including the neon light often used in laboratory and hospital settings (6,7,8,15). This photodegradation process causes bilirubin to convert into more water-soluble compounds, potentially affecting the results of bilirubin level tests in blood samples. This phenomenon presents challenges in laboratory sample management, where unwanted light exposure can lead to inaccurate measurement results (12,14). Neon lights, widely used in medical environments due to their efficiency, emit light with sufficiently high intensity. This study aims to evaluate the effect of neon light exposure on bilirubin levels in blood samples (6,7,13). By understanding this effect, it is hoped that better protocols can be developed for handling blood samples to prevent decreases in bilirubin levels due to light exposure, ensuring clinical examination results remain accurate and reliable. Light intensity also plays a role in the reduction of bilirubin levels; the higher the light intensity, the faster the photoxidation process occurs. Blood samples intended for bilirubin level testing should be protected from light exposure to achieve accurate results. Blood samples should ideally be stored in dark tubes and examined promptly or kept in a dark refrigerator (7,14,15).

Photoxidation is a chemical reaction that occurs when a molecule interacts with light. In the context of bilirubin, light (in this case, visible light from neon lamps) provides sufficient energy to trigger chemical reactions in bilirubin molecules. The structure of the bilirubin ring is complex with double bonds. These double bonds are susceptible to attack by free radicals. Unconjugated bilirubin is more likely to undergo photoxidation than conjugated bilirubin because unconjugated bilirubin has a more open structure and more double bonds that can react with light (2,7,8). Factors influencing bilirubin photoxidation include light intensity: the higher the light intensity, the more energy is absorbed by bilirubin molecules, leading to a faster photoxidation process; the wavelength of light: blue light has higher energy compared to red light, making it more effective in triggering photoxidation; and oxygen concentration: the availability of oxygen is crucial in the photoxidation process, as oxygen acts as an electron acceptor. Bilirubin molecules absorb light energy, particularly in the blue light spectrum. This energy causes electrons in bilirubin molecules to be excited to a higher energy level. These excited electrons become unstable and tend to return to their ground state. In this return process, electrons can release energy in the form of heat or trigger other chemical reactions. One possible reaction is the formation of free radicals. Free radicals are atoms or molecules with unpaired electrons, making them highly reactive. Free radicals formed from bilirubin are very reactive and easily react with surrounding oxygen molecules (O2). This reaction produces peroxide compounds containing oxygen-oxygen (O-O) bonds. The resulting peroxide compounds are unstable and easily degrade into more polar and water-soluble compounds. These degradation products are more easily excreted by the body through urine or feces (1,3,5,14).

RESEARCH METHOD

This research is an experimental study using a pre-test and post-test design. Bilirubin levels were measured before and after exposure to neon light at various time intervals. The study aimed to evaluate changes in total and indirect bilirubin levels resulting from neon light exposure in a clinical laboratory. The samples used in this study were 32 normal blood serum samples treated with neon light exposure in a clinical laboratory with time variations: 0 minutes as a control, 60 minutes of neon light exposure, and 120 minutes of neon light exposure. Bilirubin total and indirect levels were measured for each treatment. The obtained data were analyzed using paired t-tests to compare the differences in total and indirect bilirubin levels before and after neon light exposure in the clinical laboratory. The analysis was conducted using the latest version of SPSS software. The t-test results were used to determine whether there was a statistically significant difference in bilirubin levels due to neon light exposure at each time interval (60 minutes and 120 minutes). A significance criterion of $p < 0.05$ was considered statistically significant, meaning that neon light exposure significantly impacted serum bilirubin levels. If the p-value was greater than 0.05, the change in bilirubin levels was considered not significant.

RESULT AND DISCUSSION

The results evaluate changes in total and indirect bilirubin levels resulting from neon light exposure in a clinical laboratory room. The samples used in this study were 32 normal blood serum samples treated with neon light exposure in a clinical laboratory with time variations: 0 minutes as a control, 60 minutes of neon light exposure, and 120 minutes of neon light exposure :

Table 1. Average Results of Bilirubin Level Measurement from 32 samples

In Times New Roman	**Bold**	**The minimum size is 9**
Entry 1	Data	Data
Entry 2	Data	Data

This table shows the results of measuring total bilirubin and indirect bilirubin on average from 32 samples

Table2. Paired T-Test Analysis Results Paired Samples Satatistics

		Mean	N	Std. Deviation	Std. Error Mean
air 1	Total Bilirubin Levels (mg/dl)-Before	1.0167	3	.02082	.01202
	Total Bilirubin Levels (mg/dl)-After	.7500	3	.19079	.11015
Pair 2	Indirect Bilirubin Levels (mg/dl)-Before	.6700	3	.17692	.10214
	Indirect Bilirubin Levels (mg/dl)-After	.6300	3	.16093	.09292

Table. 3. Paired Samples Test

		Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	Kadar Bilirubin Total (mg/dL) – Sebelum - Kadar Bilirubin Total (mg/dL) – Setelah	.26667	.17039	2.711	2	.113
Pair 2	Kadar Bilirubin Indirek (mg/dL) – Sebelum - Kadar Bilirubin Indirek (mg/dL) – Setelah	.04000	.02646	2.619	2	.120

The p-value (Sig. (2-tailed)) is greater than 0.05, which means that the total and indirect bilirubin levels before and after neon light exposure in the laboratory were not statistically significant. Although there was a trend of decreasing total and indirect bilirubin levels after neon light exposure, the t-test analysis showed that this change was not statistically significant at the 0.05 significance level.

Bilirubin, especially indirect bilirubin, is sensitive to light exposure, particularly to light with certain wavelengths, such as blue light used in phototherapy. This light can cause structural changes to the bilirubin molecule, making it easier to be eliminated from the body. However, in this study, the intensity of neon light used may not have had enough energy to significantly trigger bilirubin photodegradation in a short time frame. Based on the research results, it was found that the analysis of total bilirubin levels in serum samples exposed to fluorescent light with an intensity of ≤ 500 lux did not show significant changes in the levels, whereas at a fluorescent light intensity of > 500 lux for 1 hour at a temperature of 27-28°C, there was a decrease in total and indirect bilirubin levels. (Saputra MA, 2020).

The study results show that after 60 and 120 minutes of exposure, bilirubin levels did decrease. However, the reduction caused by neon light, which has a lower intensity compared to phototherapy light, was not large enough to create a statistically significant difference. Therefore, the lower intensity of neon light in the clinical laboratory setting may only trigger partial degradation of bilirubin, so the changes in total and indirect bilirubin levels were not statistically significant.

Although the intensity of neon light used in this study was insufficient to produce significant differences, it is still important to consider the impact of light exposure in clinical settings. Neon light can slowly affect bilirubin levels, especially if the exposure duration is increased or the light intensity is higher. Thus, to ensure accurate laboratory results, bilirubin samples should be protected from excessive light exposure.

This study was conducted to evaluate the effect of neon light exposure in a clinical laboratory on total and indirect bilirubin levels in patient serum. From the paired t-test analysis, there was a decrease in both total and indirect bilirubin levels after neon light exposure at various exposure durations (0, 60, and 120 minutes). However, this decrease was not statistically significant, as indicated by a p-value greater than 0.05 for both types of bilirubin.

The average decrease in total bilirubin levels after neon light exposure was 0.26667 mg/dL, but the t-test showed a p-value of 0.113. This value is greater than 0.05, indicating that the decrease in total bilirubin levels was not statistically significant. Although there were observable clinical changes, these results suggest that neon light exposure for a relatively short time (up to 120 minutes) is not strong enough to significantly affect total bilirubin levels. This indicates that the light exposure during this period may not have caused significant bilirubin degradation, despite literature stating that bilirubin is sensitive to light, especially blue light commonly used in phototherapy. Similarly, indirect bilirubin levels also showed an average decrease of 0.04000 mg/dL after neon light exposure. However, the t-test produced a p-value of 0.120, which is also greater than 0.05, meaning the difference was not statistically significant. This slight difference could be due to the neon light exposure not being long enough or the light intensity being inadequate to trigger indirect bilirubin photodegradation, which is generally more susceptible to changes caused by light than total bilirubin.

Although there was a trend of decreasing bilirubin levels after neon light exposure, this study's findings indicate that in clinical laboratory conditions, neon light exposure for up to 120 minutes did not result in statistically significant changes in either total or indirect bilirubin levels. This may be due to factors such as the intensity of neon light being insufficient to influence the bilirubin degradation process, and the exposure duration being relatively short to cause significant changes. Phototherapy typically involves blue light with higher intensity for several hours or days in patients with hyperbilirubinemia. Careful handling of samples containing bilirubin is essential. Samples should be kept away from light sources or stored in covered containers to avoid potential bilirubin degradation that could affect measurement results.

This study provides important insights for clinical laboratories regarding bilirubin sample handling procedures. Although the effect of neon light in the laboratory environment was not significant in this study, it remains important to pay attention to the storage conditions and handling of serum samples that will be measured for bilirubin levels. This is to ensure more accurate results and avoid potential decreases in bilirubin levels that do not align with the patient's clinical condition. Based on the research conducted, the effect of neon light intensity on total and indirect bilirubin levels showed that, although there was a decrease in bilirubin levels after neon light exposure, the decrease was not statistically significant. This indicates that the intensity of neon light used in clinical laboratories may not be strong enough to cause significant bilirubin degradation.

CONCLUSION

This study aimed to evaluate the effect of neon light exposure on total and indirect bilirubin levels in patient serum in a clinical laboratory. The analysis results showed a decrease in total and indirect bilirubin levels after neon light exposure for 60 and 120 minutes. However, this decrease was not statistically significant ($p > 0.05$) for both total and indirect bilirubin.

From the paired t-test results, it can be concluded that the intensity and duration of neon light exposure used in this study were not sufficient to cause significant bilirubin degradation in a relatively short time. Nevertheless, this study indicates a trend of decreasing bilirubin levels, suggesting that even low-intensity light exposure, such as neon light, still has the potential to affect bilirubin measurement results if the exposure duration is extended or the light intensity is increased.

REFERENCES

Mayangsari, Y., & Prastiwi, E. H. (2016). Bank mandiri teller queuing system as an effort to improve transaction speed efficiency. Journal of Economics & Business, 1(1), 49-60.

Decree of the Minister of Health of the Republic of Indonesia Number 129 / Menkes / SK / II / 2008

Hutabarat, Y. (2022). Line Balancing Analysis with the Young Moodie Method of Production Process of Krasi Lutvi Tuntungan 2 Chips Factory (Doctoral dissertation, Medan Area University).

Sakiman, S., Arfah, M., & Suliawati, S. (2022). Line Balancing Analysis to Increase Rempeyek Production. Engineering Main Bulletin, 18(1), 16-20.

Andriansyah, A. (2017). The Role of the Head of the Community Health Center in Improving Social Security Agency Services in Palmerah District, West Jakarta. SPEKTRUM: Journal of Social and Political Sciences, 14(2).

Ilham, Husein Hi. Moh Saleh, Asngadi. (2020) "Analysis of Queuing Service System at Bank Bni Syariah Palu City Branch". Journal of Management Science, Tadulako University Vol. 6, No. 1, January 2020, 020 - 031

Putri, N. R., Guspianto, G., & Hubaybah, H. (2022). The Effect of Perceived Quality of Service on Patient Satisfaction Level at Sungai Tutung Health Center in 2022. Jambi Community Health Journal, 6(2), 7-16.