SERUM LEVELS OF TNF-α, IL-10 AND ALBUMIN CIRCULATING AMONG FEMALE PATIENTS WITH POST-SURGICAL WOUND INFECTION IN ASABA DELTA STATE, NIGERIA

ABSTRACT

Post-operative wound infections (POWIs), sometimes referred to as postsurgical wound infections (PSWIs), are a common complication following surgery. Surgeries frequently elicit a variety of immunological responses subsequent to tissue damage and incision which may hinder wound healing and infectious resolution leading to poor patient outcome. This cross-sectional study assessed the serum levels of TNF-α, IL-10 and albumin circulating among female patients with post-surgical wound infection in Asaba Delta State, Nigeria. Twenty-five (25) patients with PSWIs and 25 apparently healthy individuals (control group) were recruited by random sampling method. Four millilitres (4 ml) of venous blood samples were collected for the determination of serum TNF-α, IL-10 and albumin levels. TNF-α and IL-10 levels were estimated with a sandwich enzyme-linked immunosorbent assay, whereas serum albumin was assessed with the Bromocresol green (BCG) method. The data obtained was analyzed using an independent t-test and Pearson correlation, with a p-value of <0.05 indicating statistical significance. The mean serum TNF-α (143.44 ±7.35 Vs 37.32 ±8.92; p = 0.001) and IL-10 (27.52 ±7.77 Vs 17.12 ±6.23; p = 0.001) levels were significantly higher while serum albumin level was significantly lower (34.14 ±5.43 Vs 40.19 ±3.38; p = 0.001) in the female patients with PSWIs than in the control group. However, no significant correlation was observed between the levels of TNF-α Vs albumin and IL-10 Vs albumin (p>0.05). These findings may hinder wound healing, slow infection resolution, and lead to poor patient outcome.

INTRODUCTION

Post-operative wound infections (POWIs), sometimes referred to as postsurgical wound infections (PSWIs), are a common complication following surgery, characterized by complex and multifaceted pathophysiology (Zabaglo *et al*., 2025). Post-operative wound infection (POWIs) is still a leading cause of morbidity and death for patients having surgery, even with improvements in surgical techniques and a better understanding of the pathophysiology of wound infection (Kallakuri *et al*., 2024). The prevalence of POWIs is still rising in many nations, communities, and hospitals, albeit it varies greatly (Ehiaghe *et al*., 2025; Ehiaghe *et al*., 2024; Kallakuri *et al*., 2024).

Surgeries frequently elicit a variety of immunological responses subsequent to tissue damage and incision (Weledji, 2021). This include the secretion of cytokines, stress responses, and acute phase proteins, which can be detrimental when excessive (Chidambaran *et al*., 2024; Hsing and Wang, 2015). Cytokines represent a viable therapeutic target, as they regulate all phases of wound healing, and abnormalities in cytokine production can lead to inflammatory non-healing wounds (Wong *et al*., 2025). Cytokines are soluble molecular entities synthesized by inflammatory cells. They can be broadly classified as either pro-inflammatory cytokines (e.g., interleukins (IL)-1, 2, 8, 12; tumor necrosis factor α (TNF-α), interferon γ (IFNγ), etc.), or anti-inflammatory cytokines e.g., transforming growth factor beta (TGFβ), IL-4, IL-10, IL-13 while others, like IL-6, can be both (Chidambaran *et al*., 2024).

TNF-α attracts pro-inflammatory cells including neutrophils, macrophages, and fibroblasts to the wound site, where they assist remove debris and pathogens (Wong *et al*., 2025; Jang *et al*., 2021), thereby facilitating wound healing or resolution under physiological state. However, exaggerated TNF-α responses can culminate in failed wound infection resolution (Choy *et al*., 2023; Jang *et al*., 2021).

Interleukin 10 (IL-10) is an important anti-inflammatory cytokine produced mainly by the CD4+ T cells although other leukocytes such as neutrophils, B cells, dendritic cells, natural killer cells, and macrophages also secret it as well (Sun *et al*., 2020). Its primary functions include anti-inflammatory, inhibitory, or self-regulating, as IL-10 appears to be a potent negative feedback regulator that influences inflammation management and resolution (Al-Qahtani *et al*., 2024; Steen *et al*., 2020). By suppressing the activity of macrophages and dendritic cells, IL-10 directly shuts down the inflammatory immune response (Cocea and Stoica, 2024; Saraiva *et al*., 2020; Mittal *et al*., 2015). It also indirectly does so by restricting T cell activation, differentiation, and effector function and encouraging peripheral tolerance (Saraiva *et al*., 2020; Mittal *et al*., 2015). Excessive IL-10 production or signaling can suppress host's effective inflammatory responses, induce tolerance and immune escape, and favor microbial persistence, which can lead to the establishment of chronic or latent infections (Carlini *et al*., 2023; Rojas *et al*., 2017; Iyer and Cheng, 2012). In contrast, during acute infections, IL-10 limits the magnitude of the immune responses, preventing excessive inflammation and protecting tissues from immune-mediated damage by allowing inflammation resolution when the pathogen is cleared (Carlini *et al*., 2023; Rojas *et al*., 2017).

Nutritional deficiency has been associated with an increased risk of wound infections (Tfaily *et al*., 2022) and serum albumin level can be used to determine an individual’s nutritional and inflammatory condition (Keller, 2019). Hypoalbuminemia has been identified as one of the risk factors for surgical site infections (SSIs) in surgery populations (Mostafa *et al*., 2024; Ryan *et al*., 2018). Hypoalbuminemia, on the other hand, can increase the expression of TNF-ɑ, C-Reactive Protein (CRP) and several interleukins, all known to be acute-phase proteins that promote tissue damage (Cooper *et al*., 2004; Yildirim *et al*., 2004). Albumin influences wound healing by increasing the transcription of tissue-forming proteins, which in turn triggers the NFKB pathway and speeds up the healing process (Utariani *et al*., 2020). Identifying risk factors for surgical site infections early can improve post-operative outcomes, minimize re-admission rates (He *et al*., 2019; Fong *et al*., 2014), and reduce treatment costs by 23.8% (Javed *et al*., 2019).

In view of all these, it has become pertinent to evaluate the serum levels of TNF-α, IL-10 and albumin circulating among female patients with post-surgical wound infection in Asaba Delta State, Nigeria.

MATERIALS AND METHODS

**Study site**

The study was conducted at the Federal Medical Center in Asaba, Delta State, Nigeria.

Study Design

This cross-sectional study examined the serum levels of tumor necrosis factor-alpha, interleukin-10, and albumin in female patients with post-surgical wound infection in Asaba, Nigeria.

Study population

Simple random sampling was used to select 50 participants for the study. The test group consisted of 25 female patients with post-surgical wound infection, while the control group included 25 apparently healthy participants.

Sample size and sample size calculation

The sample size (N) was calculated using prevalence from previous studies on the prevalence of post-surgical wound infections globally which was found to be 2.5% (Mengistu *et al.*, 2023) according to the sample size calculation formula described by Daniel and Cross (1999).

N = Z2P (1 – P)

D2

N = required sample size

Z = confidence level at 95% (standard value of 1.96)

P = estimated prevalence of post-surgical wound infections globally which was found to be 2.5% (Mengistu *et al*., 2023).

D = margin of error at 5% (standard value = 0.05)

N = 1.962 X 0.025(1-0.025)

0.052

3.8416 X 0.025(0.975)

0.0025

N = 37 minimum sample size

Therefore, a minimum of 50 participants was used for this study.

Inclusion criteria

Female patients with confirmed cases of post-surgical wound infection as well as healthy female participants who provided informed consent were included for this study.

Exclusion Criteria

Female patients with post-surgical wound infection and apparently healthy female individuals without post-surgical wound infection who did not give their informed consent were excluded from this study.

Ethical considerations

The ethical committee of the Federal Medical Centre in Asaba, Delta State, approved the study before it commenced. The informed consent of all involved participants was sought and gained.

Sample collection

Each participant provided five milliliters (5 ml) of venous blood into a plain container for cytokine and albumin analysis. Blood samples were allowed to clot before being retracted and centrifuged for 10 minutes at 4000 rpm. Serum samples were separated and kept frozen at -20°C until analysis.

Estimation of Cytokine Levels

The levels of tumor necrosis factor-alpha and interleukin-10 were determined using the sandwich enzyme-linked immunosorbent assay technique.

Estimation of Serum Albumin

This was determined using the Bromocresol green method (BCG), as described by Doumas and Watson (1971) and cited by Okpogba *et al*. (2021).

Statistical analysis

The data was analyzed using SPSS 20.0 and represented as mean ± standard deviation. The independent t-test and Pearson correlation were employed to determine the statistical difference and association between variables. A P value of < 0.05 was considered statistically significant.

RESULTS

The mean serum TNF-α level was significantly higher in the female patients with post-surgical wound infections than in the control group (143.44 ±7.35 Vs 37.32 ±8.92; p = 0.001). in like manner, the mean serum IL-10 level was significantly higher in the female patients with post-surgical wound infections compared to the control group (27.52 ±7.77 Vs 17.12 ±6.23; p = 0.001).

However, there was a statistically significant decrease in the mean serum albumin level observed in the female patients with post-surgical wound infections than in the control group (34.14 ±5.43 Vs 40.19 ±3.38; p = 0.001), (see table 1).

Furthermore, there was no significant correlation observed between the levels TNF-α and albumin (r-value = -0.154; p = 0.470) as well as between IL-10 and albumin levels (r-value = 0.271; p = 0.190) in the study participants (see table 2).

Table 1: Levels of serum TNF-α, IL-10 and albumin circulating among female patients with post-surgical wound infection and apparently healthy individuals (MEAN±SD).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PARAMETER | GROUP | N | MEAN±SD | T value | P value |
| TNF-α  IL-10  Albumin | TEST  CONTROL  TEST  CONTROL  TEST  CONTROL | 25  25  25  25  25  25 | 143.44 ±7.35  37.32 ±8.92  27.52 ±7.77  17.12 ±6.23  34.14 ±5.43  40.19 ±3.38 | 45.93  5.22  4.73 | 0.001  0.001  0.001 |

\*Statistically significant = P<0.05; TNF-α = Tumour necrosis factor- alpha, IL-10 = Interleukin -10.

Table 2: The correlation between the levels of TNF-α, IL-10 and albumin in the study population.

|  |  |  |
| --- | --- | --- |
| Parameters  TNFα  Vs Albumin | r-value  -0.154 | p-value  0.470 |
|  |  |  |
|  |  |  |
|  |  |  |
| IL-10  Vs Albumin | 0.271 | 0.190 |
|  |  |  |

\*Statistically significant at p<0.05

DISCUSSION

The present study noted a significantly higher mean serum TNF-α level in the female patients with post-surgical wound infections than in the control group. Elevated TNF-α levels indicate a pro-inflammatory response linked to chronic illnesses and infections (Chen *et al*., 2017). This finding aligns with the reports of other similar studies (Ehiaghe *et al*., 2025a; Ehiaghe *et al*., 2025b). Exaggerated TNF-α responses may culminate in failed wound infection resolution (Choy *et al*., 2023).

Furthermore, the higher IL-10 level observed in the female patients with post-surgical wound infections show an attempt by the body to moderate the excessive inflammatory responses, a phenomenon commonly observed in chronic inflammation, where anti-inflammatory cytokines act to avoid tissue damage. IL-10 limits the magnitude of the immune responses, preventing excessive inflammation and protecting tissues from immune-mediated damage by allowing inflammation resolution when the pathogen is cleared (Carlini *et al*., 2023). Nevertheless, elevating IL-10 levels can provide some anti-inflammatory buffering, but its efficiency may be limited by pro-inflammatory cytokines like TNF-α, leading to an unsustainable immunological balance. Thus, increased inflammatory response shown in our current investigation may hamper infection resolution, eventually leading to poor treatment outcome in these patients.

In the present study, the mean serum albumin level was found to be significantly lower in the female patients with post-surgical wound infection compared to the control group. This result agrees with several studies that found significantly lower serum albumin levels in PSWIs patients (Choudhary *et al*., 2024; Sultana *et al*., 2024; Llombart *et al*., 2023; Singh *et al*., 2023; He *et al*., 2020). Hypoalbuminemia, an indicator of malnutrition and illness, has been shown to increase the likelihood of poor post-operative outcomes, especially reduced wound healing (Sultana *et al*., 2024). In addition to increasing albumin production, inflammatory conditions can enhance albumin breakdown, which can result in hypoalbuminemia (Weaving *et al*., 2016). Interstitial oedema results from a decrease in oncotic pressure caused by a decrease in serum albumin levels, which might impede the healing and recovery process.

CONCLUSION

This study found that female patients with post-surgical wound infections had significantly higher mean serum TNF-α and IL-10 levels, as well as lower mean serum albumin levels. These findings may hinder wound healing, slow infection resolution, and lead to poor post-operative outcomes.

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