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The Effect of Smoking on The Recovery Time of Surgical Wounds

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Abstract
Background: Cigarette consumption inhibits wound healing as nicotine and carbon monoxide interfere with blood flow, oxygenation, and immune function, increasing the risk of infection and prolonging wound recovery time.
Purpose: To determine the effectiveness of modern dressing in wound care on diabetic wound healing.
Methods: This study used a cross-sectional model to observe two groups: smokers (with a history of cigarette use) and a control group (non-smokers). Using purposive non-probability sampling, 9 smokers and 9 non-smokers meeting research criteria were selected, all undergoing elective surgery with sterile wounds. Data were analyzed with Spearman Correlation using SPSS version 12
Findings: The study involved 20 respondents, split evenly between smokers and non-smokers. Among the smokers, 48% were in the productive age group, and 68% consumed more than 10 cigarettes daily. All smokers use filtered cigarettes. Regarding wound healing, 79% of respondents experienced slow healing, 11% had optimal healing, 7% had standard healing, and 3% had rapid healing. Spearman Correlation test results indicated a significant relationship between smoking and wound healing time ($p < 0.05$), suggesting that cigarette consumption adversely affects the wound healing process.
Conclusion: Smoking raises the risk of post-surgical infections, wound dehiscence, and delayed healing by causing inflammation, vasoconstriction, reduced oxygen delivery, and impaired cell recruitment. This highlights the importance of pre-surgery smoking cessation and further research to better quantify these effects and improve pre-operative treatments.

Keywords: recovery time, smoking, surgical wound, wound healing

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Introduction

Cigarette smoke contains various toxic compounds that are either inhaled directly or absorbed into the bloodstream, impacting all organs and tissues. Besides its well-known harmful effects on the respiratory system, smoking is linked to multiple postoperative complications (Benowitz, 2009). These complications include respiratory and cardiovascular issues, gastrointestinal problems, vascular damage, and an increased risk of hernia recurrence. Additionally, smoking hinders wound healing by affecting inflammation, and immune function, and reducing fibroblast production, which is essential for extracellular matrix synthesis at surgical wound sites (McDaniel & Browning, 2014). The relationship between smoking and cutaneous healing rates is still debated. If cigarette smoking reduces cutaneous reperfusion in the early phase of wound healing, it may delay the healing process. This is because prolonged time until hemoperfusion generally correlates with extended wound healing. Based on this premise, we investigated the impact of smoking in the first postoperative year on the healing process of surgical wounds (McRobert-Tuck, 2013). This was assessed by examining the microcirculatory blood flow at the incision site during the early healing phase after surgery (Yousefi et al., 2014).

Keywords: recovery time, smoking, surgical wound, wound healing

Our study aimed to establish a clear link between smoking and delayed wound healing by focusing on early postoperative microcirculatory blood flow. Understanding this relationship could provide insights into the negative effects of smoking on surgical recovery and highlight the importance of smoking cessation, especially in the perioperative period.

Method

The approach in this study is a Cross-Sectional model by observing two groups, namely the cigarette-exposed group (has a history of cigarette consumption) and the control group (never consumes cigarettes). The study was conducted at Ganzouri Specialized Hospital, Toman Bai, Cairo, Egypt from July 1, 2024 - July 30, 2024 and the study has received ethical approval from Ganzouri Specialized Hospital, Toman Bai, Cairo, Egypt with Number. 245.77.627. The sampling technique used in this study was nonprobability sampling, namely purposive sampling, which is the selection of samples by determining subjects who meet the research criteria to be included in the study until the number of respondents is met, consisting of 9 smokers and nine non-smokers who all underwent elective surgery with sterile wounds. Data analysis using “Spearman Correlation” computerized with the SPSS version 12 program.

Results

Based on the sample criteria, the number of respondents was 20 people. Of the total number of respondents, 10 respondents (50%) had a smoking pattern and 10 respondents (50%) never had a smoking habit.

Table 1. Frequency Distribution Based on Total Cigarette Consumption of Respondents

No	Group	Frequence	Percentage
1	<30 Age years	48	37%
	30-40 Age years	52	63%
2	<10 Cigarette	44	32%
	>10 Cigarette	76	68%

Most respondents were in the productive age group 48 people (37%) and a small proportion 52 people (63%). Almost half of the respondents 44 people consumed less than 10 cigarettes per day and more than half of the respondents 76 people (68%) consumed more than 10 cigarettes per day. All smoker respondents consumed filtered cigarettes.

Table 2. Frequency Distribution Based on Wound Healing Time

No	Group	Frequence	Percentage
1	7 days	2	3%
	14 days	5	7%
	21 days	7	11%
	>28 days	86	79%

Half of the respondents 86 people (79%) had a slow healing time, almost half of the respondents 7 people (11%) had optimal wound healing time and a small portion of 5 people (7%) had standard wound healing time and 2 people experienced rapid wound healing. The results of statistical tests using the “Spearman Correlation” test from the SPSS version 12 analysis program in computerise (nominal - ordinal data measurement scale, with a degree of significance of 95% obtained the results Approx. sig. 0.05 or p value smaller than 0.05 so that Ho is rejected, which means there is a significant relationship between the habit of consuming cigarettes on wound healing time.

Discussions

Cigarette smoking has numerous detrimental effects on wound healing due to the presence of harmful components like tobacco tar, which stimulate inflammation and hinder wound re-epithelialization. One of the primary mechanisms through which smoking affects wound healing is by accelerating collagen breakdown and disrupting fibroblast function (Lassig et al., 2018). Collagen is crucial for providing structural integrity to healing tissues, and fibroblasts are essential for synthesizing new collagen fibers. When smoking disrupts these processes, it weakens the foundation of the healing tissue. Furthermore, smoking has a significant impact on alveolar bone metabolism, which is critical for oral health, leading to tooth loss (Mathew-Steiner et al., 2021). This is particularly problematic because the loss of teeth can further complicate oral wounds and make healing even more difficult. Smokers experience impaired postsurgical healing, which is particularly evident in studies focusing on soft and

hard tissue grafting. The negative impact on both types of grafting underscores the broad spectrum of healing processes affected by smoking (Levin & Schwartz-Arad, 2005).

The reduction of capillary blood flow due to smoking-induced vasoconstriction causes hypoxia, a condition characterized by insufficient oxygen reaching the tissues. Oxygen is vital for cellular processes involved in wound healing, including cell proliferation and collagen synthesis (Han et al., 2023). Hypoxia prolongs inflammation, which is a necessary phase in wound healing but should be timely resolved to allow for subsequent phases. Prolonged inflammation can lead to excessive tissue damage and delays in the healing process. Additionally, smoking disrupts the movement of neutrophils, the white blood cells essential for defending against infections, and the synthesis of collagen, further impeding the healing process. This disruption results in an imbalance in the body's ability to respond to injury and infection, further complicating the healing process (Strzelak et al., 2018).

Cigarette smoke significantly alters the body's inflammatory profile by increasing pro-inflammatory immune cells and cytokines, yet paradoxically suppressing their function. This means that while there is an increased presence of inflammation mediators, their actual ability to function properly is compromised (Yamaguchi, 2019). The immune system's impaired response to inflammation and infection hinders the effective progression through the healing stages of inflammation, proliferation, and remodeling. This imbalance is crucial because a properly functioning inflammatory response is necessary to initially deal with the injury and prevent infection. (Guo & DiPietro, 2010). If this response is disrupted, the subsequent stages of healing cannot proceed efficiently, leading to prolonged and complicated wound healing.

Nicotine and carbon monoxide in cigarette smoke reduce oxygen delivery to tissues, further impairing the cellular functions necessary for healing. Nicotine-induced vasoconstriction exacerbates the issue, particularly in larger wounds where adequate blood flow is crucial for delivering nutrients and oxygen to the healing tissue. This interference with oxygenation and blood flow hampers tissue repair and angiogenesis, the formation of new blood vessels, which is essential for providing the necessary support for the new tissue (Sørensen et al., 2009). Clinical studies consistently show that smoking slows wound healing and increases complication rates, such as infections. The risk of surgical site infections decreases with each smoking-free day, highlighting the clear relationship between smoking intensity and wound healing complications. These findings underscore the need for smoking cessation to improve surgical outcomes and overall wound healing (Fan Chiang et al., 2023).

The harmful components of cigarette smoke, such as tobacco tar, nicotine, and carbon monoxide, significantly impair wound healing through multiple mechanisms. Smoking accelerates collagen breakdown, disrupts fibroblast function, affects alveolar bone metabolism, and leads to tooth loss, all of which are detrimental to wound healing. The reduction in capillary blood flow caused by smoking-induced vasoconstriction results in hypoxia and prolonged inflammation, further delaying the healing process (Zhang et al., 2022). Additionally, the disruption of neutrophil movement and collagen synthesis impedes effective wound repair. Cigarette smoke also alters the inflammatory profile, increasing pro-inflammatory immune cells and cytokines while suppressing their function, leading to an imbalance that hinders the healing process. The combined effects of reduced oxygen delivery, impaired cellular functions, and disrupted blood flow significantly hamper tissue repair and angiogenesis (Herrero-Cervera et al., 2022). Clinical evidence consistently shows that smoking slows wound healing and increases complication rates, emphasizing the importance of smoking cessation for improved surgical outcomes and overall wound healing. The clear relationship between smoking intensity and wound healing complications highlights the critical need for smokers to quit to facilitate better healing and recovery

Strengths And Limitations of The Study

The study's strengths include a sample of 20 respondents with an even distribution between smokers and non-smokers, enabling a clear comparison between the two groups. The diverse age range (from under 30 to over 40 years) provided insights into the impact of smoking on wound healing across different age groups. By categorizing smoking intensity (<10 and >10 cigarettes per day), the study offered detailed insights into how varying levels of cigarette consumption affect wound healing. Additionally, comprehensive data collection on smoking habits and wound healing times enabled a holistic view of smoking's effects. However, the study's limitations include its small sample size, which restricts the generalizability of findings, and the reliance on self-reported smoking data, which may introduce bias. The absence of controls for confounding factors like overall health, nutrition, and comorbidities further limits the study's robustness, and the lack of a specified observation period constrains understanding of long-term effects

implications on patient care and the profession.

The study highlights critical implications for patient care and the healthcare profession regarding smoking cessation. For patient care, it underscores the importance of smoking cessation programs, especially for surgical patients or those with chronic wounds, as quitting smoking can significantly improve healing outcomes. Healthcare providers are encouraged to engage in pre-surgical counseling, educating patients on the risks of smoking and the

benefits of cessation to reduce complications and promote recovery. Additionally, clinicians should create personalized care plans that support smoking cessation and address other lifestyle factors that may impact healing. On a professional level, there is a call for enhanced education and training within medical and nursing programs, emphasizing the impact of smoking on wound healing and the necessity of cessation interventions. Healthcare institutions should develop supportive policies for smoking cessation, offering resources for both patients and staff who wish to quit. Finally, ongoing research and advocacy are essential, as further studies are needed to deepen the understanding of smoking's effects on health, with healthcare professionals playing a vital role in securing funding and support for such initiatives

Conclusion

Smoking worsens post-surgical wound healing by increasing the risk of infections, dehiscence, and impaired healing. The main mechanisms affected by smoking include inflammation, vasoconstriction, reduced oxygen delivery, and the recruitment of fibroblasts and endothelial cells. This underscores the importance of clinical understanding of smoking's impact on surgical outcomes and the necessity for smoking cessation plans before surgery. Although much research exists, further studies are needed to measure the specific impact of each mechanism and to develop effective interventions for pre-operative patients

Author contribution

Sara Tanayah Uma and Dakari Cleo Denzel greatly assisted with conceptualization, design, data gathering, and analysis. Eifel Ayubi Azi assisted with draughting and significant revisions to the book. Final publication approval was given by Ferezie Clevon Dalmar and Maisha Naaila Safiy; each author was held responsible for their contributions. Throughout, Lathaya Maha Ismita kept an eye on things to make sure that any concerns about the reliability of the study were taken care of.

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Conflict of Interest Statement

The authors declare that they have no competing interests.

Data Availability

The datasets produced or examined in the present investigation can be obtained from the corresponding author upon a reasonable request.

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