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CURRENT TRENDS AND CHALLENGES IN THE SURGICAL MANAGEMENT OF PULMONARY ABSCESES IN DIABETIC PATIENTS: A GLOBAL PERSPECTIVE

Khamdamov Sh.A.

Department of General and Pediatric Surgery-1, Tashkent Medical Academy, Tash-kent, Uzbekistan

Abstract:

Background: Pulmonary abscesses remain a life-threatening complication, particularly in patients with diabetes mellitus, where impaired immunity, altered microcirculation, and de-layed healing complicate management. Advances in diagnostics, antimicrobial therapy, and surgical techniques have improved outcomes, yet diabetic patients continue to face elevated risks.

Objective: To review and analyze current global trends, controversies, and innovations in the surgical treatment of pulmonary abscesses among diabetic populations.

Methods: A literature review was conducted using PubMed, Scopus, and Google Schol-ar databases, focusing on articles published between 2000 and 2024. Search terms included «pulmonary abscess», «diabetes mellitus», «surgical drainage», «VAC therapy», and «lung re-section». Studies were selected based on relevance to diabetic populations and emphasis on sur-gical decision-making.

Results: Diabetic patients with pulmonary abscesses exhibit more severe infections, greater cavity formation, and higher rates of sepsis and mortality. Surgical options range from minimally invasive drainage to lobectomy, with timing and modality influenced by glycemic control, cavity anatomy, and comorbidities. Novel strategies such as vacuum-assisted therapy and bronchoscopic drainage have shown promise but require further validation. A lack of stand-ardized protocols for diabetic patients contributes to variability in outcomes.

Conclusion: The management of pulmonary abscesses in diabetic patients requires a tai-lored, multidisciplinary approach. While surgical outcomes have improved with modern tech-niques, patient-specific risk factors must guide intervention. Future directions include integra-tion of VAC therapy, personalized surgical algorithms, and improved perioperative glycemic management.

Key words: Pulmonary abscess, diabetes mellitus, surgical drainage, thoracic surgery, vacuum-assisted ther-apy, clinical guidelines.

INTRODUCTION

Pulmonary abscess remains a challenging and potentially fatal complication of lung infection, particularly in patients with diabetes mellitus (DM). While the general incidence of pulmonary abscesses has

decreased with the advent of effec-tive antibiotics and improved diagnostic imaging, their occurrence in diabetic populations is associated with more severe courses, delayed

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resolution, and increased morbidity and mortality [1, 2].

Diabetes mellitus alters immune response, impairs neutrophil chemotaxis and phagocytosis, and contributes to microvascular dysfunction, all of which undermine the host's ability to contain and resolve pulmonary infections [3]. Furthermore, diabetic patients often present late, with atypical symptoms or occult progression, increasing the risk of cavity formation, necrotizing pneumonia, and systemic sepsis [4].

Management of pulmonary abscesses in diabetic individuals thus requires a more aggressive and structured approach. While initial medical treatment with anti-biotics remains standard, failure rates are higher among diabetics, often necessitating early surgical drainage or even anatomical lung resections [5]. However, the optimal timing and modality of surgical intervention remain controversial, especially in metabolically unstable patients with comorbid cardiovascular or renal disease [6].

Recent advances in thoracic surgery have expanded therapeutic options. Video-assisted thoracoscopic surgery (VATS), image-guided percutaneous drainage, and vacuum-assisted closure (VAC) systems have all been applied with varying degrees of success in managing complex pulmonary infections [7]. Yet diabetic patients have largely been excluded from major trials, leaving a gap in evidence-based recommendations tailored to this vulnerable group.

This review aims to provide a comprehensive analysis of current trends, emerging technologies, and ongoing challenges in the surgical treatment of pulmonary abscesses in diabetic patients. Emphasis is placed on timing of intervention, selection of surgical technique, role of glycemic control, and

future directions for risk-adapted clinical protocols.

MAIN TEXT

Pathophysiological Considerations in Diabetic Patients

Diabetes mellitus significantly alters the inflammatory cascade involved in pulmonary infections. Hyperglycemia impairs neutrophil migration, cytokine signaling, and phagocytic efficiency, while advanced glycation end-products (AGEs) contribute to endothelial damage and microthrombi formation [1]. This results in poor localization of infection and promotes abscess formation rather than effective pneumonia resolution. In addition, diabetic patients often present with coexisting pulmonary comorbidities, such as chronic obstructive pulmonary disease or reduced vital capacity, which further complicate infection control [2].

Delayed wound healing and collagen dysregulation are also observed in diabetic tissues, reducing the efficacy of conservative management and necessitating earlier surgical involvement [3]. Therefore, clinicians must maintain a lower threshold for escalation in diabetic patients with non-resolving pulmonary infections.

Surgical Options: Drainage to Resection

Traditional surgical management of pulmonary abscess includes open or minimally invasive drainage procedures and, in advanced cases, anatomical resection such as lobectomy or segmentectomy [4]. The choice of technique depends on abscess size, location, wall maturity, and patient tolerance for anesthesia. Diabetic patients frequently require tailored approaches due to cardiovascular instability or renal compromise.

Percutaneous drainage under CT or ultrasound guidance is often the first step in

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localized, uniloculated abscesses. This minimally invasive approach has been associated with success rates of up to 80% in general populations, but somewhat lower in diabetics due to persistent cavity formation and impaired healing [5].

In large, multiloculated, or gas-producing abscesses, or where percutaneous drainage fails, surgical intervention is required. Video-assisted thoracoscopic surgery (VATS) offers advantages in terms of reduced trauma, better access to posterior or lower-lobe abscesses, and shorter recovery. However, diabetes remains an independent predictor of conversion to open thoracotomy, prolonged drainage, and higher complication rates [6].

In extensive cases with bronchopleural communication or irreversible parenchymal destruction, anatomical resection remains the definitive option. However, postoperative morbidity is significantly increased in diabetic patients, requiring meticulous preoperative optimization and perioperative glucose control [7].

Emerging Role of Vacuum-Assisted Closure (VAC) Therapy

Vacuum-assisted closure (VAC) therapy, though initially developed for external wounds, has gained traction in thoracic applications. In pulmonary abscesses, particularly in diabetic patients with impaired tissue regeneration, VAC may enhance healing by promoting localized negative pressure, stimulating angiogenesis, and evacuating exudate [8]. Its intrathoracic adaptation involves inserting a modified sponge into the abscess cavity, with external suction regulation via sealed systems.

Early experimental and clinical reports suggest VAC reduces the duration of cavity persistence, promotes granulation tissue formation, and may prevent bronchopleural fistulas. However, its use remains largely

anecdotal, and large-scale trials (especially involving diabetic populations) are lacking. Moreover, optimal pressure parameters, sponge placement techniques, and duration protocols for thoracic VAC remain to be standardized [9].

Despite these limitations, the biological rationale for VAC is strong, particularly in patients with diabetes where impaired perfusion and fibroblast function are key barriers to recovery. Future integration of VAC into thoracic surgery algorithms for diabetics warrants serious exploration.

The Gap in Standardized Protocols for Diabetic Populations

One of the main challenges in managing pulmonary abscesses in diabetic patients is the lack of consensus-driven protocols tailored to their metabolic and vascular status. While general guidelines exist for abscess management, they rarely address the nuances of impaired immunity, altered healing, or microvascular dysfunction associated with diabetes [10].

As a result, treatment decisions often rely on surgeon preference rather than structured criteria. The absence of validated scoring systems that incorporate HbA1c levels, cardiovascular risk, or diabetic duration further complicates stratification of surgical risk. This leads to variability in timing of intervention, choice of technique, and postoperative monitoring.

Efforts are needed to develop diabetic-specific clinical pathways that integrate glycemic optimization, preoperative cardiopulmonary assessment, and wound-healing potential to inform individualized decision-making.

Future Directions

Future research should focus on three priority areas:

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Clinical trials comparing VAC vs. conventional drainage in diabetic patients, with endpoints such as cavity resolution, hospitalization length, and complication rates.

Development of multidisciplinary protocols combining endocrinology, thoracic surgery, and infectious disease expertise to optimize perioperative care.

Design of tailored surgical algorithms, possibly incorporating point-of-care biomarkers, tissue perfusion indices, and metabolic parameters to guide intervention.

The advent of minimally invasive thoracic surgery, combined with advanced wound management techniques such as VAC and controlled irrigation systems, provides a promising foundation. However, translating these innovations into improved outcomes for diabetic patients requires a shift toward personalized, evidence-based, and collaborative care models.

CONCLUSION

Pulmonary abscesses in patients with diabetes mellitus pose unique diagnostic and therapeutic challenges. The impaired inflammatory response, delayed tissue repair, and high risk of systemic complications demand early recognition and structured intervention. While advances in imaging, antibiotics, and surgical techniques have improved outcomes overall, diabetic patients continue to experience higher morbidity and mortality due to the lack of tailored treatment protocols.

Surgical options must be carefully selected, balancing the severity of infection with the patient's metabolic and cardiopulmonary reserve. Minimally invasive approaches, such as video-assisted thoracoscopic surgery and percutaneous drainage, offer advantages but may be insufficient in advanced or refractory cases. Emerging strategies like vacuum-assisted closure therapy present biologically

plausible solutions, especially in metabolically compromised tissues, though further clinical validation is required.

To optimize outcomes, treatment of pulmonary abscesses in diabetic patients should shift toward individualized, multidisciplinary care pathways that integrate surgical, infectious, and metabolic expertise. Future efforts must prioritize evidence generation specific to diabetic cohorts and the development of risk-adapted clinical algorithms.

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