Hepatocellular Carcinoma and Hepatectomy: A Survey on Surgical Site Infection Incidence and Prevention Strategies

Abstract

This survey paper delves into the intricate management of hepatocellular carcinoma (HCC), emphasizing the incidence and prevention of surgical site infections (SSIs) and postoperative complications following hepatectomy. The study underscores the global burden of HCC, driven by metabolic risk factors like nonalcoholic fatty liver disease, necessitating updated clinical guidelines and innovative surgical practices. Precision hepatectomy emerges as a superior method, reducing complications through individualized treatment rules and advanced imaging. The survey highlights the critical role of preoperative assessments in identifying at-risk patients and tailoring surgical strategies to minimize SSIs. It further explores the impact of surgical techniques on complications, advocating for minimally invasive approaches such as laparoscopic and robotic hepatectomy, which offer reduced morbidity and enhanced recovery. The integration of predictive models and multi-modal data in preoperative planning enhances infection prevention measures. Postoperative care, including advanced monitoring technologies and interdisciplinary teamwork, is crucial for optimizing recovery and reducing SSIs. The survey calls for ongoing research into personalized treatment strategies and the development of standardized SSI prevention protocols. By addressing the complexities of HCC management, this survey provides valuable insights into improving patient outcomes and advancing clinical practices in liver cancer surgery.

1 Introduction

1.1 Significance of Hepatocellular Carcinoma in Liver Cancer Surgery

Hepatocellular carcinoma (HCC) is a leading form of liver cancer, significantly impacting surgical practices and patient outcomes [1]. Its high incidence and the complexities of diagnosis and treatment underscore its prominence in liver cancer surgery [2]. The global rise in HCC cases, particularly in regions with limited healthcare access, emphasizes the urgent need for effective management strategies [3]. This trend is notably driven by the increasing prevalence of HCC associated with nonalcoholic fatty liver disease (NAFLD) [4].

In the Asia-Pacific region, the rising incidence and mortality rates of HCC necessitate regular updates to clinical practice guidelines [5]. The influence of HCC on surgical practices is profound, requiring the integration of complex treatment options and individualized treatment rules (ITRs) to improve patient outcomes [6]. The exploration of precision hepatectomy, as an alternative to traditional surgical approaches, highlights the need for innovative surgical techniques to enhance treatment success [7]. Additionally, the recurrence of HCC post-partial hepatectomy remains a major concern, prompting advancements in surgical techniques and postoperative care [8].

Recent therapeutic advancements have concentrated on updating treatment strategies and evaluating their effectiveness, given the high mortality rates and limited options for advanced HCC [9]. Ad-

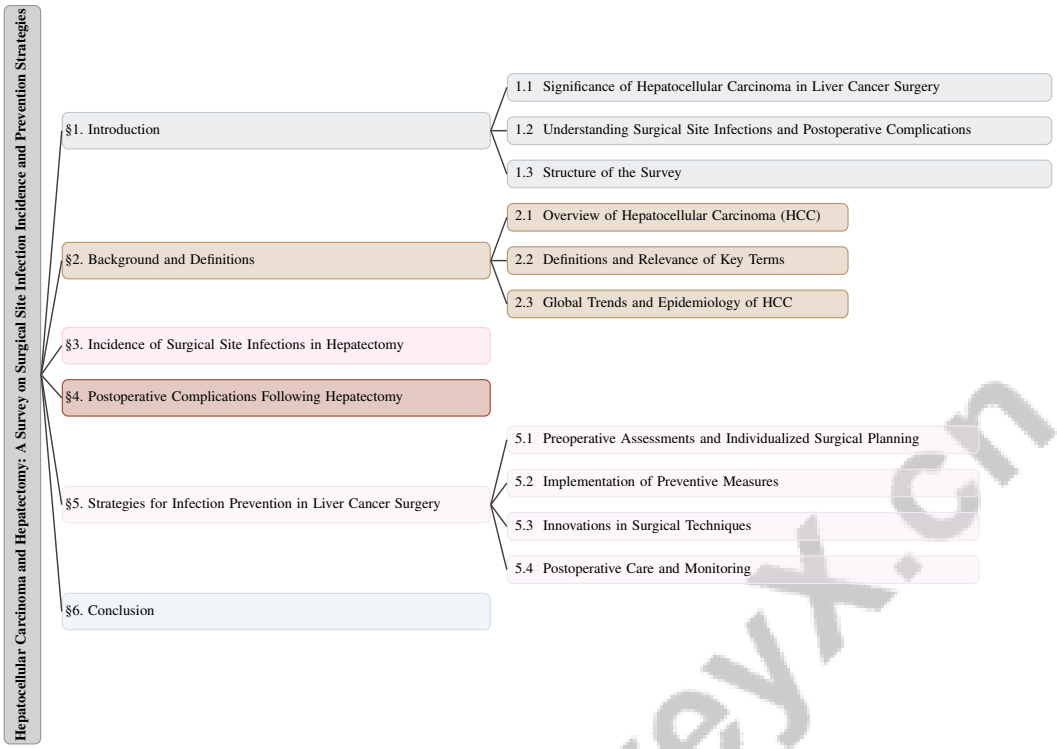

Figure 1: chapter structure

dressing risk factors such as sarcopenia and obesity is crucial in surgical planning and management, as they are associated with increased morbidity and mortality in HCC patients. The complexity of HCC, encompassing its etiology, molecular biology, and biomarker diagnosis, further necessitates comprehensive updates to treatment protocols to enhance patient outcomes [10].

1.2 Understanding Surgical Site Infections and Postoperative Complications

Surgical site infections (SSIs) are a critical concern in hepatectomy for HCC, given their prevalence and detrimental impact on patient outcomes. SSIs are among the most common hospital-acquired infections, leading to increased morbidity, mortality, and healthcare costs [11]. In the United States, SSIs affect approximately 3-5% of surgical patients, marking them as a national healthcare priority [12]. The burden of SSIs is particularly severe in developing countries, where limited healthcare resources exacerbate morbidity and mortality rates [13].

The incidence of SSIs after hepatectomy poses significant challenges, resulting in prolonged hospital stays and worse patient outcomes [12]. Research into the comparative effectiveness of precision versus traditional hepatectomy has shown promise in reducing postoperative complications and enhancing patient safety [7]. This underscores the importance of surgical innovations and tailored treatment strategies to minimize SSI incidence and improve recovery.

Postoperative complications extend beyond SSIs, encompassing various adverse events that can impede recovery and compromise surgical success. These complications are influenced by patient comorbidities, surgical techniques, and the extent of liver resection. A comprehensive understanding of the underlying risk factors, alongside effective preventive strategies, is essential to optimize patient outcomes in the surgical management of HCC.

1.3 Structure of the Survey

This survey comprehensively addresses critical aspects of HCC management within liver cancer surgery, focusing on SSIs and postoperative complications following hepatectomy. Initial sections provide a foundational understanding of HCC, emphasizing its significance in liver cancer surgery and the challenges posed by SSIs and postoperative complications. The survey further explores the

epidemiology and global trends of HCC, offering detailed definitions and relevance of key surgical terms to prepare for subsequent discussions.

The analysis then focuses on the incidence of SSIs following hepatectomy, utilizing a thorough literature review to identify factors influencing infection rates. This includes a comparative evaluation of traditional and precision hepatectomy techniques in reducing SSI occurrences, while also considering patient factors such as body composition and the impact of robotic surgical systems on outcomes [11, 7, 14, 9]. The discussion extends to postoperative complications, examining risk factors and the influence of surgical methods on patient outcomes, including complications related to tumor recurrence and liver regeneration.

In later sections, the survey shifts to infection prevention strategies in liver cancer surgery, analyzing preoperative assessments, individualized surgical planning, preventive measures, and innovations in surgical techniques. The significance of postoperative care and monitoring is also highlighted as a crucial component in reducing SSI risk and facilitating recovery. The survey concludes by summarizing key findings, emphasizing effective infection prevention strategies, and suggesting areas for future research and clinical practice improvements [11].The following sections are organized as shown in Figure 1.

2 Background and Definitions

2.1 Overview of Hepatocellular Carcinoma (HCC)

Hepatocellular carcinoma (HCC) presents a formidable global health challenge, marked by high incidence and mortality rates. The epidemiological landscape of HCC is evolving, with an increasing prevalence linked to metabolic risk factors such as nonalcoholic fatty liver disease (NAFLD), which significantly contributes to liver fibrosis, cirrhosis, and HCC [4, 3, 1]. This shift contrasts with declining rates of HCC associated with hepatitis B and C in Western countries, highlighting the need for revised diagnostic, surveillance, and management strategies. Understanding HCC's molecular pathogenesis and genomic characteristics is crucial for developing effective treatments.

The global burden of HCC is exacerbated by difficulties in early diagnosis and the limited effectiveness of treatments for advanced stages. Current diagnostic approaches often depend on individual biomarkers, which may not adequately capture HCC's heterogeneity, underscoring the necessity for composite diagnostic tests [2]. Enhancements in diagnostic imaging and the integration of novel biomarkers are vital for improving early detection and surveillance [10].

In high-incidence regions like the Asia-Pacific, updated clinical guidelines are urgently needed to address HCC's complex etiology, including its molecular and immune microenvironment. Research on liver regeneration and tumor recurrence post-hepatectomy remains critical, with a call for models incorporating patient-specific factors to enhance outcome predictions [8]. Precision hepatectomy offers improved outcomes over traditional methods by reducing operation time, intraoperative blood loss, and postoperative complications [7]. Current guidelines emphasize preoperative assessments, particularly concerning the volume and functional capacity of the future liver remnant (FLR), although the relationship between liver volume and functionality requires further study [15].

The integration of multi-omics data is a promising research area with the potential to deepen our understanding of HCC's epidemiology and risk factors, leading to more personalized treatment strategies [16]. As surgical techniques advance, including robotic and laparoscopic hepatectomy, significant improvements in patient outcomes and reductions in HCC-related mortality are anticipated [14].

2.2 Definitions and Relevance of Key Terms

Key concepts in the surgical management of hepatocellular carcinoma (HCC) include hepatectomy, surgical site infection (SSI), and postoperative complications, all crucial to patient outcomes. Hepatectomy, the surgical resection of liver tissue, is a primary treatment for HCC, necessitating a comprehensive understanding of liver anatomy and function, along with individualized treatment protocols to enhance surgical precision and outcomes [2].

Surgical site infections are a significant concern in hepatectomy, linked to increased morbidity, extended hospital stays, and higher healthcare costs. The multifactorial nature of SSIs, influenced by

patient, procedural, and facility-related factors, complicates prevention strategies [11]. The use of dynamic clinical data, particularly through mHealth tools, is essential for predicting and managing SSIs, yet remains underutilized, especially in resource-limited settings with higher SSI incidence [12, 13].

Postoperative complications extend beyond infections to include various adverse events that impact recovery and long-term outcomes. Factors such as the extent of liver resection and the patient's overall health status influence these complications. Predicting post-hepatectomy liver failure (PHLF) is critical for postoperative management, requiring accurate assessments of the liver's functional capacity [15]. Understanding these key terms and their interrelationships is essential for optimizing surgical outcomes and advancing liver cancer management.

2.3 Global Trends and Epidemiology of HCC

Hepatocellular carcinoma (HCC) constitutes a significant global health burden due to its high incidence and mortality rates. The epidemiology of HCC varies geographically, with the highest incidence rates in East Asia and sub-Saharan Africa, primarily due to chronic hepatitis B and C infections. However, an increasing prevalence of metabolic risk factors, especially nonalcoholic fatty liver disease (NAFLD), is shifting the landscape in Western countries [4].

These global trends necessitate effective screening methods for early detection and the development of personalized treatment approaches that respond to the disease's evolving nature. The complexity of staging systems further complicates HCC management, requiring a nuanced understanding of disease progression and tailored strategies for individual patients [4].

Advancements in diagnostic imaging and biomarker research are critical for improving early detection and surveillance of HCC, particularly in high-risk populations. Despite these advancements, challenges persist, especially in low-income regions where limited access to healthcare resources exacerbates HCC-related morbidity and mortality. With projections indicating over a million new HCC cases annually by 2025, global initiatives must prioritize healthcare infrastructure enhancement and implement cost-effective screening programs. These efforts should focus on addressing preventable risk factors such as chronic hepatitis B and C, alcohol use, and metabolic liver diseases, while improving HCC surveillance and early detection to increase the likelihood of curative treatments. By effectively deploying prevention strategies and advancing therapeutic options, including novel biomarkers and immune-checkpoint inhibitors, we can significantly reduce the global burden of HCC in the coming decades [10, 3].

3 Incidence of Surgical Site Infections in Hepatectomy

3.1 Factors Influencing SSI Rates in Hepatectomy

The incidence of surgical site infections (SSIs) in hepatectomy for hepatocellular carcinoma (HCC) is influenced by patient characteristics, surgical techniques, and institutional practices. Late-stage diagnosis and inadequate surveillance exacerbate surgical outcomes, heightening SSI risk [3]. The complexity of treatment options, aimed at enhancing survival, further contributes to variability in surgical outcomes and SSI rates [17]. Variations in surgical techniques critically affect SSI rates, with traditional methods encountering anatomical challenges that increase complication risks [7]. Multicategory matched learning (M-learning) is proposed to refine treatment choices in hepatectomy, potentially reducing SSIs by optimizing surgical decision-making [6].

Patient-related factors, including age, preoperative hospital stay, and timing of antibiotic administration, significantly predict SSI rates [13]. Sarcopenic obesity correlates with poorer survival outcomes, indicating a heightened risk for postoperative complications, including SSIs [9]. Institutional adherence to evidence-based practices is vital for effective SSI management, necessitating compliance with established guidelines to mitigate infection risks [11]. Benchmarks for surgical eligibility often rely on volumetric assessments that may overlook functional liver tissue differences, potentially leading to misjudgments affecting surgical outcomes and SSI rates [15].

An effective strategy to reduce SSI rates in hepatectomy for HCC must integrate individual patient characteristics, variations in surgical techniques—including the learning curve associated with robotic and traditional laparoscopic approaches—and institutional practices. This multifaceted

approach recognizes the significance of surgeon experience, team dynamics, and disease complexity in influencing surgical outcomes [7, 14].

3.2 Comparative Analysis of Surgical Techniques

Benchmark	Size	Domain	Task Format	Metric
HCC-MML[16]	122	Hepatology	Multi-class Classification	AUC, F1
Sarcobench[9]	465	Hepatology	Survival Analysis	Overall Survival, Recurrence-Free Survival
SSIs[13]	105	Surgery	Incidence Tracking	Incidence Rate, Odds Ratio
functFLR[15]	62	Hepatobiliary Surgery	Prediction OF Liver Failure	AUC, functFLR

Table 1: Table ef presents a comparative overview of various benchmarks utilized in the analysis of surgical techniques, particularly focusing on hepatectomy for hepatocellular carcinoma. The table details the size, domain, task format, and metrics of each benchmark, providing a comprehensive understanding of their application in evaluating surgical outcomes and infection rates.

The choice of surgical technique in hepatectomy for hepatocellular carcinoma (HCC) significantly influences SSI rates and overall patient outcomes. Traditional open hepatectomy, while standard, is associated with higher morbidity and longer recovery times compared to minimally invasive techniques. Laparoscopic hepatectomy offers advantages such as reduced blood loss, shorter hospital stays, and lower morbidity, although it requires advanced surgical skills and equipment [14]. Robotic hepatectomy, an emerging technique, provides enhanced precision and dexterity. While comparable to laparoscopic approaches regarding blood loss, morbidity, and hospital stay, it entails longer operative times, potentially increasing SSI risk due to prolonged exposure and anesthesia. However, the improved precision and visualization of robotic systems can mitigate these risks by facilitating meticulous dissection and minimizing inadvertent tissue trauma.

Precision hepatectomy techniques, leveraging advanced imaging and intraoperative navigation, show promise in reducing SSIs and improving surgical outcomes by optimizing resection margins and preserving healthy liver tissue [7]. Integrating individualized treatment rules (ITRs) and multicategory matched learning (M-learning) into surgical decision-making allows for personalized approaches tailored to the unique anatomical and pathological features of each patient, potentially decreasing SSI rates [6].

As illustrated in Figure 2, the analysis titled "Incidence of Surgical Site Infections in Hepatectomy; Comparative Analysis of Surgical Techniques" categorizes various surgical approaches into traditional and minimally invasive methods, precision techniques, and individualized treatment approaches. The first figure, "Identification of Studies via Databases and Registers," presents a flowchart detailing the systematic approach to identifying relevant studies across databases such as PubMed, EMBASE, and the Cochrane Library. This flowchart is essential for understanding the scope of research considered in the analysis. The second figure, "CT Scan of the Abdomen with Purple Contours," highlights the abdominal cavity and its anatomical structures, emphasizing the precision required in surgical procedures and the critical nature of detailed anatomical knowledge in preventing infections. Together, these figures underscore the complexity and significance of the comparative analysis of surgical techniques aimed at improving surgical outcomes and reducing surgical site infections [7, 9]. Additionally, Table 1 provides a detailed overview of the benchmarks used in the comparative analysis of surgical techniques, highlighting key metrics and domains relevant to hepatectomy studies.

4 Postoperative Complications Following Hepatectomy

Postoperative complications in hepatectomy for hepatocellular carcinoma (HCC) are multifaceted, necessitating a comprehensive understanding of risk factors such as intraoperative blood loss, sarcopenic obesity, and functional future liver remnant (functFLR). Addressing these factors is crucial for optimizing patient care and tailoring strategies to enhance recovery. As illustrated in Figure 3, the hierarchical structure of postoperative complications following hepatectomy categorizes these risk factors alongside the impact of surgical techniques and complications related to tumor recurrence and liver regeneration. This figure underscores the multifaceted nature of complications, emphasizing

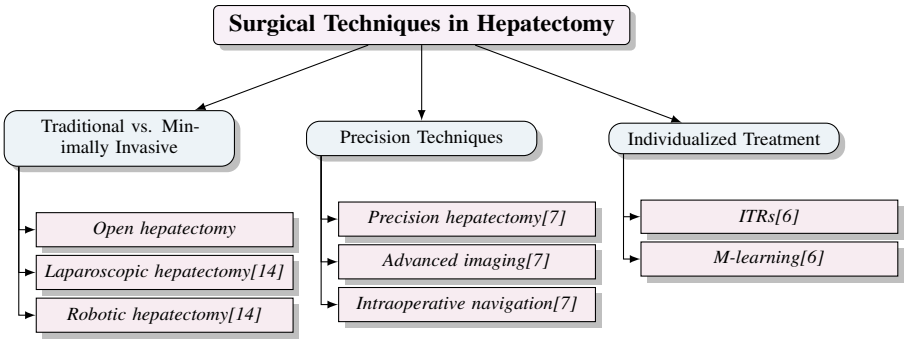

Figure 2: This figure illustrates the comparative analysis of surgical techniques for hepatectomy, categorizing them into traditional and minimally invasive methods, precision techniques, and individualized treatment approaches. It highlights the key methods and innovations aimed at improving surgical outcomes and reducing surgical site infections.

the importance of precision in surgical planning and postoperative management to enhance patient outcomes.

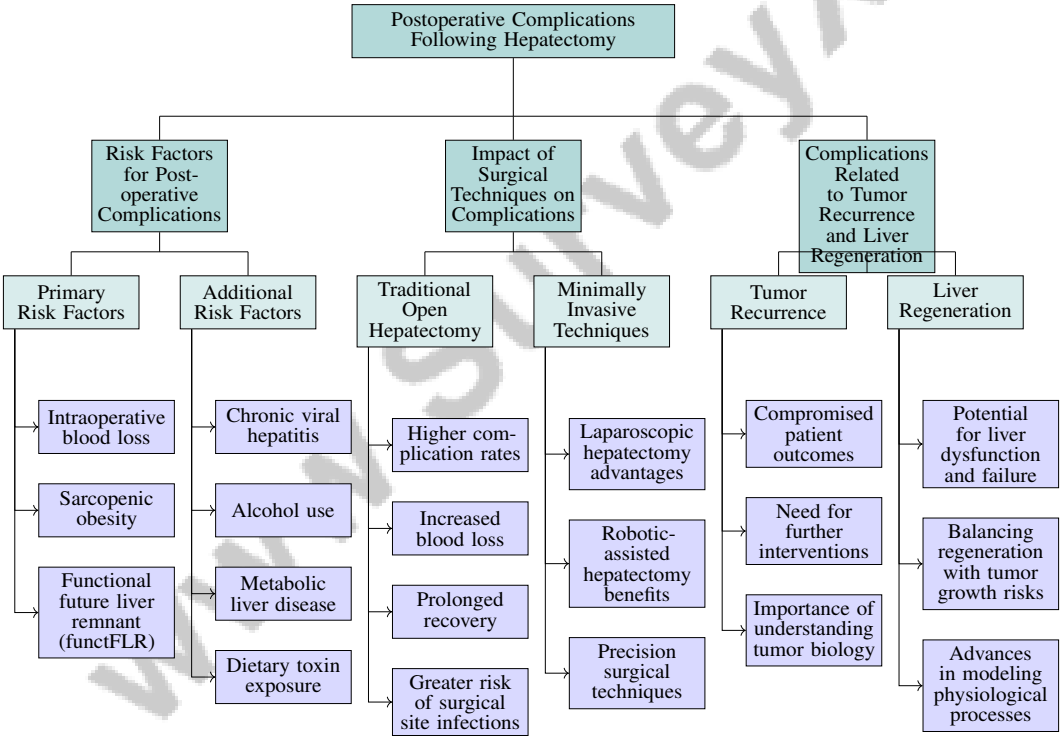

Figure 3: This figure illustrates the hierarchical structure of postoperative complications following hepatectomy, categorizing risk factors, the impact of surgical techniques, and complications related to tumor recurrence and liver regeneration. It highlights the multifaceted nature of complications, emphasizing the importance of precision in surgical planning and postoperative management to enhance patient outcomes.

4.1 Risk Factors for Postoperative Complications

Risk factors significantly impacting postoperative complications include intraoperative blood loss, sarcopenic obesity, and functFLR. Precision surgery minimizes blood loss, enhancing postoperative liver function and survival [7]. Sarcopenic obesity, characterized by muscle loss and excess fat, is an independent risk factor for increased mortality and HCC recurrence, underscoring the importance of

preoperative assessment and targeted interventions [9]. FunctFLR is a more accurate predictor of liver failure post-resection than traditional volumetric assessments, aiding in surgical planning by identifying higher-risk patients [15]. Additional factors such as chronic viral hepatitis, alcohol use, metabolic liver disease, and dietary toxin exposure complicate the clinical landscape, necessitating thorough preoperative evaluations and individualized approaches to enhance treatment efficacy and improve survival rates [4, 10, 3, 9].

4.2 Impact of Surgical Techniques on Complications

Surgical technique selection in hepatectomy for HCC significantly affects postoperative complications. Traditional open hepatectomy is associated with higher complication rates due to its invasive nature, resulting in increased blood loss, prolonged recovery, and greater risk of surgical site infections (SSIs) [7]. Minimally invasive techniques, such as laparoscopic and robotic hepatectomy, reduce these risks by minimizing intraoperative trauma and facilitating quicker recovery [14]. Laparoscopic hepatectomy offers advantages like reduced blood loss, shorter hospital stays, and lower morbidity. However, it requires significant expertise and may not suit all patients, especially those with complex tumors or significant liver disease. Robotic-assisted hepatectomy enhances laparoscopic benefits with improved dexterity and precision, reducing complications like bile leaks and liver failure, despite potentially longer operative times that may increase anesthesia risks [14]. Precision surgical techniques, guided by advanced imaging and intraoperative navigation, optimize outcomes by ensuring accurate resection margins and preserving healthy tissue [7]. Employing individualized treatment rules (ITRs) and multicategory matched learning (M-learning) in surgical planning allows tailored approaches that consider each patient's unique characteristics, potentially reducing postoperative complications [6]. The evolution of surgical techniques highlights the need for method selection based on patient-specific factors and institutional capabilities, leveraging technological advancements to improve precision and address high HCC fatality rates [10, 7, 14].

4.3 Complications Related to Tumor Recurrence and Liver Regeneration

Complications related to tumor recurrence and liver regeneration post-hepatectomy are critical in HCC management. Tumor recurrence compromises patient outcomes, necessitating further interventions. Understanding tumor biology and microenvironment interactions is essential for developing predictive models and tailored treatments to minimize risks [8]. Liver regeneration, crucial for restoring function, may lead to complications like liver dysfunction and failure if aberrant. Balancing effective regeneration and residual tumor growth risks requires careful monitoring.

Figure 4 illustrates the critical aspects of managing complications in hepatocellular carcinoma (HCC) management, focusing on tumor recurrence and liver regeneration. This figure highlights the importance of predictive models, biological interactions, and tailored treatments for tumor recurrence, while emphasizing liver dysfunction, modeling advances, and patient-specific data in liver regeneration. Advances in modeling physiological and pathological processes provide insights for optimizing surgical and postoperative care [8]. Physics-based tissue simulator models capture interactions influencing tumor recurrence and liver regeneration, enabling scenario simulations that anticipate complications and adjust treatment plans. Incorporating patient-specific data enhances postoperative management precision, potentially reducing adverse outcomes [8].

Managing the complexities of tumor recurrence and liver regeneration post-hepatectomy necessitates integrating biological mechanisms with advanced modeling techniques. Multiagent-based simulations reflect cell interactions and microenvironments, facilitating predictions of HCC recurrence and regeneration dynamics, supporting personalized treatment strategies by tailoring model parameters to individual characteristics, enhancing clinical decision-making processes [9, 8, 18, 14, 4].

5 Strategies for Infection Prevention in Liver Cancer Surgery

5.1 Preoperative Assessments and Individualized Surgical Planning

Preoperative assessments and individualized surgical planning are crucial for reducing surgical site infections (SSIs) and enhancing outcomes in hepatocellular carcinoma (HCC) management. Comprehensive evaluations identify at-risk patients, enabling targeted interventions [9]. The use of multivariate transformation models refines risk identification, improving preoperative assessments

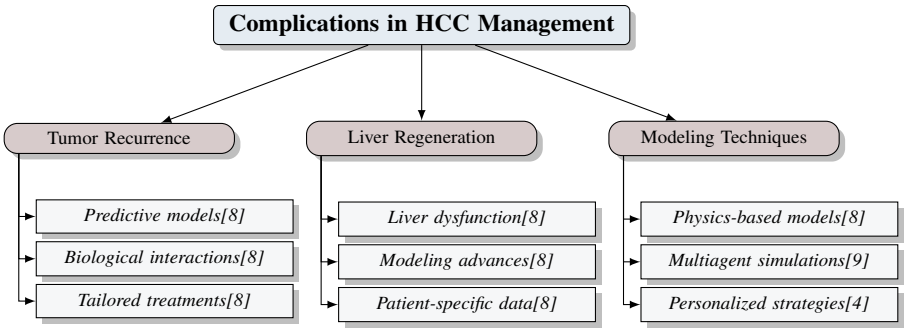

Figure 4: This figure illustrates the critical aspects of managing complications in hepatocellular carcinoma (HCC) management, focusing on tumor recurrence and liver regeneration. It highlights the importance of predictive models, biological interactions, and tailored treatments for tumor recurrence, while emphasizing liver dysfunction, modeling advances, and patient-specific data in liver regeneration. Additionally, the figure showcases the role of advanced modeling techniques, including physics-based models, multiagent simulations, and personalized strategies.

[2]. Integrating multi-modal data, including genetic, imaging, and clinical information, further tailors surgical strategies and infection prevention measures [16]. The functFLR informs patient selection for major surgeries by predicting post-resection liver function [15]. A framework categorizing surgical methods based on precision and effectiveness underscores the importance of detailed assessments and personalized planning, reducing complications and promoting recovery [7, 6]. Proficiency in both open and laparoscopic techniques is essential for implementing these tailored plans [14]. Public health measures, such as universal hepatitis B virus (HBV) vaccination, contribute to infection prevention by reducing HBV-related HCC incidence [5]. Agent-based models simulating patient-specific interactions enhance preoperative planning by elucidating liver regeneration processes and potential complications [8]. Emphasizing personalized medicine in HCC treatment requires therapies tailored to individual characteristics, focusing on biological mechanisms underlying HCC progression. Future research should integrate multi-omics and develop strategies based on molecular profiles and immune responses [1]. Understanding tumor biology and socioeconomic factors will advance therapeutic strategies and infection prevention [4].

5.2 Implementation of Preventive Measures

Effective preventive measures are vital for reducing SSIs in hepatectomy for HCC. Bilinear formulation for processing dynamic wound data enables SSI onset prediction, facilitating timely interventions [12]. Adherence to guidelines, such as short-term blood glucose control and ceasing prophylactic antibiotics at incision closure, minimizes infection risk and prevents antibiotic resistance [11]. High compliance with bundled care protocols, incorporating multiple preventive measures, achieves optimal SSI prevention outcomes [11]. Preventive measures must adapt to local factors and healthcare settings. In Ethiopia, a focused dataset benchmarks surgical practices, combining local predictors for accurate SSI risk assessment [13]. A comprehensive strategy integrating advanced predictive modeling, strict adherence to clinical guidelines, and local practices is essential for enhancing disease diagnosis and treatment outcomes [12, 6, 2, 11, 16]. This holistic approach is crucial for reducing SSI burdens in liver cancer surgery and improving patient outcomes.

5.3 Innovations in Surgical Techniques

Recent innovations in surgical techniques for hepatectomy in HCC management focus on minimizing infection risks and improving outcomes. Advancements in immunotherapy and targeted drug delivery systems synergize with surgical interventions, reducing postoperative complications [18]. Robotic hepatectomy offers enhanced precision and potentially shorter learning curves compared to traditional laparoscopic methods. Improved dexterity and visualization facilitate meticulous dissection and suturing, critical for minimizing tissue trauma and SSIs [14]. Agent-based models provide insights into cellular interactions during and after surgery, aiding in understanding liver regeneration and healing. These models simulate surgical scenarios, helping anticipate complications and optimize strategies tailored to patient profiles [8]. Integrating advanced surgical techniques, such as robotic

hepatectomy and biomarker-driven diagnostics, signifies a transformative shift in liver cancer surgery, enhancing patient outcomes and minimizing infection risks. Ongoing research into robotic systems, personalized screening protocols, and innovative treatment combinations, including immunotherapy and locoregional therapies, aims to improve surgical efficacy and survival rates for HCC patients [4, 10, 14].

5.4 Postoperative Care and Monitoring

Postoperative care and monitoring are critical for preventing SSIs following hepatectomy for HCC. Effective management strategies are essential for minimizing infection risks and enhancing recovery. Key objectives include maintaining optimal physiological conditions that support healing and reducing infection likelihood through rigorous monitoring of vital signs, wound sites, and laboratory parameters to detect early signs of infection or complications [11]. Advanced monitoring technologies, such as dynamic wound data processing and continuous glucose monitoring, improve SSI detection and management, enabling prompt responses to deviations from expected recovery patterns [12]. Predictive models incorporating patient-specific data enhance postoperative risk assessment accuracy, allowing for tailored interventions [8]. Comprehensive postoperative care also encompasses pain management and the prevention of complications like deep vein thrombosis and pulmonary embolism, which can indirectly affect infection rates. Early mobilization and respiratory exercises promote circulation and reduce respiratory complications, contributing to robust recovery [14]. The role of interdisciplinary care teams in postoperative management is crucial. Collaboration among surgeons, nurses, infection control specialists, and other healthcare professionals is essential for implementing evidence-based practices and adhering to infection prevention protocols. This team-based approach facilitates information sharing and care coordination, ultimately improving patient outcomes and reducing SSI incidence [11].

6 Conclusion

This survey on hepatocellular carcinoma (HCC) and hepatectomy emphasizes the critical need for a comprehensive treatment framework and robust infection prevention measures to improve patient outcomes and survival rates. The findings advocate for the adoption of precision hepatectomy as a superior approach to managing primary liver cancer, offering substantial improvements in patient care. The integration of advanced predictive models with multi-modal data is highlighted as a significant advancement, enhancing diagnostic precision and suggesting potential refinements in clinical practices associated with HCC.

The survey identifies a pressing demand for innovative therapeutic options and tailored treatment strategies, especially for patients with advanced HCC, to optimize clinical results. Future research directions include the development of personalized surveillance protocols, investigation into down-staging for transplant eligibility, and the broader application of immunotherapy across all stages of HCC. Additionally, advancements in diagnostic techniques and a more profound understanding of HCC's immune landscape are crucial for improving patient outcomes, offering valuable insights into disease progression and treatment efficacy.

Prioritizing the establishment of standardized protocols for surgical site infection (SSI) prevention is essential, along with exploring the use of topical antibiotics and enhancing surveillance methods post-discharge. The survey underscores the importance of continuous innovation and adaptation in clinical practices to address the evolving challenges in HCC management, ensuring that healthcare strategies remain responsive to the dynamic landscape of liver cancer treatment.

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