



The emerging role of ChatGPT in cancer and burn research: Applications in wound healing and regenerative medicine

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ABSTRACT

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Artificial intelligence (AI) is increasingly shaping biomedical sciences, offering opportunities to accelerate discovery and translation. Chat Generative Pre-trained Transformer (ChatGPT), as a large language model, demonstrates potential to enhance cancer research, tissue repair, and burn care by rapidly synthesizing evidence, generating hypotheses, and supporting decision-making. This review examines ChatGPT's emerging role in oncology and regenerative medicine, emphasizing the biological parallels between tumor progression and wound healing, including immune modulation, angiogenesis, fibroblast activation, and extracellular matrix remodeling. In oncology, ChatGPT may facilitate the identification of biomarkers, drug discovery, and the development of personalized therapeutic strategies. In regenerative medicine, it can assist in designing biomaterials, optimizing scaffolds, and contextualizing multi-omics data to accelerate tissue engineering. In burn management, ChatGPT shows promise in wound assessment, infection monitoring, fluid resuscitation guidance, scar prediction, and clinical education. To illustrate these applications, we conducted a conceptual simulation of ChatGPT responses in burn care, highlighting its utility for rapid evidence retrieval and training support. Despite these opportunities, ChatGPT faces critical limitations: a lack of domain expertise, contextual misinterpretation, data bias, and reliance on validation by human experts. Ethical challenges, including transparency, data privacy, and clinical reliability, further underscore the need for a cautious approach to integrating these technologies. Overall, ChatGPT should be considered a complementary assistant rather than a replacement for scientific and clinical expertise. With responsible implementation, continuous refinement, and interdisciplinary collaboration, it holds the potential to transform cancer biology, wound healing, and regenerative medicine, ultimately contributing to more precise, efficient, and patient-centered healthcare.

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1. Introduction

The development of Chat Generative Pre-Trained Transformer (ChatGPT) by OpenAI marked a significant advance in natural language processing, enabling researchers to bridge human expertise with the complexity of modern science [1,2]. While early GPT models primarily focused on linguistic abilities, recent advancements have highlighted ChatGPT's potential in biomedical research, particularly in cancer biology [1,3,4]. Cancer remains a global health burden, driving rapid growth in molecular biology, precision medicine, and therapeutic innovation [5–10]. Similarly, burn injuries and wound healing cause substantial morbidity, mortality, and long-term disability worldwide. Artificial intelligence (AI), including ChatGPT, presents opportunities to enhance these fields through accelerated wound assessment, prediction of healing outcomes, and support in infection control and reconstructive surgery [1–4,10].

Initially, AI was primarily applied to streamline literature reviews and data analysis. Its ability to process vast research outputs—including clinical trials and genomic datasets—allowed rapid extraction of insights, identification of novel biomarkers, and prediction of treatment outcomes [11–15]. More recently, ChatGPT has demonstrated potential in regenerative medicine and plastic surgery by supporting hypothesis generation, treatment personalization, and decision-making based on genetic and clinical profiles [16–18]. By integrating diverse molecular and clinical data, ChatGPT contributes to precision therapies that maximize efficacy while reducing side effects. As confidence in its capabilities grew, ChatGPT evolved into a versatile tool for exploring complex questions in cell and tissue biology [19–22]. Given that cancer and wound healing share key pathways such as immune modulation, fibroblast activity, and growth factor signaling, insights from oncology can be translated into wound care and regenerative medicine [23,24]. AI tools can also accelerate biomaterials discovery, scaffold optimization, and the translation from preclinical to clinical studies. However, they remain dependent on high-quality datasets and are challenged by bias, a lack of standardization, and limited explainability [18,25–35]. Despite these limitations, ChatGPT holds promise for advancing research and clinical practice. Addressing concerns related to data privacy, bias, and transparency is crucial for the safe and reliable integration of data into medicine [36,37]. This article, therefore, explores ChatGPT's emerging role in cancer research, tissue repair, wound healing, and burn care, presenting both opportunities and challenges for its responsible use.

2. Methods

2.1 Hypothetical Burn Care Simulation with ChatGPT

To illustrate ChatGPT's potential applications in burn

care, we conducted a conceptual, prompt-based simulation. This study was not experimental or clinical. The simulation was purely conceptual and illustrative, based only on ChatGPT's responses to hypothetical prompts, without the use of real patient data. ChatGPT was asked targeted, clinical, and research-oriented questions related to burn injuries, and its responses were summarized to highlight potential contributions to diagnosis, treatment, and decision support.

2.2 Sample Dialogue

- Prompt: "What are current treatment options for deep partial-thickness burns?"

- ChatGPT Response (summarized): "Debridement, topical antimicrobials, early excision and grafting, fluid resuscitation guided by the Parkland formula, infection monitoring, and scar management strategies." This simulated interaction illustrates how ChatGPT can support clinicians and researchers by rapidly providing evidence-informed recommendations, while highlighting the importance of expert validation in acute care settings. Further illustrative examples of ChatGPT's responses to scientific and clinical questions are presented in Supplementary Table 1.

3. Outcomes

3.1 Literature Review and Hypothesis Generation

ChatGPT can be a valuable, creative, and intelligent assistant in an immunogenetics laboratory due to its advanced natural language processing capabilities. ChatGPT can accelerate literature exploration and propose hypotheses or experimental designs in fields such as cancer immunogenetics and tissue repair, forming a foundation for scientific inquiry. ChatGPT can propose potential research hypotheses and experimental designs based on the information gathered from the literature.

It can leverage its understanding of genetic and immunological factors to suggest novel research directions and identify knowledge gaps. This creative input can inspire scientists and steer their investigations toward unexplored avenues. Additionally, it can facilitate collaboration among researchers by bridging the gap between experts in different fields and promoting interdisciplinary approaches to link the biomedical research to clinical practices.

3.2 Personalized Medicine and Cancer Therapies

By integrating a patient's genetic profile and immune characteristics, ChatGPT can support oncologists in selecting optimal therapies and immunotherapies, thereby improving treatment precision and outcomes. Its ability to detect patterns and correlations within complex datasets may also suggest novel drug combinations or off-label applications with potential clinical benefit. Furthermore, ChatGPT can assist in early-stage drug discovery through in silico simulations

of molecular interactions, enabling the prediction of drug–target relationships and the prioritization of compounds most likely to be effective. Such approaches can reduce the time and cost traditionally required to screen large chemical libraries. Despite these advantages, predictions remain limited by the quality of training data and cannot substitute for experimental validation. Beyond therapeutics, ChatGPT may also accelerate vaccine research by scanning vast biomedical literature to identify candidate targets, predict immune interactions, and summarize evidence from clinical trials. These applications highlight its role as a complementary tool in advancing personalized oncology and cancer prevention strategies.

3.3 Tissue Repair and Wound Healing

ChatGPT can aid in tissue repair and wound healing research by accelerating literature review, hypothesis generation, and experimental design. It can rapidly synthesize findings from diverse sources, identify knowledge gaps, and suggest novel directions, such as biomaterials, growth factors, stem cell applications, or signaling pathways relevant to healing. In the laboratory, ChatGPT can support protocol optimization by comparing methodologies, drafting standard operating procedures, and troubleshooting experimental challenges.

Additionally, it can aid in data interpretation by contextualizing results within existing evidence, proposing mechanistic explanations, and even suggesting statistical approaches for analysis. Beyond research, ChatGPT can streamline grant writing, manuscript preparation, and collaborative communication, helping researchers focus more on experimentation while maintaining scientific rigor and innovation.

3.4 Applications in Burn Patient Management and Education

Beyond general wound healing, ChatGPT demonstrates specific utility in burn care. First, it can integrate clinical scoring systems and published datasets to predict healing timelines, thereby assisting clinicians in planning treatment schedules and anticipating complications. Second, by synthesizing evidence on antimicrobial dressings, fluid resuscitation guidelines,

and early excision strategies, ChatGPT may contribute to the design or refinement of infection control protocols. Ultimately, it provides significant educational value, serving as an accessible training resource for nurses, medical students, and residents. It can effectively explain burn management strategies, summarize treatment algorithms, and address frequently asked questions. Such support is particularly valuable in resource-limited settings or hospitals with restricted access to burn specialists. A summary of the main applications and limitations of ChatGPT in cancer research, wound healing, and burn care is provided in Table 1.

3.5 Lack of Contextual Understanding

ChatGPT lacks a deep understanding of context despite its impressive language capabilities. Moreover, ChatGPT can inadvertently pick up biases in the training data. This limitation can lead to inaccurate or misleading responses, particularly in complex scientific contexts or specialized domains. As an AI language model, ChatGPT requires extensive training data, which may include sensitive or proprietary information. When generating hypotheses or making critical decisions, scientists might require more transparent and justifiable explanations, which ChatGPT may not be able to provide adequately.

3.6 Lack of Domain Expertise

While ChatGPT can be trained on specific domains, such as cell biology, it remains a general language model and not a substitute for domain-specific expertise. It may not fully comprehend complex scientific concepts and may provide incorrect or incomplete information, especially in highly specialized areas of immunogenetics. The quality and diversity of the training data have a significant influence on the performance of ChatGPT. If the data is incomplete, biased, or limited in scope, it can impact the model's ability to provide accurate and reliable information. Despite being able to generate creative responses, ChatGPT is unable to interpret intuition and creativity accurately. While ChatGPT can be fine-tuned on specific datasets, significant changes in research focus or experimental designs may require additional training or adaptation, making it less flexible than human researchers.

Table 1. Applications and limitations of ChatGPT in cancer, wound healing, and burn care

Domain	Applications of ChatGPT	Key Limitations
Cancer Research	Literature review, hypothesis generation, data interpretation, education	Requires domain expertise; not a substitute for lab work
Tissue Repair & Wound Healing	Literature synthesis, hypothesis generation, protocol support, troubleshooting	Contextual understanding is limited
Burn Care	Wound assessment, infection monitoring, scar prediction, education	Needs expert validation; cannot replace clinical judgment

4. Discussion

In cancer immunogenetics, tissue repair, and regenerative medicine, massive genomic and immunological datasets are generated, creating challenges for interpretation. Artificial intelligence (AI), through advanced machine learning, can assist researchers in managing these data effectively [18,38–40]. The integration of ChatGPT into cancer immunogenetics has the potential to streamline research workflows. These functions—literature synthesis, hypothesis generation, and support for clinical decision-making—are recurring themes throughout this review, highlighting the tool's cross-disciplinary utility. By supporting clustering analysis, feature selection, and predictive modeling, ChatGPT can help uncover hidden biological patterns and complex molecular relationships [41,42]. Automating these analytical processes not only saves researchers valuable time but also allows them to focus on interpretation and hypothesis formulation. Importantly, this impartial and data-driven approach may reveal unexpected associations, driving the development of innovative therapeutic strategies and broadening current scientific understanding [43,44].

A particularly significant aspect is the shared biological hallmarks between cancer progression and wound repair. Both processes involve mechanisms such as uncontrolled cell proliferation, extracellular matrix remodeling, and cytokine-mediated signaling pathways. By leveraging AI tools like ChatGPT, these overlapping biological insights could be applied in clinical practice to predict healing trajectories, model tissue responses, and guide individualized patient management [45,46]. With simultaneous analysis of molecular and clinical datasets, predictive biomarkers can be identified, leading to optimized treatment regimens and improved patient outcomes [47,48].

Building on these shared mechanisms, recent evidence suggests that AI-driven approaches like ChatGPT could accelerate tissue repair and wound-healing research by integrating data on extracellular matrix biology, stem cell differentiation, biomaterials, and key signaling pathways such as Transforming Growth Factor-Beta (TGF- β), Wnt/ β -catenin, and Vascular Endothelial Growth Factor (VEGF) [49–51]. Fine-tuning large language models with such domain-specific data may help researchers design more effective experiments, clinicians develop personalized wound-management strategies, and engineers optimize biomaterial scaffolds. At the same time, continuous incorporation of new preclinical and clinical findings, combined with strict ethical safeguards and engagement of domain experts, remains essential to ensure reliability and mitigate bias [52–61].

Beyond research and prediction, ChatGPT also holds promise in the fields of communication and education. It can transform complex scientific terminology into accessible language for patients, thereby improving understanding, promoting shared decision-making, and

increasing adherence to treatment [62,63]. For medical trainees, ChatGPT offers interactive simulations of clinical dialogues, making it a valuable adjunct to conventional medical education [64,65]. These applications highlight the dual role of AI in both clinical and educational domains. Despite its potential, ChatGPT faces notable challenges. As a language model, it relies on pre-existing data and lacks genuine reasoning or creativity. Consequently, it may generate biased, outdated, or inaccurate outputs if not carefully validated against current evidence [66,67]. Ethical concerns are equally important. Issues of patient privacy, informed consent, and the potential misuse of AI-driven recommendations in clinical decision-making demand strict oversight [68–70].

Furthermore, the "black-box" nature of AI outputs can reduce transparency and clinician confidence if not accompanied by precise validation mechanisms. Therefore, the successful integration of ChatGPT into oncology, wound healing, and burn care requires continuous refinement, validation using reliable datasets, and collaboration among clinicians, researchers, and AI developers. Only through careful monitoring and ethical safeguards can the benefits of ChatGPT be maximized while minimizing risks [71–73].

5. Conclusion

The integration of ChatGPT into cancer biology, wound healing, and regenerative medicine offers a transformative opportunity to accelerate discovery, interpret complex datasets, and generate novel hypotheses. By analyzing large-scale genomic, immunological, and regenerative data, ChatGPT can help identify biomarkers, signaling pathways, and therapeutic targets that might otherwise remain hidden. Importantly, the shared mechanisms between cancer progression and tissue repair—such as immune modulation, stem cell activity, and extracellular matrix remodeling—create a translational bridge, enabling insights from oncology to inform wound care and regenerative strategies.

As AI technologies advance, ChatGPT's role is expected to expand from data synthesis to predictive modeling, personalized therapy design, and optimization of combination treatments. However, its outputs must undergo rigorous experimental and clinical validation to ensure safety, reliability, and applicability. When used responsibly and in close collaboration with clinicians and researchers, ChatGPT has the potential to become a pivotal tool not only in oncology but also in burn management and regenerative medicine, ultimately improving patient outcomes while reshaping the landscape of oncology, burn management, and regenerative medicine.

Supplementary files

Supplementary file 1.

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Authors' contributions

K Gh and Sh A contributed to the study conception and design. N F and T Z: Literature search and collected data. The first draft of the manuscript was written by N F and P M. All authors discussed the results and contributed to the writing of the final version. All authors have read and approved the final version of the manuscript for publication.

Conflict of interest

No potential conflict of interest was reported by the authors.

Ethical declarations

Not applicable.

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