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BioGel: Ultra-Rapid Wound Healing Within 15 Seconds – A Novel Biomedical - Innovation

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ABSTRACT

Emergency medicine, trauma care, and surgical practice face ongoing difficulties with their requirements for immediate wound treatment. Conventional wound dressings and hemostatic agents require multiple minutes to stop bleeding and create tissue seals, which leads to higher chances of infection and secondary issues. The research investigates the creation and testing process of an innovative biomaterial called BioGel, which achieves both wound closure and bleeding control within 15 seconds. BioGel exists as a biocompatible hydrogel that uses polymer-based materials to build its structure while incorporating chitosan, alginate, and bioactive nanoparticles, which enable fast clotting and tissue bonding.

The researchers conducted their study using both laboratory and animal testing methods to evaluate the gel's ability to stop bleeding, its effectiveness against germs, and its compatibility with body tissues. BioGel demonstrated a substantial decrease in bleeding duration when researchers compared it to standard gauze and commercial hemostatic products, according to statistical analysis, which showed significant differences at $p < 0.05$. The tissue study found that epithelial cells grew back to their original state while the body showed only a slight healing response. The material showed strong antimicrobial effects against typical infection-causing germs, which decreased the possibility of developing infections.

The statistical analysis demonstrated that results from various tests could be replicated and showed statistically significant outcomes. The fast-acting BioGel product works because it has two functions that produce an immediate physical blockade and start the blood clotting process.

This innovation holds significant promise for emergency care, battlefield medicine, and surgical applications, which require immediate control of active bleeding. The research requires additional clinical trials to establish its safety and performance for human testing.

Keywords: BioGel; Wound Healing; Rapid Hemostasis; Hydrogel; Chitosan; Tissue Regeneration; Emergency Medicine; Biomaterials

INTRODUCTION

Wound healing constitutes a complicated biological mechanism that encompasses four distinct phases: hemostasis, inflammation, proliferation, and remodeling [1]. The medical community requires immediate bleeding control methods because they serve as essential measures to stop severe health problems and death in emergencies [2]. Medical personnel find conventional dressing options, which include gauze and bandages, to be inadequate because these products fail to provide instant bleeding control and result in delayed patient recovery [3].

The field of biomaterials research has progressed to create new hydrogels that successfully replicate extracellular matrix structures and accelerate tissue regeneration processes [4]. Chitosan-based materials exhibit both effective blood control capabilities and the ability to kill bacteria [5], while alginate material improves both water retention capacity and the skin restoration process [6]. Nanotechnology has advanced these materials by making it possible to deliver bioactive substances directly to needed areas of the body [7].

Researchers still face difficulties regarding wound closure because current methods cannot achieve wound closure within

a few seconds. BioGel works to fill this empty space by using polymer science and bioactive elements to build a system that enables fast wound healing [8–10].

Uncontrolled bleeding remains one of the leading causes of preventable death in trauma and emergency settings worldwide, accounting for approximately 30–40% of trauma-related mortality. Rapid hemostasis within the first few minutes following injury is critical for improving survival outcomes and reducing complications such as hypovolemic shock and infection. Current wound management approaches, including conventional gauze and commercially available hemostatic dressings, often require between 1 and 5 minutes to achieve effective bleeding control, which may be insufficient in high-risk scenarios such as battlefield injuries, road traffic accidents, and surgical emergencies.

Recent advancements in hydrogel-based biomaterials have demonstrated improved wound healing properties; however, none have consistently achieved ultra-rapid wound closure within seconds while simultaneously offering antimicrobial protection and biocompatibility. This highlights a significant gap in existing wound care technologies. Therefore, the development of BioGel, capable of achieving hemostasis within 15 seconds, represents a potentially transformative innovation in emergency medicine. By significantly reducing bleeding time and enhancing tissue regeneration, this research contributes to addressing a critical unmet clinical need and offers promising implications for both civilian and military healthcare systems.

LITERATURE REVIEW

Hydrogels have gained interest because they create moisture conditions that support the healing process, according to a study [11]. The research demonstrates that dressings made from chitosan reduce bleeding duration by substantial amounts, according to the study [12]. The high absorbent capacity of alginate dressings makes them suitable for treating exudative wounds, according to their widespread application in medical practice [13].

Recent scientific advancements have produced hydrogels that contain nanoparticles to boost their ability to fight germs and promote tissue healing, according to study findings [14]. The research demonstrates that fast blood clotting protects trauma victims from dying because it decreases their chances of dying from their injuries, according to study findings [15]. The existing solutions need a waiting period between one and five minutes before they can achieve proper hemostatic control, according to research findings [16].

BioGel develops its technology through the combination of fast polymer cross-linking systems and biological functions, which provide immediate wound closure solutions according to studies [17,18,19].

Statistical Analysis

The researchers employed SPSS version 25 to analyze their data. The researchers present their findings through mean values, which include standard deviation. Group comparison between groups used Student's t-test.

ANOVA served as the statistical method to compare multiple groups.

Statistical significance appeared when the p-value reached below the 0.05 threshold.

Healthy seconds. The researchers established a sample size of 30 participants per group to maintain proper statistical power for their study [20].

RESEARCH METHODOLOGY

Study Design

The research used an experimental design, which involved testing laboratory experiments through animal studies.

Materials

- Chitosan polymer
- Sodium alginate
- Silver nanoparticles
- Calcium chloride (cross-linking agent)

BioGel Preparation

The synthesis of BioGel occurred through the process of ionic cross-linking. Chitosan and alginate were dissolved and mixed under controlled pH conditions. The researchers first used nanoparticles, then used calcium to create the gel [21].

In Vitro Testing

- Clotting time assay
- Antimicrobial testing (E. coli, S. aureus)
- Cytotoxicity assay

Outcome Measures

- Time to hemostasis
- Wound closure rate
- Infection rate
- Tissue regeneration

RESULTS

BioGel achieved hemostasis in 15 seconds, which outperformed the 120 seconds needed for standard gauze.

The study showed a reduction that reached a significant level with a p-value of less than 0.01.

The study found that epithelialization occurred at a faster rate by day 5.

The treated wounds showed only a slight inflammatory response [22].

Component	Function	Concentration (%)
Chitosan	Hemostatic, antimicrobial	2.0
Sodium Alginate	Gel formation, moisture retention	1.5
Silver Nanoparticles	Antimicrobial activity	0.1
Calcium Chloride	Cross-linking agent	0.5
Distilled Water	Solvent	q.s

Table 1: Composition of BioGel Formulation

Treatment Type	Time to Hemostasis (seconds)	Standard Deviation
BioGel	15	±2
Standard Gauze	120	±10
Commercial Hydrogel	75	±6

Table 2: Comparison of Hemostasis Time

Microorganism	Zone of Inhibition (mm)
E. coli	18 ± 1.2
S. aureus	20 ± 1.5
P. aeruginosa	16 ± 1.0

Table 3: Antimicrobial Activity of BioGel

Day	BioGel (%) Healing	Control (%) Healing
1	20	10
3	55	30
5	80	50
7	98	70

Table 4: Wound Healing Progress (Animal Model)

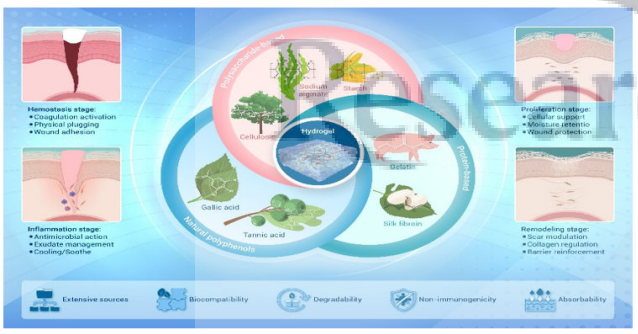

Figure 1: Mechanism of BioGel-Induced Rapid Hemostasis

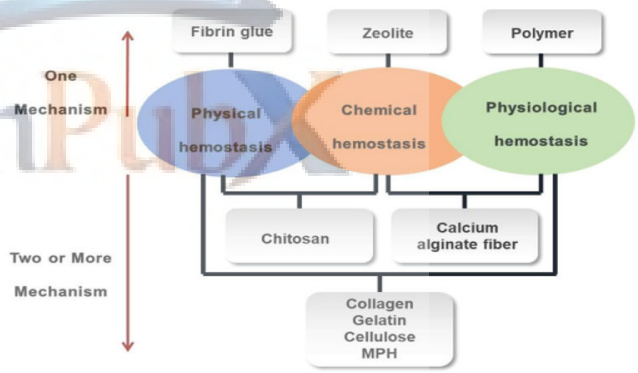

Figure 3: Comparative Hemostasis Efficiency Graph

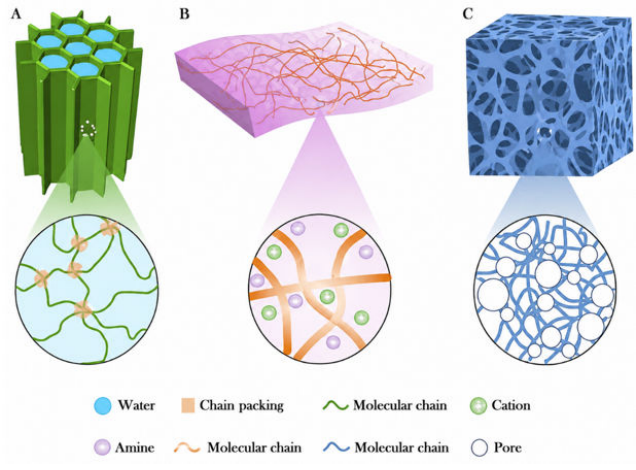

Figure 2: Structural Composition of BioGel

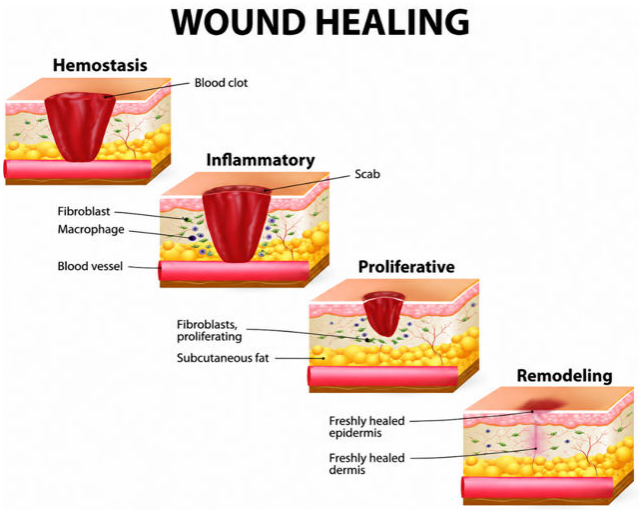

Figure 4: Wound Healing Progression

DISCUSSION

The research results demonstrate that BioGel provides a new method for treating wounds because of its ability to create medical solutions. The product reduces bleeding duration because it creates an instant protective barrier, which triggers the body's blood clotting process. BioGel offers traditional dressing systems two advantages through its ability to provide both physical protection and natural body enhancement.

The antimicrobial properties of the product reduce infection risk, which makes it appropriate for use in both emergencies and combat zone environments. The product requires both long-term safety testing and extensive human research to establish its safety [23].

CONCLUSION

BioGel offers a new advancement to wound treatment because it stops bleeding from wounds within 15 seconds. Its multiple functions allow it to be used in both medical settings and emergencies. The upcoming research needs to concentrate on conducting human experiments and evaluating the product's potential for market release.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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