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Hemocoll: A Novel Hemostatic Agent in Periodontal Surgery

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ABSTRACT: Effective hemostasis is crucial in periodontal surgical procedures to ensure optimal healing and patient comfort. Hemocoll, an absorbable sterile fibrillar collagen, has emerged as a promising hemostatic agent in periodontics due to its superior clotting properties and biocompatibility. This review explores the role of Hemocoll in periodontal surgeries, particularly in controlling bleeding at donor and recipient sites, stabilizing blood clots, and promoting faster wound healing. Its mechanism of action involves platelet aggregation and the activation of the intrinsic coagulation pathway, facilitating efficient clot formation. Additionally, Hemocoll is resorbable, eliminating the need for removal and minimizing post-operative complications. Clinical studies have demonstrated its efficacy in various periodontal procedures, including free gingival grafting and flap surgeries. Given its advantages over conventional hemostatic agents, Hemocoll represents a valuable adjunct in periodontal therapy, enhancing surgical outcomes and patient recovery. Further research is warranted to explore its long-term effects and potential applications in regenerative periodontics.

KEYWORDS: Hemocoll, periodontal surgery, implants

I. INTRODUCTION

- Periodontal plastic surgeries are turning out to be the promising treatment modality in the field of dentistry. In which achieving hemostasis soon after the surgery and prognostic wound healing are the two inevitable essential tools for a successful periodontal surgery.
- In this review we have dived in to the deep sea of various hemostatic agents and have defined in detail about their pros and cons and their clinical outcomes based on various studies.
- The major purpose of the review is to introduce a promising adjunct to regular hemostatic agents –"THE HEMOCOLL".

- An overview of blood coagulation:-
- Purpose:
- To form a stable blood clot at the site of injury to prevent excessive blood loss and initiate wound healing.

Key Steps in Coagulation:

1. Vascular Spasm

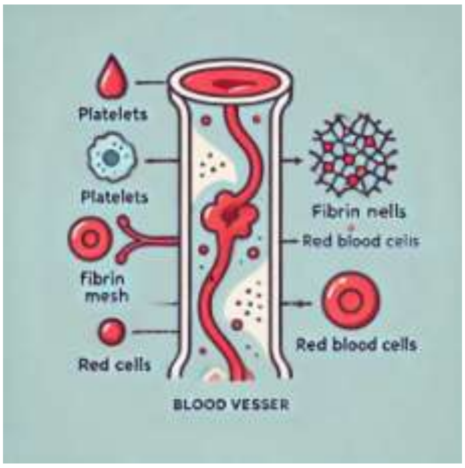
- Immediate vasoconstriction of blood vessels to reduce blood flow.

2. Platelet Plug Formation (Primary Hemostasis)

- Platelet adhesion to exposed collagen (via von Willebrand factor).
- **Platelet activation:** shape change, release of granules (ADP, thromboxane A2).
- **Platelet aggregation:** forms a temporary "platelet plug".

3. Coagulation Cascade (Secondary Hemostasis)

- The Coagulation Cascade, the core process in blood clotting, involving a series of enzymatic reactions that lead to the formation of a fibrin clot.



- **Coagulation Cascade**
- **Divided into Three Pathways:**

1. Intrinsic Pathway

- (Activated by trauma inside the blood vessel, or contact with negatively charged surfaces)

- **Factor XII → XIIa**
- **XIIa activates Factor XI → XIa**
- **XIa activates Factor IX → IXa**

- **IXa + Factor VIIIa (cofactor) → activate Factor X**
- **Trigger: Exposure to collagen, subendothelium, or foreign surface.**

2. Extrinsic Pathway

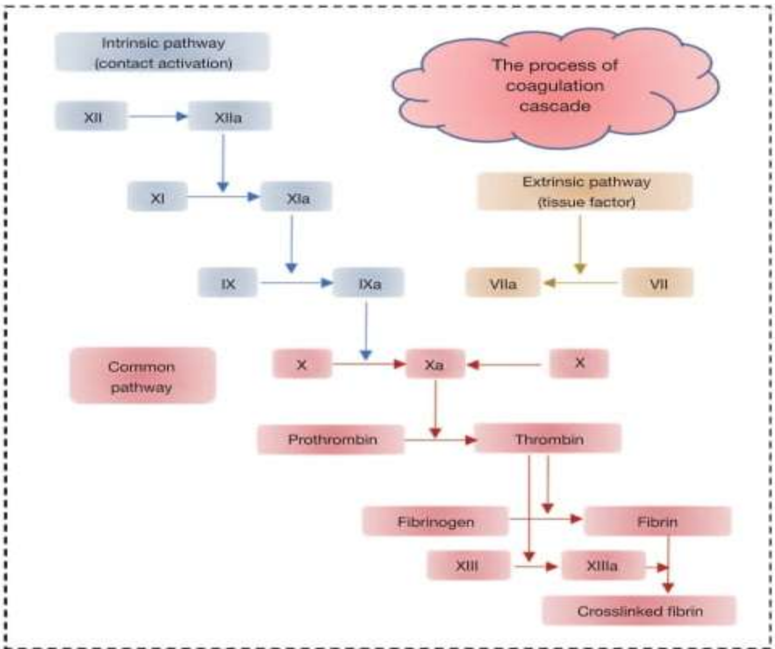
- (Activated by external trauma causing blood to escape the vessel)
- **Tissue Factor (TF) released from damaged tissue binds Factor VII**
- **TF + VII → VIIa-TF complex**
- **This complex activates Factor X**
- **Trigger: Tissue injury exposing Tissue Factor.**

3. Common Pathway

- (Both intrinsic and extrinsic pathways converge here)
- **Factor X → Xa**
- **Xa + Factor Va convert Prothrombin (Factor II) → Thrombin (IIa)**

- **Thrombin converts Fibrinogen (Factor I) → Fibrin (Ia)**
- **Fibrin forms a mesh, stabilized by Factor XIIIa (activated by thrombin)**

Schematic Representation:



Key Points:

- Calcium (Factor IV) is essential in many steps.
- Thrombin amplifies the cascade by activating Factors V, VIII, XI, XIII.
- Fibrin is cross-linked by Factor XIIIa for clot strength.
- Regulated by anticoagulants like Antithrombin III and Protein C/S.

- **HEMOSTATIC AGENTS :-**

CLASSIFICATION OF HEMOSTATIC AGENT :

Based on mechanism of action:
Classification of Hemostatic Agents

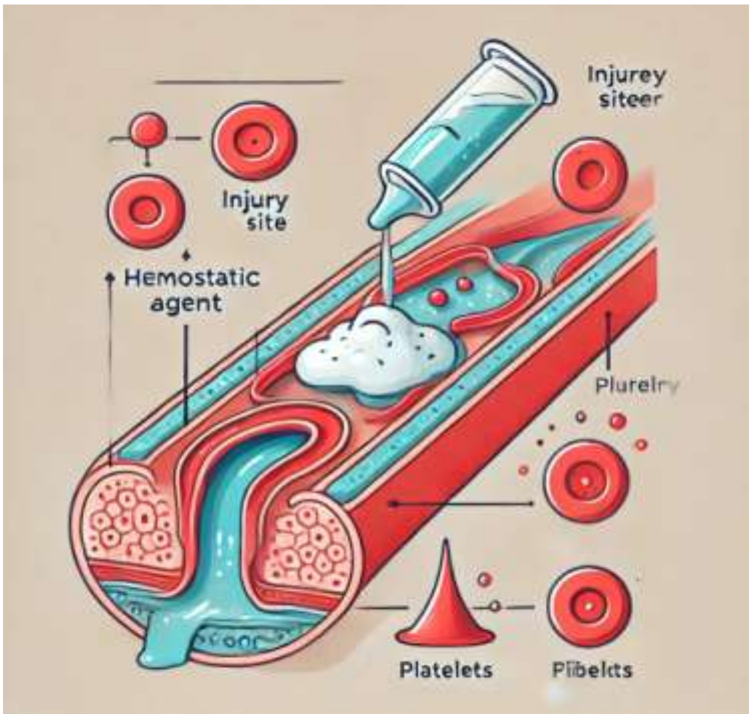
- 1. Mechanical (Passive)
  - Gelatin sponge (Gelfoam)
  - Collagen (Helistat)
  - Oxidized regenerated cellulose (Surgicel)
- 2. Active
  - Thrombin
  - Fibrin sealants (Tisseel, Evicel)
- 3. Flowable
  - Floseal
  - Surgiflo
- 4. Topical Sealants & Adhesives
  - Fibrin glue
  - Cyanoacrylate
  - PEG-based sealants

CLASSIFICATION BASED ON MATERIAL USED IN HEMOSTATIC AGENTS:

Classification of Hemostatic Agents Based on Material

- 1. Polysaccharide-Based Agents
  - Oxidized regenerated cellulose (Surgicel)
  - Chitosan (Celox, HemCon)
  - Starch-derived agents (Arista)
- 2. Protein-Based Agents
  - Collagen (Helistat, Collastat)
  - Gelatin (Gelfoam, Surgifoam)
  - Fibrin sealants (Tisseel, Evicel)
- 3. Mineral-Based Agents
  - Zeolite (QuikClot)
- 4. Synthetic Agents
  - Cyanoacrylate adhesives
  - Polyethylene glycol (PEG)-based sealants

CLASSIFICATION OF HEMOSTATIC AGENTS BASED ON MATERIAL, INCLUDING SOURCES, MECHANISMS, AND COMMON EXAMPLES.



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1. POLYSACCHARIDE-BASED AGENTS
Derived from plant or marine sources; primarily act by absorbing water and concentrating clotting factors.

Oxidized Regenerated Cellulose (ORC)
Source: Plant-derived cellulose
Mechanism: Provides a matrix for platelet aggregation, acidic pH helps bacteriostasis.
Examples: Surgicel, Oxycel

Chitosan
Source: Derived from chitin (shellfish exoskeleton)
Mechanism: Positively charged; promotes red blood cell and platelet adhesion.
Examples: Celox, HemCon

Starch-Derived Agents
Source: Plant starch
Mechanism: Absorb water, concentrate clotting factors, accelerate clotting.
Examples: Arista AH

2. PROTEIN-BASED AGENTS
Animal- or human-derived proteins; act via mechanical support and/or direct clotting cascade activation.

Collagen
Source: Bovine or porcine collagen
Mechanism: Platelet activation and aggregation scaffold.
Examples: Helistat, Collastat

Gelatin
Source: Bovine or porcine skin/bone
Mechanism: Expands upon contact with blood; supports clot formation.
Examples: Gelfoam, Surgifoam

Fibrin Sealants (Fibrin Glue)
Source: Human fibrinogen and thrombin
Mechanism: Mimic final coagulation step (fibrin clot formation).
Examples: Tisseel, Evicel

3. MINERAL-BASED AGENTS
Inorganic materials; often used in emergency/trauma settings for rapid clotting.

Zeolite
Source: Volcanic mineral
Mechanism: Absorbs water rapidly, concentrates clotting factors.
Examples: QuikClot (older generation)
Note: May cause heat release (exothermic reaction).

4. SYNTHETIC AGENTS
Chemically manufactured materials; often used as sealants or adhesives.

Cyanoacrylate Adhesives
Source: Synthetic polymer
Mechanism: Tissue adhesive; forms a barrier and seals vessels.
Examples: Dermabond, Histoacryl

Polyethylene Glycol (PEG)-Based Sealants
Source: Synthetic hydrogels
Mechanism: Swell and seal tissues; absorb fluid.
Examples: CoSeal, DuraSeal

II. OXIDIZED REGENERATED CELLULOSE

- **Composition:-**

Oxidized Regenerated Cellulose (ORC) is a biodegradable and bioabsorbable hemostatic agent derived from plant-based cellulose.It undergoes oxidation to form carboxylated cellulose, which enhances its hemostatic properties. The final product is typically available in a gauze or sponge-like form**.**

KEY COMPONENTS:-
- Oxidized cellulose fibers(carboxylated polysaccharides)
- Low pH environment(promotes clot formation)
- Biodegradable matrix(absorbed within 1-2 weeks).

MECHANISM OF ACTION:-
- ORC achieves hemostasis primarily through physical & biochemical interactions.
- Absorption of blood & fluid – ORC has a high affinity for water and rapidly absorbs exudates , concentrating platelets & clotting factors at the site of bleeding.
- Acidic pH promotes coagulation-the ORC lowers the pH of the microenvironment, enhancing platelet aggregation and fibrin formation.
- Mechanical barrier formation- ORC forms a gel-like matrix when in contact with blood, acting as a physical barrier to prevent further bleeding.
- Activation of intrinsic clotting casecade – ORC indirectly stimulated clot formation by creating a localized acidic environment that accelerates the clotting casecade , particularly the conversion of fibrinogen to fibrin.

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- Biodegradation & healing – the material is enzymatically degraded into glucose & acidicbyproducts , which areeventually absorbed by the body without causing a foreign reaction.

- **ADVANTAGE:-**
  - Effective hemostasis
  - Biodegradable & absorbable
  - Bacteriostatic properties
  - Promotes wound healing
  - Easy to use
  - Compatible with bone grafting.

- **DISADVANTAGE:-**
  - Tissue reaction in some cases
  - Delayed healing in large quantities
  - Swelling & expansion
  - Not suitable for large arterial bleeding
  - Potential interference with bone healing
  - Expensive .

CLINICAL SIGNIFICANCE:-

- **HEMOSTASIS TIME:-** Median time to hemostasis was significantly shorter when ORC is applied in the management of soft tissue graft donor site bleeding.
- **HEALING:-** studies shows that 21 days post operative period of periodontal surgery with ORC shows normal to rapid healing.
- **MEAN SHRINKAGE :-** studies shows at the 10^{th} month of post operative period 24% mean tissue shrinkage of recipient graft site is seen.
- **PRIMARY BLEEDING:-** ORC shows in case of graft harvesting from palate 40% of donor sites have primary bleeding spots. This is one of the major disadvantages in ORC.

III. ABSORBABLE GELATIN SPONGE

- **Composition:-**

Absorbable gelatin sponges are hemostatic agents derived from purified porcine or bovine collagen. The sponge is made from gelatin, which is a denatured form of collagen, and is designed to be biocompatible and absorbable.

KEY COMPONENTS:-

- Gelatin type A or type B collagen derived protein
- Porous structure
- pH neutral or slightly acidic
- Sterile processing.

MECHANISM OF ACTION:-

- Absorbable gelatin sponges control bleeding through a combination of mechanical hemostasis and biochemical interactions.
- Rapid Absorption of Blood – The porous sponge structure absorbs blood up to 40–50 times its weight,helping to concentrate platelets and clotting factors at the site.
- Mechanical Tamponade Effect – The sponge physically fills the bleeding site, applying gentle pressure to stop hemorrhage.
- Platelet Activation and Clot Formation – The absorbed blood components stimulate platelet aggregation and facilitate fibrin clot development.
- Stimulation of Coagulation Cascade – While it does not actively trigger coagulation, the sponge provides a scaffold that enhances clot stability and promotes faster coagulation.
- Bioabsorption and Degradation – The gelatin is gradually broken down by proteolytic enzymes and absorbed by the body within 4–6 weeks, leaving minimal residue.

- **ADVANTAGE:-**
  - Effective Hemostasis
  - Biodegradable and Absorbable.
  - Porous Structure Enhances Healing.
  - Minimal Tissue Reaction.
  - Easy to Handle and Apply.
  - Sterile and Safe.
  - Compatible with Other Treatments.

- **DISADVANTAGE:-**
  - Swelling After Absorption.
  - Not Suitable for Heavy Arterial Bleeding.
  - Delayed Bone Healing in Some Cases.
  - Possible Foreign Body Reaction.
  - Short-Term Hemostatic Effect.

CLINICAL CONSIDERATION:-

- **HEMOSTASIS TIME:** the hemostasis is achieved in significanty very shorter period of time when compared with other hemostatic agents while managing soft tissue graft donor site bleeding.
- **SOCKET SEALING:** Absorbable gelatin shows successful results when placed in immediate implant as a socket sealing membrane to prevent implant from oral flora.
- **HEALING:** unaltered healing in case of both donor site bleeding and as a socket sealing barrier in immediate implants.
- **HANDLING:** it is easy to handle and application is not technique sensitive in case of emergency management.
- **COST:** it is a cost effective hemostatic agent yet comparatively less expensive than the other hemostatic agents.

IV. DENSE POLYTETRAFLUOROETHYLENE MEMBRANE(D-PTFE)

- **Composition:**

Dense polytetrafluoroethylene (d-PTFE) membranes are non-resorbable barrier membranes used in periodontal andimplant surgeries, particularly for guided tissue regeneration (GTR) and guided bone regeneration (GBR).

KEY COPONENTS:-

- Polytetrafluorethylene (PTFE)
- Dense structure
- Non – absorbable material.

MECHANISM OF ACTION:-

- d-PTFE membranes function as a barrier to selectively facilitate periodontal and bone regeneration.
- Exclusion of Unwanted Cells – The dense structure prevents epithelial and connective tissue ingrowth, allowing bone and periodontal ligament cells to repopulate the defect.
- Space Maintenance – The membrane helps maintain space for bone and periodontal regeneration by preventing soft tissue collapse into the defect.
- Prevention of Bacterial Contamination – The non-porous nature of d-PTFE resists bacterial infiltration, making it suitable for exposed applications (e.g., socket preservation).
- Facilitates Angiogenesis and Osteogenesis – By protecting the healing site from external disturbances, it allows for new blood vessel formation and bone growth.
- Stabilization of Grafts – Often used with bone grafts to enhance bone regeneration in defects or extraction sockets.

- **ADVANTAGE:-**

- Prevents Soft Tissue Ingrowth.
- Bacterial Resistance.
- Excellent Space Maintenance.
- Biocompatible and Chemically Inert.
- Can Be Used Without Primary Closure.
- Supports Bone Grafting Procedures.

- **DISADVANTAGE:-**

- Non-Resorbable.
- Risk of Membrane Exposure.
- Technique-Sensitive Placement.
- Higher Cost Compared to Some Resorbable Membranes.
- Risk of Fibrosis if Left Too Long.

CLINICAL CONSIDERATION:-

- **Guided Tissue Regeneration (GTR**): Used in periodontal defect repair to regenerate the periodontal ligament and alveolar bone.
- **Guided Bone Regeneration (GBR):** Applied in ridge augmentation and implant site preparation to promote bone formation.
- **Socket Preservation:** Prevents soft tissue collapse into the extraction site, promoting bone regeneration for future implant placement.
- **Peri-implant Defects:** Supports bone healing around implants in cases of dehiscence or fenestration defects.
- Socket sealing membrane: based on studies d-PTFE is a gold standard socket sealing barrier due to their impermeability to the oral flora which allows for undisturbed implant healing. But the membrane was removed after 4 weeks of placement in the immediate implant socket and aids in osseointegration.

Brand name	Generic name or description
Gelfoam (Pfizer, Markham, Ont.)	Absorbant gelatin sponge material
Bleed-X (QAS, Orlando, Fla.)	Microporous polysaccharide hemispheres
Surgicel (Ethicon, Markham, Ont.)	Oxidized cellulose
Tisseel (Baxter, Mississauga, Ont.)	Fibrin sealant
Thrombostat (Pfizer)	Topical thrombin
Cyklokapron (Pfizer)	Tranexamic acid

V. HEMOCOLL

- **Hemocoll is a hemostatic agent used in various medical and dental procedures, including implant placement.**
- **Uses of Hemocoll in implants:-**

1. Control of Bleeding-Hemocoll is used to control bleeding during and after implant placement surgery. It helps to:-

- Reduce bleeding from the surgical site.
- Promote clotting and hemostasis.
- Minimize the risk of post-operative bleeding complications.

2. Stabilization of the Implant Site Hemocoll can be used to stabilize the implant site by:-

- Promoting clot formation and tissue organization.
- Enhancing the stability of the implant.
- Reducing the risk of implant mobility or failure.

3. Promotion of Wound Healing Hemocoll can promote wound healing by:-

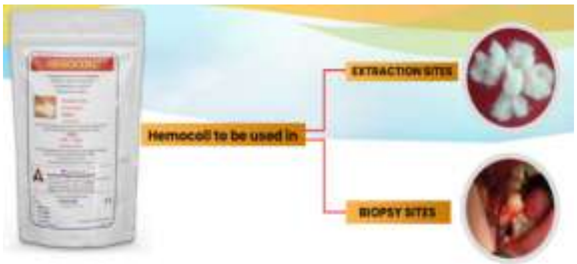
- Enhancing the migration and proliferation of fibroblasts and other cells.
- Promoting the formation of granulation tissue.
- Reducing the risk of wound complications and delayed healing.

4. Reduction of Swelling and Edema Hemocoll can help reduce swelling and edema at the implant site by:-

- Reducing inflammation and promoting the resolution of edema.
- Enhancing the removal of excess fluids and proteins from the tissue.

5. Improvement of Implant OsseointegrationHemocoll may improve implant osseointegration by:-

- Enhancing the formation of bone tissue around the implant.
- Promoting the integration of the implant with the surrounding bone.



Contraindications and Precautions:-

- While Hemocoll is generally considered safe and effective, there are some contraindications and precautions to be aware of:-
- Hypersensitivity to Hemocoll or its components.
- Active bleeding disorders or coagulopathy.
- Pregnancy or breastfeeding (use with caution).

VI . CONCLUSION

Hemocoll is a valuable adjunct in implant placement surgery, helping to control bleeding, stabilize the implant site, promote wound healing, reduce swelling and edema, and improve implant osseointegration. However, it is essential to use Hemocoll judiciously and follow proper surgical techniques to minimize the risk of complications.

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