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ABSTRACT

Oral and maxillofacial surgery is a specialized branch for the treatment of many diseases, injuries and defects in head, neck, face and jaw regions. Minor oral surgical procedures constitute extraction of retained tooth, fractured tooth, impaction, excision of cyst, preprosthetic surgery, apical surgery, removal of mucocele, granula, biopsy etc. All surgical procedures comes with a risk of complications including pain, nerve, injury, swelling, infection and excessive bleeding(hemorrhage). Bleeding during surgery is a common clinical problem. Loss of blood beyond a certain limit is potential life threatening. Hemostasis during the minor surgical procedures can be acquired by mechanical, thermal, chemical(pharmacological based) methods and through knowledge of these methods are vital for desired results. This article is a collective review on types of bleeding, assessment and its various surgical and non surgical methods of management.

KEYWORDS:

Hemorrhage, Hemostasis, Hemostatic agent, Oral and maxillofacial surgery.

INTRODUCTION

RATIONALE

Oral and maxillofacial surgery is a specialized branch aiming, on reconstructive surgery of the face, the oral cavity, head and neck. The principle goal of surgical correction of these deformities is restoration and/or improvement in function and prevention of potential sequel [1]

Excessive bleeding during and after surgery can be troublesome for patients and surgeon and if uncontrolled ,can lead to serious consequences[1].

Bleeding normally occurs when a vessel is cut or interrupted during surgery or due to trauma, which can be managed successfully in most cases by applying pressure[2].

Bleeding in uncontrolled levels can causes lack of visibility and can interfere with procedure. Uncontrolled bleeding is surgical complication which should be prevented by adequate application of hemostatic techniques. In minor oral surgical procedures and other normal bleeding occurring due to ligated vessels can be controlled by application of pressure[3].

A general knowledge and understanding ofthe hemostatic agent working can help in better management of intra oral bleeding. This articles rationale is to review the literature about the local hemostatic agents in the management of bleeding in intra oral minor surgery , their mechanism ,action, uses and contraindications.

INFORMATION SOURCES :

A systematic literature search has been done in PubMed and Google. Several journals were searched manually in the institution library.

SEARCH :

The search of literature was done through PubMed, Google search and institution library . Details of the search were done through filters such as free full text .
Google search is done by entering keywords such as bleeding, methods to control bleeding, vasoconstrictors, hemostasis, hemostatic agents in the search bar. Manual search and other electronic search are performed in the institutional library to find out the relevant articles

DISCUSSION

ARTERIAL BLEEDING(spurting)-Arterial bleeding is the most severe and urgent type of bleeding. It can result from a penetrating injury, blunt trauma, or damage to organs or blood vessels. Because the blood comes from the arteries, it is distinctive from the other types of bleeding[4]. Arterial bleeding is bright red and spurting in nature.

VENOUS BLEEDING(flowing)-Venous bleeding occurs when a vein is torn or cut. The blood will look dark red and ooze out of the body, moving steadily and slowly.
CAPILLARY BLEEDING(oozing)- Capillary bleeding is the most common type of bleeding. It happens whenever the skin is injured, so it occurs with all wounds. Capillary blood oozes or trickles out of the body[4].

EXTERNAL BLEEDING-Bleeding, also called hemorrhage, is the name used to describe blood loss[3] . Blood loss outside of the body, called external bleeding .External bleeding happens when blood exits through a break in the skin.

INTERNAL BLEEDING- It can refer to blood loss inside the body, called internal bleeding. Internal bleeding occurs when blood leaks out through a damaged blood vessel or organ.

PRIMARY BLEEDING- It occurs at time of surgery and cause injury to vessel. It can be arterial, venous or capillary and are generally seen in surgery on malignancy.

REACTIONARY BLEEDING- It occurs within 24hrs(usually 4-6hrs) of surgery. It could be a result of slipping of ligature, dislodgement of clot or cessation of reflex vasospasm. Bleeding begins when there is a rise in arterial or venous pressure.

SECONDARY BLEEDING – Secondary bleeding occurs after 7-14 days of surgery. It is due to sloughing of blood vessel due to infection . A warning stain is followed with sudden severe bleeding which is common after radical neck dissection ,amputations, hemorrhoids.

Identification of source of bleeding require good illumination, adequate retraction, and through suctioning.

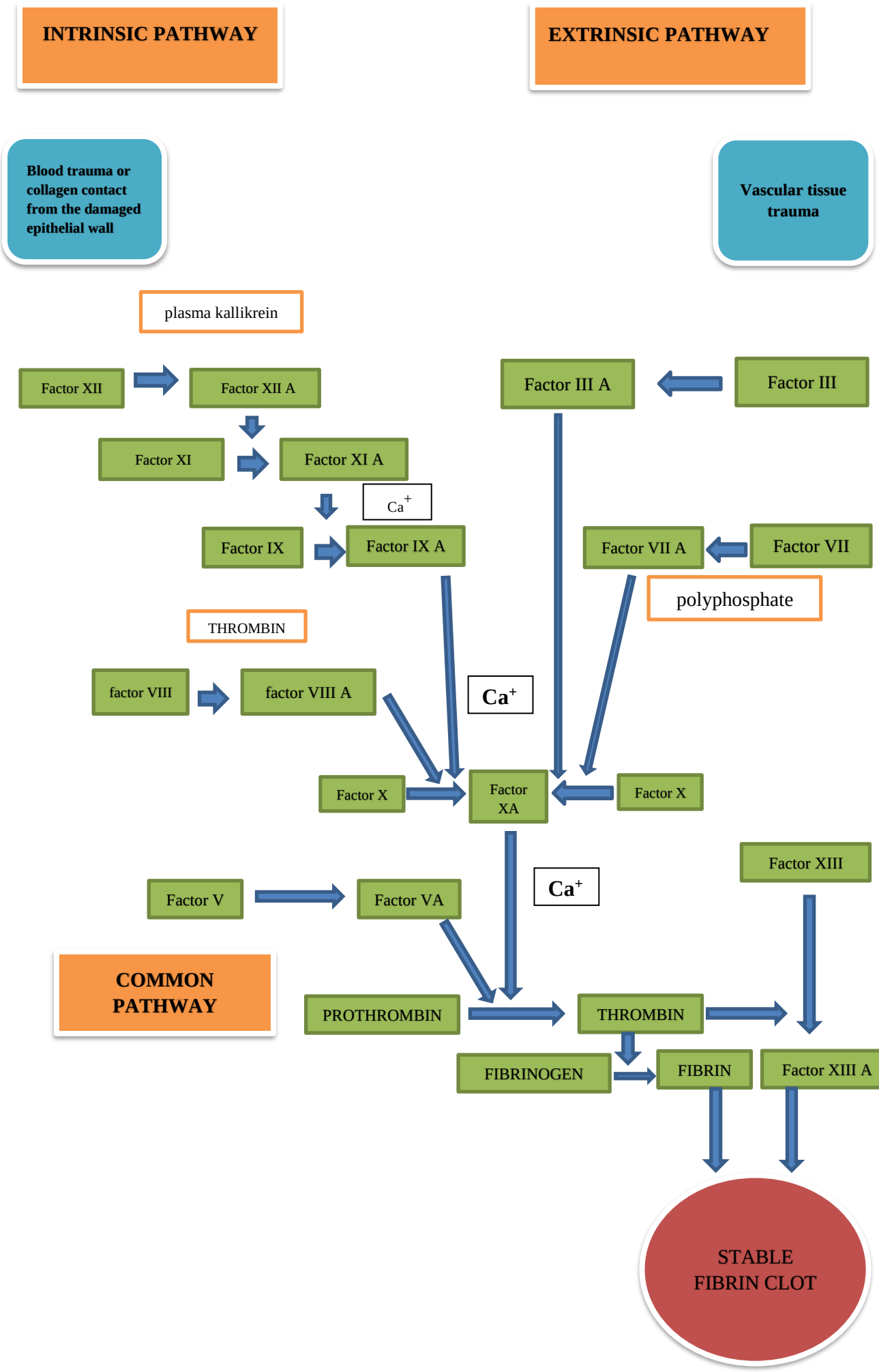
HEMOSTASIS

The arrest or stoppage of bleeding mainly occurs in three steps

1)vasoconstriction/vascular spasm 2) formation of platelet plug 3) coagulation.

When there is injury to blood vessels , it results in activation of platelets and there by constriction of blood vessels, causing temporary reduction or stoppage of blood. There is platelet plug formation and is activated by platelet aggrevating factors such as , adenosine diphosphate, fibronectin, thrombospondin, fibrinogen, platelet derived growth factor, thus enhancing vasoconstriction and helps in formation of platelet seal[5]. Secondary hemostasis refers to the cascade of enzymatic reactions that ultimately results in the conversion of fibrinogen to fibrin monomers. It is divided into 2 major pathways, intrinsic and extrinsic pathway.

In intrinsic pathway all the factors required to activate the pathway are found with in the blood while for later, it is found extrinsically or outside of blood . Both pathways can become activated independently and ultimately culminate in the activation of factor X, which then proceeds to activate the rest of the coagulation cascade via the common pathway[5] .


INTRINSIC PATHWAY
EXTRINSIC PATHWAY
Blood trauma or collagen contact from the damaged epithelial wall
Vascular tissue trauma
plasma kallikrein
Factor XII
Factor XII A
Factor XI
Factor XI A
Ca+
Factor IX
Factor IX A
Factor III A
Factor III
Factor VII A
Factor VII
polyphosphate
THROMBIN
factor VIII
factor VIII A
Ca+
Factor X
Factor XA
Factor X
Factor V
Factor VA
Ca+
Factor XIII
COMMON PATHWAY
PROTHROMBIN
THROMBIN
FIBRINOGEN
FIBRIN
Factor XIII A
STABLE FIBRIN CLOT

LABORATORY SCREENING TEST FOR BLEEDING

- **BLEEDING TIME**
  Bleeding time measures primary phase of hemostasis [6]. Used majorly for screeningof coagulation disorder and platelet function disorder.
- **CLOTTING TIME**
  Clotting times measure the time needed to form a clot. Abnormalities in clotting times can be the result of reduced quantity of the coagulation factors. Common technique of measuring clotting times are prothrombintime (PT) and activated partial thromboplastin time (aPTT)[7].
- **PLATELET COUNT**
  Platelet count includes mean platelet volume(MPV) and platelet distribution width (PDW) platelecit (PCT) . Platelet count under 1,50,000 platelet/microliter is known as thrombocytopenia , can cause prolonged bleeding[7].
- **PROTHROMBIN TIME**
  PT measures the activity of common and extrinsic pathway of coagulation[8]. Prothrombin Time is a one-stage test based upon the time required for a fibrin clot to form after the addition of Tissue Factor (tissue thromboplastin), phospholipid and calcium to de-calcified, platelet poor plasma.
- **PARTIAL THROMBOPLASTIN TIME**- Partial thromboplastin time (PTT) is the time it takes for a patient's blood to form a clot as measured in seconds. It is used to measure the scheme of the intrinsic pathway in clotting cascade.

METHODS TO ACHIEVE HAEMOSTASIS

Hemostasis can be achieved either in natural method or it can be induced. There are mainly mechanical, thermal , chemical (pharmacological) methods to achieve effective hemostasis during surgery.

MECHANICAL METHODS

Mechanical methods include direct pressure, ligating clips and staples, sutures, fabric pads and gauze while hemostatic scalpels and lasers also reduce bleeding during surgery[9]. Arterial bleeding can be controlled effectively using direct pressure technique and it’s the first choice on achieving hemostasis. Pressure with oral fabric packs/ sponge gauze can also work on providing temporary hemostasis. Sutures, stapples and ligating clips can also be used in mechanical closure of wound providing hemostasis. Bony surface bleeding and bleeding from the intramedullarycanals are almost impossible to control with mechanical methods[9] .

THERMAL OR ENERGY BASED METHOD

Cautery is the remodeling of tissue by a passive transfer of heat or application of caustic substance, there by inducing a controlled third degree burns.

• **ELECTROSURGERY/CAUTERY**	Electrocautery works over the entire surface of the electrode tip in contact with the tissue hence ideal for living tissue[10]

• **ULTRASONIC DEVICES**	Ultrasonic scalpel works by generating the high frequency harmonic motion creating vibrations through a metallic rod, which denatures proteins and simultaneously cut tissues [11].
• **LASER**	Benefits include selective and accurate truncate of tissues-which results in less trauma, ability to lower the bacterial load in the surgical field, reduced inflammation and stimulation of new fibroblasts and osteoblasts for improved healing[11].

CHEMICAL METHOD

Chemical methods include chemicals that stop active bleeding by inducing a blood clot.

• **EPINEPHRINE**	It induces local vasoconstriction by binding to alpha 1 adrenergic receptor and provides mechanical compression during placement[12].
• **PROTAMINE SULPHATE**	It is capable of causing direct histamine release from mast cells and activating the complement pathway to produce thromboxane, which causes bronchoconstriction, pulmonary artery hypertension, and systemic hypotension[13].
• **DESMOPRESSIN**	Stimulates the release of Von Willebrand factor (vWF), andenhances primary hemostasis.
• **LYSINE ANALOGES**	They include aminocarporic acid, tranexamic acid ,which have antifibrinotic action and competitively inhibit plasminogen hence prevents the breakdown of a protein called fibrin,the main protein in formation of a blood[14]
• **HYPOTENSIVE ANAESTHESIA**	Techniques involves both pharmacological and physical measures. Pharmacological agents include vasodilators (sodium nitroprusside , nitrglycerine ,calcium channel blockers), autonomic nervous system inhibitors (trimetaphan, labetalol), ACE inhibitors (captopril, enalapril)[15]. Postural manoeuevers and artificial ventilation are physical methods used to attain hypotensive anesthesia [15]

HEMOSTATIC AGENTS :

Hemostatic agent is a material that induces hemostasis. Hemostatic agents are broadly classified into two categories based on the area of usage. They are 1. Local hemostatic agents 2. Transfusional agents 3. Non transfusional agents [16] .

LOCAL HEMOSTATIC AGENTS

ACTIVE AGENTS	PASSIVE AGENTS
Directly include in the coagulation cascade and clot formation	Depends on fibrin production for clot formation
Active biologically and they participate in the coagulation cascade to form a clot	Not tightly bound to the tissue Have less effect on clot formation
MECHANISM OF ACTION Concentrated thrombin ↓ Converts fibrinogen to fibrin ↓ Activating factor V, VIII,XI, XII ↓ Platelet plug	MECHANISM OF ACTION Forms a physical barrier of fibrin at the bleeding site ↓ Activates clotting pathway ↓ Forms a matrix around platelets ↓ Clot formation
Commonly used are – thrombin, thromboplastin, fibrin sealants, floseal, astringents.	Commonly used are avitine, helistat, gelfoam, surgicel

PASSIVE HEMOSTATIC AGENTS :

Commonly used passive hemostatic agents are as followed

1. MICROFIBILLAR COLLAGEN (AVITENE) :

It is produced from bovine dermal collagen, insoluble in water. It stimulates platelets and causes aggregation of them into thrombin thereby resulting in the formation of a physiologic platelet plug and forms clot.

2. ABSORBABLE COLLAGEN HEMOSTAT SPONGE (HELISTAT) :

It is a collagen produced from bovine flexor tendon.
When it contacts the blood, collagen causes degranulation by thromboxane A2. These materials are again reabsorbed in 15 days [17].

3. GELATIN BASED :

Gelfoam is a porous ,gelatin sponge formed from animal collagen[18]. The absorption rate is around 40 times its weight in blood. It provides a clotting framework and prevents small vessel bleeding. Gelfoam is widely used in managing post- operative bleeding after extractions. [19].

4. CELLULOSE BASED PRODUCTS :

When they get in contact with blood , its volume increases by 3-4 times . It gets dissolved in 1-2 weeks into a bio degradable end product [20]. Gelita-Cel is a fast acting , topical, resorbable in nature, cellulose hemostatic gauze.
Surgicel and Oxycel are the most commonly available materials .

5. POLYSACCHARIDE HEMOSPHERES :

These are new topical agents produced from vegetable starch and few animal elements. This product creates a hydrophilic effect by forming a barrier and thus concentrates the blood . A 3D scaffold is formed that concentrates the formation of clot [21].

6. ADHESIVES (BIOGLUE) :

It comprises of 10% gluteraldehyde , 45%bovine albumin . It is widely used as a sealant[22].

7. CELLULOSE BASED PRODUCTS :

Gelita-Cel is a fast acting , topical, resorbable in nature, cellulose hemostatic gauze.
Oxidized regenerated cellulose (ORC) is derived from a plant based alpha cellulose and is available in absorbable, knitted fabric mesh like material made by treating sterilized cellulose ,commercially available as Surgicel[20].
Surgicel and Oxycel are the most commonly available materials .

8. POLYSACCHARIDE HEMOSPHERES :

These are new topical agents produced from vegetable starch and they contain few animal elements as well. This product creates a hydrophilic effect by forming a barrier and thus concentrates the blood .

9. ADHESIVES (BIOGLUE) :

These are a good substitute to conventional agents. It comprises of 10% gluteraldehyde , 45%bovine albumin . It is widely used as a sealant.The drawback includes risk of leakage through the tracks of suture[22].

ACTIVE HEMOSTATIC AGENTS:

Active hemostatic agents are included in biologic activity and directly participate in the coagulation cascade to induce a clot. Active agents include thrombin and its products, in which thrombin is combined with a passive agent and it provides as active product .

1) THROMBIN :

It is the key for hemostatis and generating clot formation , derived from bovine plasma. It is applied topically combined with gelatin sponges as a solution [23]. Some of the human derived plasma are Evithrombin and Recothrom.

2) THROMBOPLASTIN :

This is effective in calculating the time taken to release prothrombin and hence works as an efficient local hemostatic agent .

3) FIBRIN SEALANTS :

It is basically contains fibrinogen, factor XIII , thrombin , aprotinin and it converts fibrinogen to unstable fibrin clot. The clot degradation is prevented by apfrotinin . They also act as tissue adhesives[24] .

4) FLOSEAL :

It consists of two products, a gelatinous matrix and thrombin that is devoid of moisture. It provides excellent clot formation in the presence of thrombin[25] .

5) ASTRINGENTS AND STYPTICS :

These are two interchangeable terms with similar drugs in different proportions. It includes Aluminum and iron salts , zinc , silver.[25] .

6) ADENOCHROM

It is efficient in reducing the bleeding at the local site of injury. It improves the tone . Hence useful in situations of secondary bleeding from wounds.

10. ETHANOLAMINE OLEATE :

This agent induces inflammation at the local site of application stimulating coagulation leading to fibrosis. It is said to have poor efficacy in surgical scenarios.

11. FERACRYLIUM :

This agent acts great in the case of an oozing blood vessel forming a plasma protein complex. It is not instructed orally due to its tendency to cause burning sensation[26] .

12. VASOCONSTRICTORS:

Hemostatic agents like epinephrine are applied locally or near the mucosa for minimal amount of time to avoid ischemia and necrosis of the tissue

III) . TRANSFUSIONAL AGENTS:

1.FIBRINOGEN :	-derived from the human plasma -helps in maintaining the fibrinogen levels in case of acute to chronic hemorrhagic situations.

2. ANTIHAEMOPHILIC GLOBULIN	-Also referred as factor VIII(AHG) -Useful in the treatment of cases with hemophiliaA -Prepared from human plasma and recombinant DNA.
3.COAGULATION FACTORS	-Factor VIII, factor VII and factor IX are readily associated with the coagulation cascade -It inhibits the formation of other inducing agents like IgG antibody production and causes clot
4.FRESH FROZEN PLASMA	-It consists of most of the coagulation factors including Factor II ,VII, IX and X aiding in excellent clotting

IV) . NON-TRANSFUSIONAL AGENTS:

1.VITAMIN -K	It consists of fat soluble , napthoquinone compounds in the biosynthesis of other clotting factors, actively synthesizing prothrombin and factor VII,IX X.
2.APROTININ	-It is an enzyme that inhibits the production of serene protease by polypeptide enzyme thereby decreasing the production of plasmin, kallikren and trypsin also leading to fibrinolysis .
3.TRANEXAMIC ACID	-It helps in the cessation of post extraction bleeding . -It is mostly given orally with a dosage of 10-15 mg/kg for 3 times a day.

CONCLUSION

Control of bleeding is an integral part of any surgical treatment procedure in oral and maxillofacial surgery. Hemostasis is achieved by various conventional methods like pressure applications, suturing and ligation of blood vessels. While conducting extensive surgeries these conventional methods are not sufficient . Hence newer methods of achieving hemostasis by the application of various agents has been explained. Extensive bleeding can be controlled by the combination of conventional and newer methods.

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