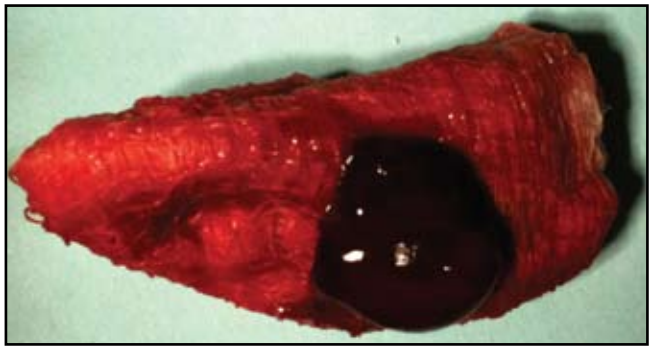
JIACD Continuing Education

Management of the Actively Bleeding and Hypovolemic Dental Patient

Dan Holtzclaw, DDS, MS • Nicholas Toscano, DDS, MS

Abstract



Background: With an increasing number of dentists incorporating surgical procedures such as implant dentistry into their daily practice, the ability to manage hemorrhagic complications is indispensable. The purpose of this article is to provide an updated review on contemporary oral hemostatic measures and offer literature based recommendations on the perioperative management of the actively bleeding and hypovolemic dental patient.

Methods: The authors reviewed medical and dental literature for reports of dental related hemorrhagic complications, oral hemostatic measures, and treatment of hypovolemia.

Results: Dental literature reported life threatening hemorrhagic complications with common surgical dental procedures ranging from endosseous implant placement to third molar extractions. In most cases, actively bleeding and hypovolemic patients were managed with relatively simple local measures.

Conclusions: Under most circumstances, and with proper management, the risk of uncontrolled hemorrhage attributed to dental procedures is minimal. Proper management in such scenarios involves adequate pre-operative patient assessment, proficiency with local hemostatic control measures, and familiarity with hypovolemic treatment protocols.

KEY WORDS: Hypovolemia, bleeding, hemostasis, emergency

1. Private practice limited to Periodontics and Implant Dentistry, Austin, TX, USA
2. Private practice limited to Periodontics and Implant Dentistry, Washington DC, USA

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Learning Objectives

After reading this article, the reader should be able to:

1. Recognize the signs and symptoms of hypovolemia.
2. Understand how to manage hypovolemia.
3. Understand how to manage intraoral hemorrhaging.

INTRODUCTION

Though rare, life threatening hemorrhage has been reported with common surgical dental procedures ranging from endosseous implant placement to third molar extractions.[1-3] With an increasing number of dentists now incorporating surgical procedures into their daily practice, their risk of encountering hemorrhagic complications is likely to increase.[4-8] Knowledge of predisposing factors, physiologic responses to, and clinical management of excessive hemorrhage may prove useful for providers in such situations. Accordingly, the purpose of this case report is to review hemorrhage management in the dental setting and to provide an example of practical application of such principles.

PRE-OPERATIVE CONSIDERATIONS

With systemically healthy patients, the possibility of uncontrolled hemorrhage resulting from a dental procedure seems remote. In fact, the risk of moderate to severe bleeding induced by dental treatment is less than 1% for the average patient.[9] While obvious conditions such as Hemophilia and Von Willenbrand's Disease may cause clinicians to consider the possibility of hemorrhagic complications, most providers commonly associate potential bleeding problems with patients taking antiplatelet and/or anticoagulation medications.

Improved understanding of cardiovascular physiology and advances in the management and treatment of cardiovascular disease have rendered oral anticoagulation therapy a mainstay of modern medicine. It is estimated that more than 50 million Americans adhere to a low dose daily aspirin protocol and other anticoagulants such as warfarin sodium and clopidogrel bisulfate routinely rank among the top 50 medications prescribed in the United States.[10,11] As such, the likelihood of encountering anticoagulated patients is significant. Should clinicians be worried about uncontrolled hemorrhage with these patients? Studies examining the hemorrhagic effects of antiplatelet anticoagulants on dental procedures have found negligible increases in intraoperative and postoperative bleeding when local measures were used.[12-14] Likewise, similar studies evaluating coagulation cascade anticoagulants have generally found no increased risk of intraoperative or postoperative bleeding that could not be controlled with local measures when International Normal Ratio (INR) values were within therapeutic levels.[15-18]

In addition to pre-operative consideration of a patient's medication profile, anticipated blood loss from the planned procedure must be considered. Expectant blood loss from a restorative procedure such as a dental amalgam will be considerably different from that of a surgical procedure such as dental implant placement, periodontal flap procedure, or impacted third molar extraction. Studies evaluating blood loss from restorative procedures have reported minimal hemorrhagic complications, while those evaluating surgical operations such as flap-osseous procedures have found up to 592ml

of blood loss from a single surgical site.[19,20] Blood loss from surgical procedures is also influenced by the experience level of the provider. Surgeries performed by less experienced providers have been shown to take up to three times longer and may result in nearly twice as much blood loss as those performed by more experienced practitioners.[20] In general, however, most studies have found that blood loss from dental procedures is under 200ml and may be even less if the duration of the procedure does not exceed 2 hours.[20-23] Considering that a pint of blood, the amount generally taken during blood donation, is 473ml, the amount of blood lost during most dental procedures is well within the limits of safety.

HYPOVOLEMIA RECOGNITION AND MANAGEMENT

Life threatening situations resulting from excessive blood loss are often due to hypovolemic induced hemorrhagic shock.[24] Blood loss exceeding 1000ml, or 1/5 of an adult's average blood volume, may precipitate hypovolemic shock and lead to inadequate tissue perfusion/oxygenation.[25] Compensatory signs of hypovolemia include tachycardia, hypotension, tachypnea, pallor, diaphoresis, anxiety, nausea, thirst, and light headedness. If left untreated, hemorrhagic shock may progress to loss of consciousness, coma, or even death.

When the source of bleeding is known, primary goals in the treatment of hemorrhagic shock are to stop the source of hemorrhaging and restore circulating blood volume. The "three-to-one" rule for the treatment of hemorrhagic shock dictates the administration of 3ml of crystalloid (Lactated Ringers solution or normal saline) for every 1ml of blood loss replaced.[26] Although hemorrhagic shock does not typically occur until blood loss exceeds 1000ml, dental literature recommends fluid replacement when blood loss exceeds 500ml to account for postoperative hemorrhagic oozing (figure 1).[27,28] A pragmatic approach to fluid resuscitation in outpatient dental settings is limited to cases with less than 1000ml of blood loss and the ability to control hemorrhaging. Cases exceeding these parameters should be referred to a higher echelon of care.

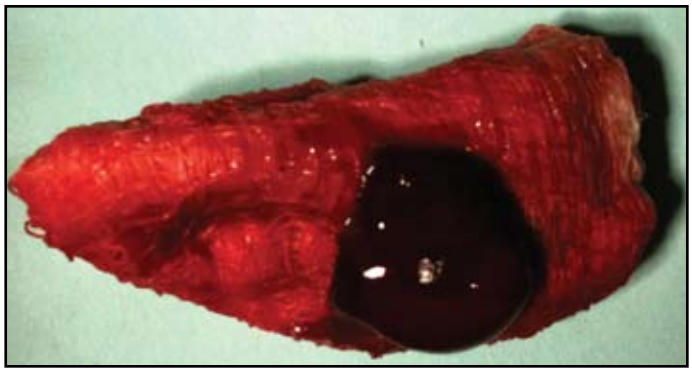

Figure 1: Blood clot removed from patient with slow continuous hemorrhaging secondary to osseous periodontal surgery.

HEMHORRAGE MANAGEMENT

With proper management, nearly all scenarios of excessive bleeding can be adequately managed with relatively simple local measures (Figure 2, Table 1) such as:

Positive Pressure

Positive pressure aids hemostasis by promoting occlusion of the site of injury and providing mechanical aid to clot formation.[29] Positive pressure to intraoral wounds is typically accomplished by compressing moistened gauze on the site of hemorrhaging. Suturing wound margins or severed vessels is another method in which compressive force may be applied to bleed-

Table 1: Local Hemostatic aids		
Product or Action	**Composition**	**Action**
Positive Pressure	N/A	Manual occulusive aid to clot formation
Vasoconstrictor	1:100,000 Epinephrine	Activation of α adrenergic receptors
Gelfoam®	Porcine derived gelatin sponge	Occlusive matrix; activation of intrinsic pathway
Surgicel®	Plant derived α-cellulose	Occlusive matrix: activation of intrinsic pathway, antibacterial properties
CollaCote®, CollaPlug® CollaTape®, UltraFoam™ UltraWrap™	Bovine derived collagen	Occlusive matrix, activation of intrinsic pathway
HemCon®	Crustacean derived chitosan	Positively charged chitosan attracts negatively negatively charged red blood cells, antibacterial properties
4.8% Tranexamic Acid Mouth Rinse	Tranexamic acid	Binds to lysine receptor sites on plasmin and plasminogen inhibiting fibrin binding and fibrinolysis
Topical Thrombin	Bovine derived thrombin	Enhances conversion of fibrinogen to fibrin
Electrocautery	N/A	High frequency electric current cauterizes tissue and induces blood coagulation

Figure 2: Products commonly used to aid hemostasis. Clockwise from top: Gelatin sponge, Collagen plug, Collagen tape, Oxidized regenerated cellulose, Chitosan derived.

ing areas.[30] In many cases, minor hemorrhaging is often controlled with positive pressure alone.

Vasoconstrictor

Dental anesthetics contain vasoconstrictor primarily to increase their duration of action and minimize the risk of local anesthetic toxicity.[31] Epinephrine, the most commonly utilized vasoconstrictor in dental local anesthetics, is a catecholamine that facilitates vasoconstriction via the activation of alpha adrenergic receptors. Alpha adrenergic activation by sympathomimietic drugs such as epinephrine induces smooth muscle contraction within blood vessels and ultimately leads to short term vasoconstriction.

Absorbable Gelatin Sponge

Gelfoam® (Pfizer, New York, NY) is a resorbable gelatin sponge of porcine origin that is capable of absorbing up to 45 times it weight in whole blood.[32] Absorbable collagen sponges aids hemostasis by providing a simple occlusive matrix and through contact activation of the intrinsic pathway.[33] When used for oral applications, this material typically liquefies within 2-5 days.

Oxidized Regenerated Cellulose

Oxidized regenerated cellulose based products such as Surgicel® (Ethicon Inc, Somerville, NJ) are derived from plant based alpha-cellulose and function hemostatically in a manner similar to absorbable gelatin sponges.[34] A unique property of oxidized regenerated cellulose is antibacterial activity. Because this product has a relatively low pH, a broad range of gram negative, gram positive, and antibiotic-resistant bacteria have proven to be locally susceptible to oxidized regenerated cellulose.[35] When used for oral applications, this product typically resorbs with 7-14 days.

Absorbable Collagen Products

Absorbable collagen products such as collagen tape, collagen plugs, and collagen foam are derived from bovine deep flexor tendons and typically resorb completely within 14 days.[36] Additional bovine derived products such as Avitene®, UltraFoam™, and UltraWrap™ (Traatek, Inc, Fort Lauderdale, FL.) have similar properties. In addition to providing a simple occlusive matrix, these products promote hemostasis by virtue of their collagen content which activates the intrinsic coagulation cascade.

Chitosan Derived Products

Chitosan derived products such as HemCon® (HemCon Medical Technologies Inc, Portland, OR.) are extremely effective at promoting hemostasis and have recently been used by United

States military medical personnel for treatment of battlefield injuries. Chitosan is a naturally occurring polysaccharide that is commercially produced via the deacetylation of crustacean chitin.[37] Positively charged chitosan molecules readily attract negatively charged red blood cells and the two form an extremely strong seal that acts as a primary occlusive barrier for hemorrhagic sites. With hemorrhaging limited and/or stopped by this initial seal, the natural coagulation cascade ensues. Like oxidized regenerated cellulose, chitosan derived products have locally active antibacterial properties.[38] Unlike oxidized regenerated cellulose which relies on low pH for its antibacterial activity, however, chitosan derived products achieve antibacterial properties via active cell wall disruption.[39]

Tranexamic Acid

Tranexamic acid is an anticoagulant oral rinse that binds to lysine receptor sites on plasmin and plasminogen, ultimately inhibiting fibrin binding and fibrinolysis.[40] This rinse is supplied in a 4.8% solution and patients may be instructed to rinse with 10ml four times daily for 7 days following surgery.[41] Rinsing with tranexamic acid solution results in therapeutic levels (>100mg/ml) within the saliva for 2-3 hours. Wounds healing in the presence of tranexamic acid have demonstrated increased tensile strength, thus making the clot more resistant to mechanical disruption.[42]

Topical Thrombin

Topical thrombin facilitates clot stabilization by enhancing the conversion of fibrinogen to fibrin and forming a reinforcing meshwork for initial platelet plugs. Medical grade topical thrombin is often bovine derived and is typically supplied as a freeze dried sterile powder that must be reconstituted with sterile saline. For general use in dental applications, a topical thrombin solution of 100 International Units/ml is recommended.[43] Topical thrombin is often delivered via pump/syringe spray or combined with a carrier such as a hemostatic gelatin sponge.

Electrocautery

Electrocautery involves the application of a high-frequency electric current to cauterize tissue and induce blood coagulation. In dentistry, this process is typically accomplished with monophasic electrosurgical units. In comparison to other local means of hemostasis management, electrocautery may induce collateral thermal damage to adjacent tissues.[44,45] As such, this treatment option is typically reserved for severe hemorrhaging scenarios.

PRACTICAL CASE REPORT

The primary author was contacted by a patient with a chief complaint of "my mouth won't stop bleeding." Telephonic interview revealed the patient to be a 22 year old white male with a non-contributory medical history. The patient had undergone impacted third molar extractions one week prior and was without complication until the bleeding episode. According to the patient, his lower right extraction site began to hemorrhage during dinner subsequent to traumatic disruption with a piece of partially masticated food. The patient had attempted to control the bleeding by biting on moistened paper towels for over 2 hours prior to contacting the clinic.

Upon arrival of the treatment provider to the dental clinic, the patient appeared ashen, diaphoretic, and continued to actively bleed from

the mouth. The patient was seated in a dental chair and rapid evaluation revealed fast paced active hemorrhaging from extraction site 32 and vital signs of the following: blood pressure (90/48), pulse (99), and oxygen saturation (95%). Using the pace of the active hemorrhaging as a guide, it was estimated that the patient had lost approximately 1000ml of blood at this point. As vital signs were being taken, the patient began to complain of "dizziness" and nausea. The patient was placed into Trendelenburg position, oxygen was administered via nasal canula at a rate of 6L/min, oral suction was initiated, and intravenous access was obtained in the left antecubital vein with an 18 gauge catheter. As 2000ml of Lactated Ringers solution were delivered to the patient, attempts were made to stop the hemorrhaging. The patient was repositioned and site 32 was generously infiltrated with 2% lidocaine/1:100,000 epinephrine. As the vasoconstrictor took effect, bleeding from site 32 decreased significantly and the patient was instructed to bite with positive pressure on moist gauze as he received the remainder of the Lactated Ringers solution. After 30 minutes of subsequent evaluation, hemorrhaging from extraction site 32 ceased and the patient's vital signs stabilized to within normal limits.

CONCLUSION

Dental literature clearly demonstrates that under most circumstances, and with proper management, the risk of uncontrolled hemorrhage attributed to dental procedures is minimal. Proper management in these scenarios involves adequate pre-operative patient assessment, proficiency with local hemostatic control measures, and familiarity with hypovolemic treatment protocols. As more general dentists now routinely perform surgical procedures that induce blood loss, such a knowledge base is essential and may one day prove life saving.

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Correspondence:
Dr. Dan Holtzclaw
3016 Hidden Bluff Cove
Round Rock, TX 78665

Disclosure
The authors report no conflicts of interest with anything mentioned in this article.

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Continuing Education JIACD Quiz #4

1. The risk of moderate to severe bleeding induced by dental treatment is less than:

a. 1%
b. 2%
c. 5%
d. 10%

2. An estimate of how many Americans adhere to a low dose daily aspirin protocol?

a. 2 million
b. 14 million
c. 50 million
d. 75 million

3. Surgical operations such as flap-osseous procedures have found up to how much blood loss from a single surgical site?

a. 100 ml
b. 250 ml
c. 495 ml
d. 592 ml

4. Surgeries performed by less experienced providers have been shown to take up to how many times longer than those performed by more experienced practitioners?

a. 2 times longer
b. 3 times longer
c. 4 times longer
d. 5 times longer

5. In general, most studies have found that blood loss from dental procedures is:

a. Negligible
b. < 100 ml
c. < 200 ml
d. > 500 ml

6. How much blood loss may precipitate hypovolemic shock and lead to inadequate tissue perfusion/oxygenation?

a. 100 ml
b. 250 ml
c. 750 ml
d. 1,000+ ml

7. Compensatory signs of hypovolemia include which of the following?

a. Tachycardia
b. Hypotension
c. Tachypnea
d. Nausea
e. All of the above

8. How many milliliters of crystalloid should be administered for every 1 milliliter of blood lost?

a. 1 ml
b. 2 ml
c. 3 ml
d. 5 ml

9. Methods of hemorrhage management include which of the following?

a. Positive pressure
b. Vasoconstrictor
c. Absorbable gelatin sponge
d. Electrocautery
e. All of the above

10. Rinsing with tranexamic acid solution results in therapeutic levels (>100mg/ml) within the saliva for how long?

a. 30 – 45 minutes
b. 2 – 3 hours
c. 3 – 4 hours
d. 5 – 6 hours