Tranexamic Acid Tamponade to Control Postoperative Surgical Hemorrhage

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When preparing for oral surgery, patients taking anticoagulants usually should not discontinue their medication because of the risk of a thromboembolic event. The therapeutic effect of many anticoagulants is not readily measured, so preoperatively, the surgeon cannot know the true risk for postoperative hemorrhage. The risk of a thromboembolic event usually outweighs the concerns of controlling postoperative hemorrhage. Hemophilia patients are also at risk for postoperative bleeding. Single extractions probably do not pose a serious risk for postoperative hemorrhage. However, when a mucogingival flap is raised in these patients, there may be prolonged bleeding. Surgical sponges saturated with aqueous tranexamic acid solution and compressed onto the bleeding site with biting pressure may stop bleeding. Bleeding was stopped in the case example presented here after three 10-minute compressions over 30 minutes in a patient taking aspirin and clopidogrel for a previous thromboembolic event and a metal coronary stent. The clot formed is very fragile and is prone to bleeding, so it should not be disturbed. This technique needs to be studied for efficacy.

Key Words: hemorrhage, coagulation, bleeding, bleeding control, local bleeding control, oral bleeding, oral surgery, dental implant, anticoagulants.

INTRODUCTION

The implant dentist can be confronted with patients who present with anticoagulant therapy for treatment of various systemic conditions. Warfarin has been the most frequently used anticoagulant, being the 21st most common prescription in the United States in 2011. It is an anticoagulant for which the expected bleeding can be measured by the international normalized ratio (INR), which measures the extrinsic coagulation cascade. This indicates to the implant dentist whether patients may need to have the dosage of medication reduced to decrease the anticoagulation so that the surgery will not induce prolonged bleeding. Drugs with an antiplatelet effect, such as aspirin and clopidogrel (Plavix), are being used more widely. Their therapeutic effect is not easily measured for preoperative consideration. The implant dentist may not know preoperatively which patients will not stop bleeding quickly after implant surgery. Cessation of an anticoagulant may have serious cardiovascular sequelae, such as myocardial infarction or embolic cerebrovascular stroke. Cessation may have a 6% risk for an adverse thromboembolic event. Stopping anticoagulant therapy should be done only after consultation with the patient’s physician. Bridging therapy may be instituted where low-molecular-weight heparin is administered to temporarily perform the anticoagulant therapy. This may be done for some patients to allow for postsurgical clotting. Nevertheless, many patients may undergo minor oral surgery without cessation of anticoagulant therapy, thus minimizing the risk.

The decision to stop or bridge anticoagulant therapy for an impending implant surgery is ultimately a clinical decision made by the implant dentist based on the magnitude of the surgical wound, postoperative hemorrhage considerations, and the thromboembolic risk. The cessation of anticoagulant, including aspirin and clopidogrel, may cause thrombosis. These patients may be at the highest risk for a vascular event if anticoagulant therapy is ceased or bridged.

Tranexamic acid, trans-4-(aminomethyl)cyclohexanecarboxylic acid (TA; Cyclokapron, Pfizer, New York, NY; Figure 1) is derived from lecithin. It has been used systemically for many years to minimize post- and intraoperative hemorrhage. Topical use has not been extensive. With the advent of anticoagulants for which the therapeutic effect cannot be monitored conveniently, a topical hemostatic agent may be very beneficial if cessation or bridging is inappropriate.

The aim of this article is to review the topical use of TA to control postoperative bleeding for minor oral surgical procedures in patients taking anticoagulant therapy and for whom the decision has been made not to cease anticoagulant therapy.

MATERIALS AND METHODS

Literature search

An electronic literature search was performed using the key word tranexamic acid AND hemorrhage. All addressed nontopical use of TA except one.

Patient usage

We included 10 patients who underwent an oral surgical procedure including extraction, apically positioned or partial
thickness mucogingival flap. All patients had a tamponade of an aqueous saturated solution of TA. Most bleeding stopped in 10 minutes, and the patients on anticoagulant therapy bleeding stopped with 1 or 2 additional applications.

**CASE EXAMPLE**

In 2009, a 51-year-old man with a history of high blood pressure and cholesterol and cardiac stent surgery 7 years prior (2003), presented for implant-supported restorative treatment. Clinical and radiographic examination revealed maxillary right (teeth Nos. 1–5) and mandibular left partial edentulism (tooth No. 19) with moderate bone atrophy. Treatment options were discussed. The remaining teeth were to be restored as well. The mandibular left premolars were deemed poor to guarded periodontal, coronal, or endodontic prognosis.

Telephone consultation with his physician revealed that the patient took the following medications daily: famotidine besylate (Pepcid) 10 mg, rosuvastatin (Crestor) 10 mg, ezetimibe (Zetia) 10 mg, lisinopril (Zestril) 20 mg, metoprolol (Toprol) 100 mg, clopidogrel (Plavix) 75 mg, aspirin 81 mg, and L-thyroxine (Synthroid) 50 mg. The physician determined that the patient would tolerate dental implant surgery well. The risk for a thrombosis would be minimized by not discontinuing the dual antiplatelet drugs, clopidogrel and aspirin. Implants were successfully placed at the maxillary right and restored without discontinuing anticoagulant therapy with no hemorrhagic sequelae. The maxillary right implants and restorations (treatment by D.F.) were placed in 2010 and had been in successful function for 2 years.

In 2012, the mandibular left premolars were extracted with infiltration local anesthesia using articaine (Septocaine). The implants were placed flaplessly at the first molar site and immediately at the first premolar site, again without discontinuing the anticoagulant therapy. The premolar extraction sites were filled with calcium sulfate and covered with collagen plugs (Salvin) and secured with a 3-0 chromic suture. No prolonged postoperative bleeding occurred.

At second-stage uncover surgery for the left mandible, the anticoagulants were again not stopped. After facial and lingual infiltration of 1.6 mL articaine (Septocaine) at the No. 19 site, an approximately 15-mm-long partial-thickness facial surgical flap with releasing incisions was raised and apically positioned. The No. 21 implant had adequate attached tissue and did not require augmentation, and the gingival overgrowth here was removed with a medium-coarse high-speed diamond stone. Abutment analogues were placed, and an open tray polyvinyl siloxane (Imprint, 3M ESPE) impression was made. A porcine collagen matrix (MucoGraft) was placed under the flap to increase the thickness of collagenous tissue. Healing caps were placed and bleeding was controlled with a local anesthetic infiltration and a tea bag compress. No sutures were placed, but a bis-acryl stent was placed. The patient was instructed on postoperative care and left in good condition with no bleeding. However, that night, the patient awoke because of bleeding from the site. He went to a local hospital emergency department for treatment. The physician on duty controlled the bleeding again with moistened tea bag compression. The next morning, the patient was seen and the site was bleeding again. The stent was removed. A saturated aqueous solution (16%) of TA was made by dissolving TA powder in approximately 10 mL of water and soaking into 2 × 2 surgical sponges. The sponges were placed on the surgical site and compressed with the patient’s biting pressure for 10 minutes. This was repeated twice. After the third compression, the bleeding stopped completely. The patient was monitored for another 30 minutes, and there was no reoccurrence of bleeding. The patient was instructed as to home care and was dismissed. He was called 2 hours later, and he reported no bleeding from the site. The patient again reported no bleeding from the site 2 days later. He subsequently returned 1 week later for follow-up and was healing well with no bleeding reoccurrence (Figure 2).
weeks later, the fixed partial denture was fitted, adjusted, and definitively cemented with resin-modified glass ionomer cement (FujiCem).

**Discussion**

**Example patient with TA tamponade**

Oral anticoagulant therapy does not contraindicate dental implant surgery. Discontinuing anticoagulant therapy is not advisable for minor oral surgery, such as single tooth extraction and implant placement. When there are more invasive procedures such as large flap and autogenous bone grafting, anticoagulant cessation or bridging therapy may be instituted. Topical agents and compression are generally effective in controlling postoperative bleeding in minor sites in these patients. However, there is no definition of a “minor” site. The extent of anticoagulation in individual patients may vary due to dosage and timing, individual physiologic metabolism, or circadian variations. This creates an uncertain physiologic parameter for the dentist. The above patient had 3 prior “minor” oral surgeries and no bleeding complications. The recovery second-stage flap in the left mandible was a slightly larger surgical wound than the previous surgeries. The stent protected the flap wound but did not apply pressure and prevented direct contact with the applied tea bags. After the stent was removed, the wound was exposed for direct compression and contact with the TA solution. The patient may have altered his dosing by inconsistent drug compliance that resulted in less anticoagulation in the early surgeries and more during the last flap surgery. This may have contributed to the bleeding episode that required TA tamponade.

The polypharmacy in the example patient herein may be of concern. Among other drugs, he was taking famotidine (Pepcid), rosvastatin (Crestor), ezetimibe (Zetia), metoprolol, and lisinopril. Famotidine is an H2 receptor antagonist that may rarely induce thrombocytopenia. This patient, however, was not thrombocytopenic. Rosuvastatin is a statin drug that does not have significant vascular side effects. Its clearance can be affected by some anticoagulants—clopidogrel not being one of those. Ezetimibe inhibits cholesterol intestinal absorption and rarely induces thrombocytopenia. Metoprolol is a selective β-1 blocker for hypertension with no hemorrhagic effects. Lisinopril, an angiotensin-converting enzyme (ACE) inhibitor, rarely may induce anemia, leukopenia, and thrombocytopenia, which may alter clotting. ACE inhibitors, such as lisinopril, may slightly inhibit platelet function by various mechanisms. There is no evidence that the patient was not taking his L-thyroxine. Hypothyroidism may induce a bleeding tendency. It is not certain whether the patient was using any complementary or alternative medication (CAM). CAMs may cause significant perioperative bleeding. The patient had no clinical evidence of a blood dyscrasia.

This patient had a metal coronary artery stent placed 7 years prior and was chronically taking clopidogrel. Clopidogrel is a thienopyridine antiplatelet drug used in coronary syndrome, peripheral vascular disease, cerebrovascular disease, and coronary stents. Coronary stents have become routine treatment for atherosclerotic coronary arteries. The stent can reduce patient mortality and can improve symptoms. Drug-eluting stents are now available, and discontinuing anticoagulant therapy may be possible with a low risk for serious complications. For coronary stent patients on clopidogrel, routine platelet function may be monitored, but this can be inconvenient and may not improve the clinical results. There is no consensus as to the most appropriate anticoagulant therapy. Aspirin alone may be the best antiplatelet regimen. After coronary stent surgery, dual anticoagulant therapy with clopidogrel and aspirin is well accepted. However, with clopidogrel, there is important patient variability in the antiplatelet response. These are genetically related and may have increased risks for bleeding sequelae. These issues may affect the potential for dental implant surgery hemorrhage, which may have been at least contributory to the incident reported here.

**Clotting mechanism**

Thrombogenesis (clotting) is the result of a complex cascade of biological chemical events. Generally, platelets become activated by tissue factor released from injury to epithelium. There then occurs a cascade of biochemical reactions by the extrinsic and intrinsic pathways that contribute to the conversion of prothrombin to thrombin, which in turn converts fibrinogen to fibrin. Fibrin is then cross-linked to stabilize the clot.

**Pharmacology of TA**

Tranexamic acid (TA) is a derivative of lysine that has been used as a first-line treatment to control bleeding of menorrhagia (at least 80 mL blood loss per cycle) and cardiac surgery. Peak plasma concentration is reached within 1 hour with intravenous injection with a dose of 10 mg/kg. After 24 hours, 90% of TA is excreted in the urine, and the elimination half-life is 80 minutes. Oral administration of 10 to 15 mg/kg produces peak plasma concentration within 3 hours. Taking TA with food does not reduce or increase gastrointestinal absorption. Tranexamic acid does accumulate in tissue and joint and synovial fluid. Tranexamic acid will pass the placental barrier and be concentrated in breast milk. Studies have not shown any teratogenic effects.

Tranexamic acid is antifibrinolytic by binding to plasminogen, preventing it from converting to plasmin in the clotting cascade. Plasmin degrades fibrin. Tranexamic acid is much more potent than alpha-aminocaproic acid and epsilon or parapaminomethyl benzoic acid in this action. In this competitive inhibition action, it bonds to the Kringle class disulfide linked proteins that interact with clotting factors. Tranexamic acid inhibits plasmin action and with high dosage will reduce plasmin formation. The antifibrinolytic action of TA may also act by reducing capillary leakage of the serum protein albumin, so as to maintain intravascular blood volume. Topical application may provide a high enough dose to accomplish local coagulation, but in the past, most use has been parenteral or via oral administration. Inhibition of plasminogen may additionally inhibit angiogenesis and bone repair, but this may not be clinically significant. In addition, cartilage matrix and osteoblast formation may be inhibited by TA. The relatively
rapid clearance of TA precludes any significant inhibition of osseous healing.

**Intravenous use of TA**

In major surgical procedures, a preoperative intravenous TA dose of 20 mg/kg has been shown to reduce the postoperative blood loss of bimaxillary osteotomy surgery as compared with placebo.\(^{38}\)

Intravenously administered TA is cleared at approximately the same rate as the patient’s glomerular filtration rate.\(^{39}\) The minimum safe nontoxic dosage of this drug has not been determined. The serum concentration of intravenous TA shows high variation between patients, so the patient should be monitored for this parameter.\(^{40}\) Intravenous administration should not exceed 100 mg/min to avoid dizziness and hypotension.

Transdermal enhanced administration may be possible with a carbamic acid salt ester of TA, which may facilitate treatment.\(^{41}\) This approach was done in an effort to transdermally administer as a TA ester. The intradermally placed ester would then dissociate into an active metabolite to successfully cause skin barrier homeostasis.

Because of its inhibition of fibrinolysis, TA may be an important drug for bleeding in factor XI patients in whom high fibrinolytic activity occurs.\(^{42}\)

Topical TA therapy may decrease the risk of secondary hemorrhage in ambulatory ophthalmic patients with hypHEMA.\(^{43}\)

Tranexamic acid enhances ultrafiltration volume in dialysis patients, of which the mechanism of action is unknown.\(^{44}\) Thus, there may be a decreased therapeutic action of drugs that depend on ultrafiltration for clearance.

A Cochrane review found that when TA was administered intravenously at the time of surgery, it reduced bleeding, with no significant side effects.\(^{45}\)

In mice, the lethal dose for 50% of subjects (LD50) is more than 10 mg/kg. Symptoms of overdose may include nausea, vomiting, diarrhea, and/or hypotension. Thus, TA should be injected intravenously slowly, less than 1 mL/min. There is no evidence of teratogenicity, mutagenicity, or fertility effects, so TA is classified as a category B drug by the US Food and Drug Administration Pharmaceutical Pregnancy Categories. Thrombosis may occur when TA is intravenously administered with factor IX or anti-inhibitor coagulant.\(^{46}\)

Tranexamic acid is used in oral surgical patients with hemophilia for short-term use (2–8 days) to reduce or prevent hemorrhage following tooth extraction. Patients with most clotting disorders get an abnormal fibrin network because of lower or delayed thrombin production. The clotting process in patients with hemophilia is compromised, making the clot more soluble, and cross-linking in the fibrin polymer does not effectively occur.\(^{47}\) Patients with the rare factor XI bleeding disorder have varying tendencies of hemorrhage. Surgical bleeding has been successfully treated in these patients with TA and recombinant activated factor VII.\(^{42}\) In addition, TA may be used to prevent episodes of angioedema by preventing activation of the initial complement protein. Thus, TA may have multiple modes of pharmacologic action that need to be investigated.

Systemic dosing techniques of TA have produced variations in efficacy for optimal treatment, and it is difficult to maintain stable therapeutic serum concentrations.\(^{48}\) Thus, individual patients may exhibit variable blood concentrations during oral or intravenous administration, making dosage titration difficult.\(^{48}\)

Successful control of vaginal postpartum hemorrhage exceeding 800 mL was effective with high-dose TA with a loading infusion dose of 4 g and 1 g/h for 6 hours.\(^{49}\) The high levels of plasminogen activator found in uterus and cervical tissue may explain the beneficial effects of TA.\(^{50}\)

**Oral administration of TA**

Absorption after oral administration is about 40%, and bioavailability is not affected by taking with food. Tranexamic acid is eliminated by renal glomerular filtration, with only about 5% being metabolized.

Tranexamic acid has been used to successfully treat menorrhagia in von Willebrand’s disease with a single daily 4000-mg oral dose for 3–5 days.\(^{51}\)

Most patients can tolerate 3–6 g/d orally of TA, and it may be considered a first-line treatment for bleeding control of some conditions.\(^{24}\)

However, the oral administration of 1 g 4 times a day for 4 days of TA can produce nausea, vomiting, diarrhea, and abdominal pain in 12% of patients.\(^{52}\)

Dental surgical patients with hemophilia who were treated with TA 1 g 3 times a day for 5 days beginning 2 hours prior to surgery had significantly less postoperative bleeding as compared with a placebo group.\(^{53}\) Hospital stay time can also be reduced with treatment.\(^{54}\)

**Anticoagulants and TA local hemorrhage control**

No anticoagulant acts to 100% prevent coagulation. Tranexamic acid may act locally to act on any clotting that may occur to stabilize that clot and any further clotting activity that can occur. With time, the clotting can be significant to stop local bleeding at the oral surgical site. Hence, TA may be effective with a multiplicity of anticoagulants.

Warfarin (Coumadin) is an anticoagulant that is widely used. It acts by inhibiting the vitamin K recycling metabolism in the formation of prothrombin and affects factors II, VII, IX, and X in the clotting cascade.\(^{1,55}\) Warfarin takes about 2–5 days to become clinically significant and the same to reverse its activity with vitamin K therapy.\(^{55}\) Warfarin interacts with many medications and foods that may increase or decrease its effects. The INR measures the blood level of warfarin, which optimally ranges from 2.5–4.5 depending on the condition being treated.\(^{46}\) The INR is calculated by dividing the patient’s prothrombin time (PT) by a standard control PT as determined by the World Health Organization. This ratio standardizes results for laboratory testing differences. Excessive alcohol use can increase the INR. Leafy green vegetables and some oils are high in vitamin K and may decrease the action of warfarin. Warfarin increases the risk for osteoporosis fracture in men.\(^{57}\) Broad-spectrum antibiotics may reduce gastrointestinal bacteria that generate vitamin K, thus increasing the effects of
warfarin. The TA tamponade may be able to control local oral bleeding with these patients.

Enoxaparin (Lovenox) is a low-molecular-weight heparin that is used to treat patients with a history of deep vein thrombosis or pulmonary embolism. It is administered by subcutaneous injection by a health care provider or the patient. It acts by activating thrombin III and inhibits clotting factor Xa, which converts prothrombin to thrombin, preventing the fibrin clot. Heparin-induced thrombocytopenia, a decrease of platelets by 50%, is a very rare side effect of enoxaparin caused by an interaction with immunospecific antibodies and carries a significant risk for thrombosis. Tranexamic acid may be a local antidote to enoxaparin because of its stabilization of the fibrin clot. Any clotting that forms may be induced to prolong and resist breakdown.

Clodigogrel (Plavix) is a thienopyridine antiplatelet anticoagulant. It acts as a P2Y(12)-ADP receptor antagonist to prevent thrombosis. It is metabolically inactivated by carboxylesterase-1 into carbolic acid metabolites. Genetic variations can be responsible for a spectrum of drug responses. About 25% of patients may not fully respond to therapy. Since clopidogrel is a prodrug that is transformed into an active metabolite by hepatic CYP2C19 patients, genetic variations of this enzyme may have a subtherapeutic response or no response. Because of this, each oral surgical patient taking clopidogrel should be treated with caution and hemorrhagic control measures should be ready to be instituted if anticoagulant therapy is not to be stopped or bridged. Anticoagulant bridging therapy can be done with low-molecular-weight heparin to anticoagulate the patient with a measurable method. Since clopidogrel is an antiplatelet and TA is an antifibrinolytic and some clotting would occur from an alternative pathway, topical TA tamponade may be helpful in oral bleeding control in these patients because of the different mechanisms of action.

Rivaroxaban inhibits factor Xa in the clotting cascade and is administered orally. The factor Xa does not recover for about 24 hours, and the drug has no antagonist. A tamponade of TA is an antifibrinolytic and may contribute to local hemorrhage control in patients taking rivaroxaban.

Aspirin (acetylsalicylic acid [ASA]) is a nonsteroidal anti-inflammatory drug with antiplatelet anticoagulant activity. Acetylsalicylic acid inhibits platelet aggregation by blocking formation of platelet thromboxane A2. The thromboxane metabolites are responsible for the aggregating ability of platelets. The example patient presented above was taking 81 mg oral ASA daily working in tandem with the oral clopidogrel. The combination of clopidogrel and aspirin is used for anticoagulant therapy but is not recommended by current guidelines. However, some patients will be prescribed this dual therapy because of their specific cardiovascular issues, such as having an implanted metal coronary stent surgery. The TA was effective in stopping the local oral bleeding after 30 minutes of tamponade in this dual-therapy patient.

Dabigatran (Pradaxa) is a synthetic anticoagulant that directly inhibits thrombin and is not influenced by dietary vitamin K. The usual dose is 150 mg twice a day. Blood level monitoring is not required, but, again, the implant dentist may not be able to predict preoperatively the patient’s ability to postoperatively coagulate. Since there may be different mechanisms of action of TA, a tamponade may be able to control local oral bleeding by fibrin stabilization.

**Topical use of TA**

Topical TA has been used in ophthalmic, coronary, dental, and hemophilic surgery.

Topical ophthalmic TA may cause enhanced therapeutic intraocular drug concentrations in hyphema (blood in the iris or cornea) patients with minimal toxicity. This treatment intends to prevent additional bleeding in the eye.

Microhemorrhage after coronary artery bypass surgery can be controlled with topical compression with TA reducing total blood loss.

Tranexamic acid has been used systemically and locally to reduce postextraction and periodontal surgical bleeding by its antifibrinolytic activity during operative procedures in hemophilic and cirrhosis patients. Tranexamic acid inhibits factor Xa in the clotting cascade and is administered orally as an oral rinse for 2 minutes, it can be detected at a therapeutic level intraocular drug concentrations in hyphema (blood in the iris or cornea) patients with minimal toxicity. This treatment intends to prevent additional bleeding in the eye. In a study by Waly, dual TA mouthwash and systemic TA was compared with systemic TA alone, and dual therapy was found to be dramatically superior in postextraction bleeding in children with hemophilia.

In patients with von Willebrand’s disease, oral or topical TA has been used to control oral bleeding such as frenum tears and lacerations of the lips and buccal mucosa. When 10 mL of 5% aqueous TA is administered orally as an oral rinse for 2 minutes, it can be detected at a therapeutic level in saliva for 2 hours but is undetectable in blood plasma. Systemic TA can be administered with an oral rinse to significantly reduce postoperative bleeding.

When oral surgery is performed on patients with hemophilia who are antiocoagulated, the surgery should be performed asatraumatically as possible by an experienced surgeon. Extraction sockets can be filled with collagen plugs soaked in 5% TA and secured with a resorbable suture. A 5% TA 3-times-daily postoperative 7-day oral rinse may be additionally prescribed. Alternatively, surgical sponges soaked in a 5% TA solution may be used by the patient to bite on to promote fibrin clot stability.

Hewson et al evaluated the postoperative course of 50 hemophilia patients for 113 extractions. They were prescribed a postoperative regimen of 5% TA oral rinse 3 times a day for 7 days and 5% TA surgical sponge tamponade as necessary for any moderate bleeding. Patients were treated with clotting factor replacement therapy coverage if it was their normal protocol depending on the severity of their disease. On the eighth day, 41 patients had no bleeding incidents, 6 had mild bleeding, 3 had moderate postoperative bleeding that was treated with the tamponade, and no patient had severe postoperative bleeding. What minimum clotting factor replacement level to provide a hemostatic effect in various surgical procedures is not known, but TA may be able to reduce the concentration of the therapy in these patients.

Tranexamic acid may be better used in a surgical sponge as...
a direct pressure tamponade when there is active bleeding (Figures 3 and 4). The most appropriate concentration of the TA solution is not known. The patient treated here was given TA topically as a saturated solution.

Some patients take 2 anticoagulants for dual therapy. Here, TA may be used with other topical modalities, such as a tea bag, to induce local hemorrhage control. These conditions need to be studied for appropriate treatment to be ascertained. In another placebo-controlled study, TA oral rinse alone was able to control gingival bleeding after dental scaling in hemophilia patients.80 No preoperative clotting factor replacement therapy was used with the TA rinse in these hemophilia patients.

**Contraindications**

Tranexamic acid is contraindicated for sensitivity, subarachnoid hemorrhage, macroscopic hematuria, and ongoing acute venous or arterial thrombosis.1 There may be a risk for thromboembolism if TA is administered after high doses of prothrombin complex concentrates. Intravenous TA should not be used to stop bleeding in the upper urinary tract, where clot formation may cause an obstruction. Because of its renal clearance, the intravenous TA dosage should be reduced in patients with renal insufficiency.

**Epinephrine, compression, tannins, and ice for bleeding control**

Local circumferential injection of the surgical site with an epinephrine containing local anesthetic may be a consideration. However, in cardiac patients, this may be contraindicated, especially after the administration of the local anesthetic for intraoperative pain control.

Compression by itself may stop bleeding but may not significantly contribute to the cessation in anticoagulated patients.81 Tranexamic acid pressure tamponade may be an important modality for bleeding control in these patients. A TA oral rinse was not used in the case example to preclude a potential dislodging or lifting of the surgical flap by the circulating solution in the mouth.

A moistened tea bag has been used with compression to stop postoperative bleeding from third molar extraction. Tea leaves contain tannic acid and tannins that may induce vasoconstriction.82–84 There is a recent report of successful use of combined tannic acid and aluminum potassium sulfate as a sclerosing agent for hemorrhoids in patients taking anticoagulants and those not taking anticoagulants.85

Ice applications may not adequately slow bleeding and may impair coagulation and hemostasis. Ice may be more useful in controlling pain.86

In patients in whom stents are to be placed, a tamponade should be used to control hemorrhage before the stent is applied.87 The stent may preclude direct contact of the TA with the bleeding surgical site. The clot formed is very fragile and cannot be disturbed lest bleeding restarts.

**Conclusions**

There is a risk of an adverse thromboembolic event for anticoagulant cessation when planning oral surgical procedures. While the risk is low, about 6%, the risk for such an event may be life threatening or seriously debilitating. The patient should, however, stop using CAMs for a week or two before the surgery, as some of these may contribute to perioperative bleeding.8 There is a risk of an adverse thromboembolic event for anticoagulant cessation when planning oral surgical procedures. While the risk is low, about 6%, the risk for such an event may be life threatening or seriously debilitating. The patient should, however, stop using CAMs for a week or two before the surgery, as some of these may contribute to perioperative bleeding.8 Thus, local bleeding control is a preoperative consideration for the dental implant surgical patient if cessation is inappropriate.

The very small number of patients reported herein does not qualify as a high level of evidence. Topical TA treatment for hemorrhage control needs to be investigated for efficacy.

A saturated aqueous solution of TA may be used topically
Tranexamic Acid

in a surgical sponge with biting compression to control postoperative bleeding in dental implant patients and potentially in those who are taking anticoagulants. The clot formed is fragile and prone to rebleeding. Many anticoagulants cannot be readily measured by clinical testing and thus place the patient at risk for postoperative hemorrhage. Local bleeding control measures in these patients may be a preoperative consideration. While TA may not directly interact with anticoagulants, its antifibrinolytic action stabilizes any clotting that does occur. Tranexamic acid may have additional metabolic activity related or unrelated to coagulation. This report has a low level of credibility. Research is needed to determine if TA is truly effective. A congener of TA or a local submucosal injection of TA may be more efficacious. In the end, TA may be considered to be part of an armamentarium for postoperative hemorrhage control of localized oral sites.

ABBREVIATIONS

ACE: angiotensin-converting enzyme
ASA: acetylsalicylic acid
CAM: complementary or alternative medication
INR: international normalized ratio
PT: prothrombin time
TA: tranexamic acid

REFERENCES