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Bedside Bleeding Control, Review Paper and Proposed Algorithm

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Abstract Bleeding is a common occurrence in practice, but occasionally it may be challenging issue to overcome. It can come from numerous sources such as, trauma, during or post-surgical intervention, disorders of platelet and coagulation factors and increased fibrinolysis, wounds and cancers. This paper was inspired from our experience with a patient admitted to a local long term acute care facility with a large fungating right breast cancerous wound. During her hospital stay spontaneous bleeding from her breast cancerous mass was encountered and became more frequent and significant over the period of her stay. Different hemostatic technologies were used to control her bleeding. We felt that it was important to share our experience with our colleagues to help with potential similar situation that they may face.

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Introduction

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This paper was inspired from our experience with a patient admitted to a local long term acute care facility with a large fungating right breast cancerous wound. During her hospital stay spontaneous bleeding from her breast

cancerous mass was encountered and became more frequent and significant over the period of her stay. Different hemostatic technologies were used to control her bleeding. We felt that it was important to share our experience with our colleagues to help with potential similar situation that they may face.

Case Report

The patient was 55 year old female nurse who 3 years prior was admitted with right breast cancer with metastasis to lymph nodes, spine and bone. The patient had elected not to undergo conventional treatment with surgery, radiation and chemotherapy. Instead, she chose to turn to alternative medicine and received pills and infusions. In the weeks prior to admission she noticed a rapid increase of her right breast with increased pain and fever. The patient was then admitted with the diagnosis of right breast infection with possible

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abscess for IV antibiotics, wound care. The fungating right breast cancer was malodorous caused by the necrotic and infected tissue. The patient was offered a palliative debulking procedure to remove her breast surgically taking all the risks involved, including intraoperative excessive bleeding, pneumothorax and death but she declined. Daily dressing changes including absorptive dressings were started. During her hospital stay a rapid growth and bleeding was noticed. Due to the large mass of the tumor and heavy weight the patient respiratory fatigue required respiratory support. The occasional bleeding episodes became more frequent and more significant requiring hemostatic agents to control the bleeding. Beside elevated WBC to 52,000 the platelets counts and PT/PTT were normalized. Along with the dressing a compression dressing was applied on the bleeding sites. A figure of eight suture was placed using 3/0 Vicryl suture and resulted in more bleeding due to the inflammatory and friable nature of the cancerous tissue. Silver nitrate was successfully used to stop small areas of bleeding. Few days later a larger oozing area was seen during dressing change. Hemostatic agents, Gel foam and Surgicel were used with some success. Those were applied at the bleeding sites with compressive dressing. Non-stick dressings were also used in direct contact with the wound bed to avoid mechanical injury to the surface during dressing change. Finally Thrombin activated with calcium-gluconate was used over large area of bleeding noticed few days later with good short term result. Figures 1 and 2 show the fungating right breast bleeding mass. The patient was transfused 2 units of blood to replace the blood loss over the period of 2 weeks. Embolization by intervention radiology was also considered but the patient and her family opposed to the idea. The patient finally died from progression of her disease and acute respiratory failure.

Discussion

The following is a discussion of the numerous methods to ensure hemostasis:

Bleeding can come from multiple issues from tissue injury following trauma or from a surgical procedure to a pathologic process disrupting a section of the clotting cascade. A careful history should be taken with all patients with excessive bleeding to examine for any hemostatic disorders, trauma or medication that may be exacerbating the problem. Questions that should be asked should include any past bleeding issues such as; excessive bleeding following surgical procedures, trauma, anemia, transfusion history, vitamin K deficiency, liver failure, factor VIII deficiency. Medications are important as this may be contributing to the bleeding problem. Medications such as aspirin, warfarin, plavix and these with an SSRI may cause excessive bleeding.¹ Laboratory testing may be helpful is a primary cause of the bleeding is not known. Common test include platelet count, INR, prothrombin time, activated partial thromboplastin time. Prothrombin time is a measure of

Figure 1 Right breast cancerous mass (lateral view).

the extrinsic pathway measuring factors I, II, V, VII, and X. This test is used to monitor Coumadin doses as well as vitamin K. A normal range is between 10 and 15 seconds however this may be increased with anticoagulation medication and the target range may be higher. Activated partial thromboplastin time measures the extrinsic pathway of factors: I, II, V, VIII, IX, X, XI, XII. Normal PTT times are usually measure between 25 and 38 seconds. An increase of this finding may be the result of medication such as heparin or a deficiency of a coagulation factor. INR (International normalized ration). INR measures Coumadin dosage, liver damage, and vitamin K. Normal range is between 0.8 and 1.2. However in medications such as warfarin the target range may be increased. Specific tests include coagulation factor assay, platelet release assay, and assessment of factor XIII activity via clot solubility testing may be used to confirm specific diagnosis.

Basic first aid should be the first approach in a patient with uncontrolled bleeding. Direct pressure for 3 minutes should be applied with elevation of the limb if the bleeding is noted on the extremity. A tourniquet use proximal to the site of a more major bleed can be used on the extremity. Ligation of visible bleeding vessels with various suturing material can be an effective use in achieving hemostasis. Retracted vessels that are not visible to clamp figure of 8 deep sutures are used to stop the bleeder. Electro cautery is often used intra-operatively to stop bleeders is another viable option. These are available to the surgeon in the

Figure 2 Right breast cancerous mass (medial view).

operating room but can be used at bedside depending on the experience and the level of comfort of the physician.

Silver nitrate has been commonly used since the 1800s as prevention for gonorrhea from the mother. Fused silver nitrate sticks are traditionally called lunar caustic agents. As silver nitrate contacts with water in the blood the compound goes into solution forming nitric acid which is responsible for the cautery effects. This will result in a black or greyish staining of the area. A study Hanif et al found by histological examination found that one needs to apply silver nitrate for 5 seconds to achieve maximal tissue penetration and that no additional tissue penetration was noted at longer times.² A study by Glynn et al found that a 75% solution of silver nitrate was slightly more effective than a 95% solution in childhood epistaxis.³

Bone wax is a common agent used to control bleeding from surgical procedures. Bone wax is made of beeswax with a softening agent such as paraffin or isopropyl palmitate. Bone wax controls bleeding by occluding bleeding channels. Bone wax has been shown to reduce drainage from operative sites and decrease the possibility of hematoma formation.⁴ Bone wax is not without complication as it can inhibit bone healing and induces chronic inflammation.⁵

Surgicel (oxidized cellulose) is effective in controlling bleeding. Its exact mechanism is not completely understood but it is thought to control bleeding more through a physical barrier than through the clotting cascade. Surgicel is bactericidal.⁶ Surgicel is absorbed within two weeks. The majority of the time the surgical is absorbed without any adverse effects however in rare instances it may mimic a granuloma, psudeocancer, or abscess.⁷⁻⁹ Most of these are described as a type four cell mediated hypersensitivity.

Gel foam is used as a physical barrier to control bleeding prepared by purified porcine skin. Gel foam is typically absorbed between 4 and 6 weeks. Surgicel acts as an artificial clot and has a matrix for clotting. Gel foam may cause adverse effects similar to surgical including granulomas and abscess in rare cases.^{10,11} Gel foam is not recommended to be as a vessel occlude as emboli and necrosis have been reported.

Thrombin is a serine protease protein it among other things converts fibrinogen to fibrin, factor V to Va, VIII to VIIIa, and XI to Xia. Thrombin promotes platelet aggregation and has a negative feedback mechanism of protein C. Thrombin causes smooth muscles to contract adding in vasoconstriction. Thrombin is preceded when prothrombin is activated by factor X. Topical thrombin is derived from three main factors; bovine, human and recombinant. Topical thrombin is many times combined with a material such as gel foam or surgical to aid in hemostasis. Topical thrombin is effective when the bleeding site continues to ooze and ligation or cautery is not possible. For most mild or moderate bleeding topical thrombin is effective within 10 minutes.¹²

Interventional radiology as a means for hemostasis is a popular, cost efficient and minimally invasive procedure. It utilizes imaging guidance (primarily fluoroscopy, computed tomography and ultrasound) to perform diagnostic and therapeutic procedures in a minimally invasive manner. Approaches may be endovascular (either arterial or venous), endocanalicular, or transcatheter. Indications for interventional radiology have widely increased over the years. Some of the common consensus indications are for uterine fibroids, interventional oncology procedures for liver tumors and metastatic disease, varicose vein treatment, carotid stenting, cerebral aneurysm coiling, removable or placement of inferior vena cava (IVC) filters, angioplasty and stenting in case of superior vena cava syndrome, local fibrinolysis, foreign bodies extraction, drainages, stenosis dilations and stent placements in urinary and biliary tracts obstructions, sepsis or fistulas^{13,14} and last but not least the widespread use of interventional radiology for the management of acute GI hemorrhage emergencies. Over the past two decades, transcatheter arterial embolization has become the first-line therapy for the management of upper gastrointestinal bleeding that is refractory to endoscopic hemostasis. Transcatheter embolization is a fast, safe and effective, minimally invasive alternative to surgery when endoscopic treatment fails to control bleeding from

the upper gastrointestinal tract. It can be performed with high technical and clinical success rates, and should be considered the salvage treatment of choice in patients at high surgical risk.¹⁵

Advances in catheter-based techniques and newer embolic agents, as well as recognition of the effectiveness of minimally invasive treatment options, have expanded the role of interventional radiology in the management of hemorrhage for a variety of indications, such as peptic ulcer bleeding, malignant disease, hemorrhagic Dieulafoy lesions and iatrogenic or trauma bleeding. Transcatheter interventions include the following: selective embolization of the feeding artery, sandwich coil occlusion of the gastroduodenal artery, blind or empiric embolization of the supposed bleeding vessel based on endoscopic findings and coil pseudoaneurysm or aneurysm embolization by three-dimensional sac packing with preservation of the parent artery.¹⁶

Oncology represents a very wide field of applications in interventional radiology. Main indications of endoarterial approaches are: pain, bleeding, abnormal secretion (endocrine tumors and paraneoplastic syndrome), abnormal function (kidney, spleen), preoperative devascularization of tumors, redistribution of arterial flows before intra-arterial chemotherapy, chemoembolizations. Venous pathology is known to be particularly frequent in oncology. Nowadays, interventional radiology can be considered as a requisite weapon for a correct cancerous patient management, since it is useful from the initial diagnostic biopsy to the palliative care of cancer complications.¹⁴ Another interventional radiology technique in cancer patients is transcatheter chemoembolization which is a procedure that delivers a chemotherapeutic agent to a tumor along with sponge particles that have an ischemic effect on the mass. Tumor ablation, gene therapy and access of central veins for treatment are performed effectively under radiographic guidance. Cancer complications can also be treated with interventional radiology techniques. Examples include pain control procedures, vertebroplasty and drainage of obstructed organs. Interventional radiology techniques typically represent the least invasive definitive diagnostic or therapeutic options available for patients with cancer. They can often be performed at a lower cost and with less associated morbidity than other interventions.¹⁷

Ephedrine, a hormone that has many functions. It is produced by the adrenal medulla and neurons of the central nervous system. It was discovered in the late 19th and early 20th century by John Abel and Jokichi Takamine.¹⁸ Ephedrine has multiple uses in the body including, increasing of heart rate, respiratory rate, vasoconstriction, triggering lipolysis, and causing muscle contraction. It is a non-selective agonist of alpha one, two and beta one and two. In peripheral arteries ephedrine activates the alpha receptors to cause vasoconstriction. Ephedrine with local anesthetics is well known to increase the length of time of the anesthetic and can

decrease blood flow which can aid in hemostasis. Topical epinephrine use has been shown to achieve hemostasis faster than other topical agents such as saline, mineral oil, K-Y, and topical thrombin.^{19–21} Ephedrine has been shown to decrease recurrent bleeding recurrence to only 16–30%.²²

Conclusion

When presented with the problem of excessive bleeding a careful history and physical will help assess any physical or biological issues. One should apply direct pressure to any areas of bleeding. If the bleeding is on an extremity elevation and ice may help control the bleeding. If bleeding continues to be an issue one may try physical barriers such as ligation of a vessel if it is noted or cauterization of the vessel or tissue with silver nitrate or an electrocautery. If bleeding is noted to be from a bone, bone wax may be used to achieve hemostasis. Agents such as surgical, gel foam, topical thrombin may be used to control hemostasis if necessary. Embolization should be the last resort in stable patients. Appropriate lab testing should be used to help identify any deficiency and coagulopathy should be corrected. Bleeding is a common but can be a serious issue if left untreated. This paper will hopefully give insight and problem solving situations when encountered.

Proposed Algorithm

Spontaneous bleeding from tumor or bleeding from debrided wound: hold pressure for 3 minute then release and check. Use non-stick gauze. Always check platelets (renal patients may have dysfunctional platelets even with normal count R/DDAVP), may have to transfuse platelets if low counts. For abnormal PT/PTT may have to give Vit K or FFP.

For bedside debridement Lidocaine with epinephrine should be used to minimize bleeding.

For minor bleeding from small vessel use Silver Nitrate to cauterize bleeding. If bleeding continues and is more diffuse, hemostatic agents such as Gel Foam, Surgicel or activated thrombin may be used in addition to holding pressure. If the bleeding vessel is visible a figure of 8 suture may be placed using 3/0 vicryl. Electro cautery may be used at bedside by trained personnel for more significant bleeding. Patient must be grounded.

For significant bleeding on trunk apply pressure until surgical help is available. For bleeding on upper or lower extremity, may use direct pressure or tourniquet until surgical help is available. Do not clamp major bleeding vessel as it may make repair difficult.

For unsuccessful hemostasis from a bleeding tumor and if the patient is stable consider embolization by intervention radiology.

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