

## Management of Iatrogenic Bleeding Following Bronchoscopic Biopsies

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The management of complications that arise from bronchoscopic sampling is very dependent upon the training and experience of the bronchoscopist.

For the sake of simplicity, the source of iatrogenic bleeding can be divided into two types; originating from either endobronchial mucosa/mass (following endobronchial biopsy or endobronchial brushings) or following transbronchial biopsy. Bleeding from visible areas is much easier to control using iced saline [1], vasopressors (epinephrine) [2,3], laser, electrocautery, cryoadhesion or argon plasma coagulation [4]. Controlling the bleeding from transbronchial biopsy requires a higher level of skill and may require salvage therapy with balloon occlusion of the bleeding segment to isolate the bleeding area [5].

The 2013 British Thoracic Society (BTS) guidelines for diagnostic flexible bronchoscopy in adults do not recommend routine blood testing prior to the procedure; but recommend coagulation studies, platelet count and hemoglobin concentration when there are clinical risk factors for abnormal coagulation. (Grade D) [6]. The guidelines also recommend holding clopidogrel for 7 days prior to the procedure.

Most bronchoscopist are familiar with the use of cold saline and epinephrine to stop bleeding after biopsy. Use of advanced bronchoscopist techniques such as deploying balloon to isolate the bleeding segments and the use of laser photocoagulation requires additional training and therefore are not commonly used (even when cold saline and endobronchial epinephrine fails).

It is not surprising that there is a significant diversity in the knowledge and use of epinephrine among respiratory consultants. The literature on the use of epinephrine itself is confusing and the recommendations on epinephrine concentration varies from 1:10,000 to 1:100,000 [3]. Epinephrine in the U.S. comes in a 1 mg/ml (1: 1,000) vial and understanding of the dilution can be confusing. It's also pertinent to mention here that the use of endobronchial epinephrine should be avoided in elderly patients, those with coronary heart disease, history of arrhythmias, and in patients with endobronchial carcinoid tumors. The BTS guidelines propose the instillation of 5 - 10 mL of 1:10,000 epinephrine [6].

Studies on bronchoscopic intratumoral injection of tranexamic acid to prevent excessive bleeding during forceps biopsies of lesions with a high risk of bleeding has also been reported, but has not gained widespread acceptance [7].

In our practice, despite the lack of controlled trials, we routinely check the creatinine level, hemoglobin, platelets and coagulation profile (prothrombin time, international normalized ratio and partial thromboplastin time) prior to the transbronchial biopsy. For endobronchial biopsy we check these profiles only if the patient has known renal, liver or hematological illness or if the patient is elderly [8]. We hold clopidogrel for 5 days prior to the procedure [9].

We always have cold saline and epinephrine ready prior to the procedure. We also have endobronchial blocker, cryoprobe and argon plasma coagulation available, although they are not set for use until needed. In most cases, bleeding is self-limited but if the intervention is needed we follow the following steps:

1. Wedge the bronchoscope into the target airway during and after the biopsy until hemostasis is achieved, avoiding suctioning in order to allow clot stabilization.
2. Cold saline, 10 ml aliquot is gently instilled in the bleeding segment.
3. If the bleeding continues we use 2 ml of 1:20,000 epinephrine. We use up to 0.6 mg if needed.
4. Isolating that bronchial segment is next step. We use bronchial blocker (Arndt endobronchial blocker set, Cook Medical, USA).
5. In case of bleeding after endobronchial biopsy we use argon plasma coagulation or cryotherapy if cold saline and epinephrine fails.

Although the risk of bleeding with bronchoscopic procedure is very low the stakes are very high. We agree that the bronchoscopy check list should be performed and ideally blood work should be done routinely at least for transbronchial biopsy, although no controlled studies exist on this. All medications should be reviewed and anticoagulant and antiplatelet therapy (except aspirin) should be held days (depending upon the drug) prior to the procedure [9].

We also recommend that every bronchoscopist who is trained to do endobronchial or transbronchial biopsies should also be trained in at least one advanced mode of controlling bleeding (use of endobronchial blocker for transbronchial biopsy and argon plasma coagulation or cryotherapy in endobronchial biopsy). Use of Manikin, formal local bronchoscopy course or simulation-based training are all reasonable ways to enhance the skills.

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