



Planning For Anaphylaxis in the Catheterization Laboratory

CLINICAL PRESENTATION AND MANAGEMENT

Severe contrast media reactions are uncommon but can be fatal if not promptly treated. Prior history of contrast reaction, especially of anaphylaxis, is the strongest risk factor for anaphylaxis. However, anaphylactic shock has been reported in patients with no known history of contrast media reactions and teams should consider anaphylaxis as a diagnosis in all patients with unexplained acute hemodynamic or respiratory distress after contrast media exposure. Patients with milder reactions can progress to more severe reactions and the catheterization laboratory and the recovery team should be ready to respond accordingly.

Although traditionally considered anaphylactoid, most severe reactions are true IgE-mediated anaphylactic reactions, and in patients with prior anaphylaxis allergy testing can help guide future contrast media choice. Teams should consider the use of an alternative type of contrast media in those with prior contrast mediated anaphylaxis when allergy testing is not available or when the procedure is emergent. Anaphylaxis can also rarely result from exposure to other agents such as local anesthetics or other drugs.

| Immediate Hypersensitivity Reactions – Classification of Severity and Management <i>Adapted from American College of Radiology Manual on Contrast Media 2021</i> | | |
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| Mild | Moderate | Severe |
| Limited urticarial/pruritus | Diffuse urticarial/pruritus | Diffuse edema with dyspnea |
| Limited "itchy"/"scratchy" throat | Diffuse erythema | Diffuse erythema with hypotension |
| Nasal congestion, Sneezing/rhinorrhea | Facial edema without dyspnea | Laryngeal edema with stridor and/or hypoxia |
| Conjunctivitis | Throat tightness or hoarseness without dyspnea | Wheezing and Bronchospasm with hypoxia |
| Cutaneous Edema | Wheezing or bronchospasm with mild or no hypoxia | Anaphylaxis with or without hypotension |
| Treatment | Treatment | Treatment |
| Diphenhydramine 1mg/kg (max 50mg) PO or IV if clinically needed | Diphenhydramine 1mg/kg (max 50mg) PO or IV immediately | Epinephrine 0.1 mg IV with slow flush or IV fluids, <i>repeat every 5-10 minutes if necessary (max 1 mg)</i> or Epinephrine 0.3mg IM (or auto-injector) injected to lateral thigh |
| Monitor Vital Signs | Oxygen by mask 6-10L/min | Oxygen by mask 6-10L/min |
| Preserve IV access | Albuterol MDI 2 puffs or albuterol 2.5mg/3mL via nebulizer - repeat every 20 | IV fluids 1L rapidly |



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| | minutes <i>if respiratory symptoms present</i> | |
| | Monitor Vital Signs including pulse oximetry | Intubation if necessary |
| | Preserve IV access | Diphenhydramine 1mg/kg (max 50mg) IV immediately |
| | | Albuterol MDI 2 puffs or albuterol 2.5mg/3mL via nebulizer - repeat every 20 minutes <i>if respiratory symptoms present</i> |
| | | Monitor Vital Signs |
| | | Preserve IV access, obtain central access |
| | | Arrange for transport to ICU for monitoring once stable for transport |
| | | Serum Tryptase within 2 hours |

It is important to note that although corticosteroids are frequently used in the treatment of anaphylaxis, conclusive data is lacking on any significant benefit.

For ongoing shock, not responsive to epinephrine

Some patients, especially those on beta blockers may not respond adequately to epinephrine.

1. Begin epinephrine continuous infusion at 0.1 mcg/kg/min and titrate according to blood pressure and cardiac status.
2. Patients on beta blockers may not respond to epinephrine. They can be given glucagon 1 to 5 mg IV over 5 minutes, followed by infusion of 5-15 mcg/minute. Note, rapid administration of this drug may cause vomiting.
3. Consider Vasopressin: Vasopressin has been used for successful treatment of anaphylaxis not responding to epinephrine. Various doses have been used and there are no specific data to guide dosing of vasopressin in this setting. BMC2 recommends the use of the post cardiectomy shock dose.
 - a. IV Vasopressin: Initial: 0.03 units/minute. If the target blood pressure response is not achieved, titrate up by 0.005 units/minute at 10- to 15-minute intervals (maximum dose: 0.1 units/minute). After target blood pressure has been maintained for 8 hours without the use of catecholamines, taper by 0.005 units/minute every hour as tolerated to maintain target blood pressure.
4. Consider Angiotensin II infusion: Approved for distributive shock, there are limited data on its use specifically in anaphylaxis (anaphylactic shock is a type of distributive shock). The dose for distributive shock
 - a. IV Angiotensin II: 10 to 20 ng/kg/minute, monitor response and titrate as frequently as every 5 minutes by increments of up to 15 ng/kg/minute as needed. Maximum initial dose: 80 ng/kg/minute during the first 3 hours of treatment.

5. Evaluate for other etiologies: RHC, ECG and bed side echo should be obtained to rule out other causes of shock. Confirm that the patient is not bleeding (externally or internally). Clinical and hemodynamic findings of anaphylaxis and bleeding can overlap considerably. Both can co-exist, and bleeding can be a secondary complication resulting from resuscitation efforts applied for treatment of anaphylaxis.
6. Call for ECMO if available.

Additional pharmacotherapy and mechanical support can be used as dictated by patient's hemodynamic status. Successful resuscitation from circulatory collapse has been achieved by use of Extracorporeal membrane oxygenation (ECMO) support and this should be considered as the preferred mechanical support (when available) in patients with profound hemodynamic collapse who do not respond to appropriate resuscitative measures.

Although there are sporadic case reports of successful use of Intra-aortic balloon pump to support patients with contrast media induced anaphylaxis, other (larger) case series have not demonstrated consistent benefit, but it can be considered if ECMO is not available.

There are no data on other mechanical support devices in such settings. The marked reduction in cardiac preload in the setting of anaphylaxis is likely to limit the benefit of Impella or Tandem Heart in anaphylaxis. If these devices are used, or are already in place, adequate fluid volume should be maintained.

TEAM READINESS AND ROLES

A pre-procedure brief to discuss planned response to an anaphylactic reaction (were it to occur) in high-risk patients can be very helpful. While there are no data to validate this practice, such a step centers the team focus and generates a greater sense of control and engagement.

Pre-procedure checklist

1. Confirm which contrast media did the patient react to previously and use a different agent
2. Confirm if the patient has received pre-medication
3. Team members are aware of their role in the setting of a severe reaction
4. Confirm the availability of appropriate drugs and make sure that the team members are aware of drug dosing
5. Check airway resuscitation equipment
6. The patient has a secure IV(s)

Team member roles in the case of an allergic reaction

Clarity of roles helps ensure an organized response. Team roles are not fixed and can be transferred between team members with clear communication and delegation of responsibilities.

The following is an example of how tasks may be assigned to various team members:

1. **Interventional faculty:** Overall management
2. **Fellow/second operator** (if available): Obtain central venous access, if necessary, anticipate and plan for mechanical support if needed. Obtain ultrasound guided 4 or 5 F femoral arterial and venous access if patient still in shock after 5 minutes in case ECMO cannulation is necessary.



3. **Cath lab Nurse:** Administer medications including: IV/IM epinephrine, administer diphenhydramine, ensure anticoagulation is maintained if the reaction occurs while an intervention was underway. Continue to titrate vasopressor/inotropic support as needed.
4. **Technician 1:** Ready to provide CPR.
5. **Technician 2:**
 - a. Call airway team if respiratory distress.
 - b. Call respiratory therapy stat for inhaled bronchodilator (albuterol) administration.
 - c. Call for additional resources to support nursing team.
 - d. Call ECMO team if still in shock after 5 minutes
6. **Additional nursing team member/ pharmacist:** Order Vasopressin and or Angiotensin II if patient still in shock at 5 minutes

CHALLENGES TO SAFE AND EFFECTIVE CARE

1. A frequent cause of errors is incorrect dosing or concentration of epinephrine administered during an acute event. This can be prevented via simulation training.
2. Delay in calling for help. In the event the patient has not responded to initial resuscitation efforts, calling other teams for help is important. This includes airway team (including respiratory therapy), ECMO team and additional provider, nursing and technical team members. We recommend that this be done no later than 5 minutes into the patient becoming unstable.
3. Difficulty in obtaining secure airway access: Airway access can be a challenge in the setting of laryngeal edema.
 - a. Often the airway team is called late when the patient develops profound airway obstruction rather than when hypoxia or stridor are first noted. Airway team should be stat paged at the first sign of hypoxia or stridor.
 - b. Sometimes resuscitation efforts are interrupted to secure an airway compounding the shock spiral. Appropriate dosing of epinephrine should be continued through the resuscitation process since it will help reduce laryngeal edema and facilitate easier intubation/ventilation. VA ECMO should be considered early in such a setting.
4. Teams encounter this scenario infrequently (< 1/ year) and may fail to respond in a calm and controlled manner. Periodic virtual or simulation training with staff as well as checklists and visual aids may help reduce these errors and improve patient safety. Consistent use of a pre-procedural brief in high-risk patients can maintain a sense of readiness.

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