UNSTABLE ATRIAL TACHYCARDIA
A case for high-fidelity simulation in emergency medicine

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ABSTRACT

This educational resource provides the information and materials for a high-fidelity simulation case suitable for resident physicians in emergency medicine. This case is currently in use at our institution for emergency medicine residents completing required educational time in our Emergency Department Simulation Program. This case has been used for the past four years in our program and has recently been edited and expanded to its existing form.

This high-fidelity patient simulation case involves a patient presenting with an unstable atrial tachycardia (Option #1 is atrial flutter; Option #2 is atrial fibrillation). Evaluation in the emergency department demonstrates a narrow-complex tachycardia and low blood pressure. Appropriate treatment with synchronized cardioversion will allow stabilization of the patient. Debriefing materials are provided to illustrate and stimulate discussion of the important concepts for diagnosing and treating patients with atrial tachycardias.
I. **Title of Case:** Unstable Atrial Tachycardia

II. **Target Audience:** Resident Physicians and Medical Students

III. **Learning Objectives:**

A. **Primary Learning Objectives**
   1. Demonstrate appropriate approach to a patient with tachycardia and chest pain.
   2. Identify a narrow complex tachycardia on ECG.
   3. List the diagnostic features of stable versus unstable atrial tachycardias.
   4. Understand the treatment options for atrial tachycardias.

B. **Secondary Goals**
   1. Differentiate between different causes of unstable tachycardia.
   2. Understand the pathophysiology of narrow-complex tachycardias.

C. **Critical Actions**
   1. Obtain appropriate history of present illness from patient.
   2. Complete pertinent physical examination.
   3. Identify narrow complex tachycardia on ECG.
   4. Establish IV access.
   5. Identify unstable vital signs and symptoms.
   6. Avoid continued treatment with IV medications when the patient does not respond and becomes unstable.
   7. Utilize synchronized cardioversion to treat unstable tachycardia.
   8. Arrange appropriate consultation and admission to hospital.

IV. **Environment:**

A. **Lab set up** – Emergency Department bed #6 in simulation laboratory.

B. **Manikin set up** – The manikin will be positioned in the bed in a head-raised position, with street clothes on. At the beginning of the simulation, there are no monitor leads on the patient, no IV has been placed, and patient is not on oxygen.

C. **Props** – Available for use will be a heart monitor with leads, blood pressure cuff, and pulse oximeter. Supplemental oxygen by nasal cannula or a 15-liter facemask will be available. There will be a medicine cart with a full complement of vasoactive agents, ACLS medications, medicines necessary for sedation, rapid sequence intubation, and analgesia. In addition, a fully stocked code cart with defibrillator will be available for use, along with a selection of direct laryngoscopes and intubation supplies.

D. **Audiovisual** – (See Appendix A) Available for review when asked for by participants will be patient ECGs, chest x-rays, and laboratory studies.
E. **Distracters** – Distracters can be added at the faculty director’s discretion. However, as written, this is the only patient that needs to be cared for and there will be no extraneous inputs to distract the participants’ attention from the case at hand.

V. **ACTORS:**

A. Roles can vary depending on the number of participants in the simulation session and on potential actor availability. This case can be implemented using the minimum of one participant and one facilitator/operator who can provide oral feedback via overhead audio and play additional roles via voice only. Realism can be enhanced by using physical actors, such as nursing staff members, but these are not required to successfully implement this case.

B. Roles may be played by resident or faculty physicians, nurses, or medical students.

C. Actions for the roles will be as follows:

   a. **Primary physician** - The main scenario participant will act as the primary physician and do the primary evaluation of the patient to include obtaining a history, conducting a physical exam, and ordering any necessary medications or other interventions. The primary physician can perform any needed procedures, or can delegate these to other physicians.

   b. **Secondary physicians** - Other participants in the scenario will serve as collaborators, assistants for any necessary procedures, and consultants.

   c. **Nursing staff** - The role of the nurse will be to administer medications, verify orders, and perform other tasks as directed by the physicians. The nurse can also make observations as needed to stimulate case progression.

VI. **CASE NARRATIVE:**

A. **Scenario Background**

   a. **Chief Complaint:** “Chest pain/Heart Racing”
   b. **Triage Nursing Note:** Patient is a 60 year old previously healthy female, who came to the ED today because chest pain and heart racing for the past 1 hour.
   c. **Vital Signs:** Heart rate 230; Blood pressure 85/45; Respiratory rate 32; Pulse oximetry 94% on room air; Temperature 98.7 degrees Fahrenheit
   d. **Past Medical History:** Coronary Artery Disease, “Fast heart rate”
   e. **Medications:** Cardizem XL
   f. **Allergies:** None
   g. **Family and Social History:** No significant family history. Patient recently quit smoking.
B. Initial Scenario Conditions

a. **History given by patient:** The patient reports that symptoms began 1 hour ago and has caused her chest pain. The patient feels like her heart is racing and feeling chest pain in the center of her chest. It is a sensation of pressure that is 5 on a scale of 1-10. The pain is constant since her heart began to race and she says that it is worsening. There is no radiation of the pain. Nothing has made the pain better.

b. **Circumstances at symptom onset:** Patient was washing her dishes at the time the symptoms began.

c. **Associated symptoms:** (Review of Systems must be asked for) Patient is diaphoretic and slightly nauseated. She feels light-headed and feels like she might “fall out.”

d. **Initial Exam:**
   i. **General:** Patient is an uncomfortable appearing obese female. Patient is awake, alert, and appropriately oriented. Appears to be breathing without difficulty, but appears to be uncomfortable.
   
   ii. **Head, Ears, Eyes, Nose, Throat:** There is no evidence of trauma to head. Pupils are equal, round, and reactive from 6mm to 4mm. Extraocular movements are fully intact. Ears are normal, tympanic membranes are clear, with good light reflex, no evidence of perforation. No mucus membrane rashes, dryness, or swelling.
   
   iii. **Skin:** Normal color and turgor. Diaphoresis present. No rashes, petechiae, or purpura.
   
   iv. **Cardiovascular:** Tachycardic pulse felt equally in all four extremities on initial exam. Point of maximal impulse is nondisplaced. No murmurs, rubs, or gallops.
   
   v. **Lungs:** Clear to auscultation without wheezes, crackles, or rales. Equal breath sounds bilaterally.
   
   
   vii. **Extremities:** No muscle tenderness with full range of motion in all extremities. No swelling or edema. Symmetric extremities.
   
   viii. **Neurological:** Alert and oriented with normal mental status. Pupils equal, round, and reactive to light and accommodation. Cranial nerves II-XII intact. 2+ deep tendon reflexes in all extremities. No sensory or motor deficits.

e. **Physiology:** (appears when placed patient is placed on monitor)
   
   i. Heart rate 226
   
   ii. Blood pressure is 80/40
   
   iii. Pulse oximetry is 94% on room air, 100% if patient is on oxygen
   
   iv. Respiratory rate is 26 breaths/minute
C. Scenario Branch points

a. Changes in patient condition: The patient will become unresponsive and the cardiac rhythm will be ventricular fibrillation if patient does not undergo synchronized cardioversion within 10 minutes of presentation.

b. Request for old records: Unavailable at this time.

c. Intravenous fluid administration: Initial 500cc of fluid will maintain blood pressure. Additional fluid will cause pulmonary edema and worsening respiratory status.

d. Other medical interventions: Synchronized cardioversion will place the patient in a normal sinus rhythm of 120 that will slowly decrease to the 90’s.

e. Laboratory studies: CBC is within normal limits. BMP is unremarkable. Cardiac enzymes are normal. Portable Chest X-Ray show slight cardiomegaly and no pulmonary edema. (See Appendix A)

f. Administration of medication: Adenosine will slow the heart rate momentarily to show an underlying rhythm of atrial flutter (Case Option #1) or atrial fibrillation (Case Option #2). Both EKG options are in Appendix A. Calcium channel blockers and beta-blockers will slow the heart rate down slightly and lower blood pressure further, making the patient short of breath, and worsen her chest pain. Versed or propofol for cardioversion will not decrease blood pressure if cardioversion is completed within 3-4 minutes.

g. Consultation of specialist: If the physician managing the case asks to consult Internal Medicine or Cardiology, the on-call physician will not answer the phone in time to suggest synchronized cardioversion before patient decompensation occurs.

h. Non-recommended actions: Delay of synchronized cardioversion will lead the patient to a ventricular fibrillation code that will not respond to medications. After 3 attempts at defibrillation the patient will enter pulseless electrical activity code and expire despite properly run ACLS algorithms.

VII. Instructor Notes:

A. Scenario flow – Instructors can directly influence the flow of the scenario by providing the initial patient history via both nursing report and patient verbal responses, since the patient is awake and talking and a source of information.

a. Key aspect of case – The key aspect for case flow is diagnosis of an unstable atrial tachycardia (Option #1 = atrial flutter; Option #2 = atrial fibrillation)
B. **Information for actors** – This case can easily be presented without formal “actors” and by using other participants to serve as the nursing staff or other collaborating physicians. Any specific actors used outside of participants should be briefed about the critical actions and anticipated flow of the case ahead of time.

C. **Scenario programming** – The settings for a high-fidelity patient simulator are fairly straightforward for this scenario and do not require specific programming. The scenario can be initiated with the vital signs as presented above, with the major branch points to be diagnosis of unstable narrow-complex tachycardia presenting with hypotension, chest pain, decreasing respiratory function and decreasing mental status. Synchronized cardioversion will stabilize the patient and prevent ventricular fibrillation and PEA Code.

VII. **DEBRIEFING PLAN:**

A. **Method of debriefing** – A post-case debriefing conference can be completed immediately following the end of the scenario. Consider including some of the following elements:

   a. **Open-ended questions by facilitator** – Consider beginning the session with a question to the primary participant about how they felt the scenario went. This often leads to extensive participant-led discussion that will touch on many of the major issues in the case. Invite any secondary participants and/or observers to comment about how the case unfolded.

   b. **Brief didactic review** – Potential materials for review after the scenario have been provided in Appendix B.

   c. **Formal participant evaluation** – See Appendix C for a sample of an evaluation form that can be used for this scenario.

B. **Actual debriefing materials** – See Appendix B for debriefing materials.

C. **Rules for the debriefing** – You may find that an informal discussion format for the initial portion of the debriefing leads to an open discussion of aspects of the case management that were good, and those areas where improvement can be made. Encourage your participants to discuss the case management decisions in a non-judgmental way. When this case is used for experiential learning at our institution (without formal participant evaluation on the specific case) such discussions may be more productive as compared to situations where formal feedback is anticipated. We have found that placing an emphasis on the learning that occurs from experiencing a case like this is very effective, rather than focusing on the “correct answer” or whether the specific management decisions turned out to be the most appropriate.
D. Questions to facilitate the debriefing –

a. How do you differentiate a stable patient from an unstable patient with a narrow complex tachycardia?

b. What are the recommended biphasic and/or monophasic settings for cardioversion?

c. What drugs can be used to sedate a patient for electrical cardioversion?

IX. PILOT TESTING AND LESSONS LEARNED:

A. Number of participants – This scenario has been presented for small groups of 3-4 participants, and has been field tested approximately 15 times over the past 4 years. All participants have been PGY1, PGY2, and PGY3 emergency medicine residents.

B. Performance expectations – Our experience to date has been that residents with PGY1 and higher are able to successfully negotiate this case. Most residents have successfully performed cardioversion on the patient without problems, and some others have attempted to medically control the tachycardia leading to further hypotension and a poor patient outcome. While many residents were not initially aggressive with cardioversion, the majority of participants have realized the worsening instability and performed ultimately cardioversion.

C. Notes regarding the inspiration for this simulation case – This simulation case is based on two separate real-life patient encounters where unstable atrial tachycardias were managed. The x-rays and EKGs that are provided are the real ones from these two cases.

a. Option #1 is an EKG with unstable atrial flutter – this patient was successfully cardioverted and stabilized.

b. Option #2 is an EKG with unstable atrial fibrillation – in this patient the decision to cardiovert was delayed, and the patient went into cardiac arrest and was unable to be resuscitated despite aggressive management.

c. Case elements for Option #1 and #2 are identical for this simulation, except for the initial EKG. Both EKGs are provided in for the instructor in Appendix A, so that the case can be tailored for either atrial flutter or atrial fibrillation.
D. Anticipated management mistakes –

a. **Failure to quickly cardiovert patient** – A number of residents have failed to properly appreciate the patient’s instability which led to inappropriate medication ordering, delaying cardioversion and leading to ventricular fibrillation code.

b. **Confusion about EKG findings** – We found that a number of participants, particularly residents in the PGY1 year, were confused by the EKG findings and were not able to make the appropriate diagnosis leading to delayed cardioversion.

c. **Inability to operate the defibrillator** – Many of our residents rely heavily on nursing staff to operate defibrillators during actual patient care activities. Therefore, when presented with a simulation scenario where no ED nurses are present in the room, many participants spent excessive time figuring out how to turn on the machine, set it for appropriate synchronized cardioversion, and selecting the appropriate Joule setting. This was a valuable learning experience for many residents to understand the importance of knowing how to operate the machine themselves.

E. Evaluation form for participants – See Appendix C.

X. AUTHORS AND THEIR AFFILIATIONS:

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XI. REFERENCES:


Appendix A

Supplemental Case Materials

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Note: This is EKG for case option #1
EKG

Note: This is EKG for case option #2
EKG After Cardioversion
Old EKG for comparison
Radiologic Imaging
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Troponin: 0.085  
CK: 190  
CK-MB %: 4.4  
CPK-MB: 8.28

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<td>4.5</td>
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</table>
Unstable Atrial Tachycardia

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Unstable Atrial Tachycardia

How do you manage unstable atrial tachycardia?

• **Simulation Case Note**: This simulation case is a combination of two real-life emergency department cases. In one of the cases, the patient’s unstable condition was recognized and treated successfully with cardioversion. In the other case, the patient was not immediately cardioverted and subsequently suffered cardiac arrest and was unable to be resuscitated.
Narrow Complex Tachycardia

- QRS < 0.12 seconds
- Ventricular rate > 100
  - Atrial Fibrillation
  - Atrial Flutter
  - Multifocal Atrial Tachycardia
Atrial Tachycardias

• How common are they?
  – Seen often in the emergency department, both new onset and recurrent atrial tachycardias with rapid ventricular response

• Why is it important to treat rapidly?
  – Initiating appropriate treatment quickly can avoid progression to unstable vital signs and life threatening arrhythmias
Atrial Fibrillation

- Disorganized depolarization of atrial tissues
  - Result of multiple micro-reentry circuits

- EKG shows fibrillation and irregular QRS
  - Fibrillation waves best seen in inferior leads or V1
Atrial Fibrillation

- Causes of atrial fibrillation:
  - Ischemic Heart Disease
  - Pericarditis
  - Hyperthyroidism
  - Sick Sinus Syndrome
  - Myocardial contusion
  - Acute ethanol intoxication
  - Cardiomyopathy
  - Cardiac surgery
  - Catecholamine excess
  - Pulmonary embolism
  - Congestive Heart Failure
  - Accessory pathway (Wolfe-Parkinson-White) syndrome
Atrial Flutter

- **Regular rhythm**
  - Atrial depolarization of 250-350 beats per minute

- **Distinctive “sawtooth” appearance**
  - Best seen in leads II, III, aVF, V1, V2

- **Frequent occurrence of 2:1 or 4:1 conduction**
  - Classically described with regular ventricular rate of 150
Multifocal Atrial Tachycardia

• More than two foci of atrial impulse formation
  – EKG demonstrates at least three distinctly different P waves

• Associated with pulmonary disease and hypoxemia
  – Can be the result of using beta-adrenergic agents
  – Often resolves when hypoxemia is resolved
Initial priority is to determine patient stability
- Unstable patients have evidence of end-organ hypoperfusion as a result of the dysrhythmia

Symptoms consistent with unstable patients:
- Hypotension
- Chest pain suggestive of myocardial ischemia
- Dyspnea or pulmonary edema
- Altered mental status
Unstable Narrow Complex Tachycardia

• What are the signs?
  – Low blood pressure
  – Decreased mental status
  – Poor peripheral perfusion

• What are the symptoms?
  – Chest pain
  – Palpitations
  – Shortness of breath
Unstable Patients in the ED

• Emergency electrical cardioversion
  – Place on supplemental oxygen
  – Establish IV access
  – Sedation may be necessary for cardioversion

• Synchronized cardioversion
  – Begin at 50 to 100 J
Stable Patients in the ED

• **Adenosine may be useful diagnostically:**
  – Temporarily slows rhythm
  – Transiently slows AV nodal conduction
  – May terminate some dysrhythmias (nodal reentry)

• **Onset of action 5-20 seconds**

• **Duration 40 seconds**
Stable Patients in the ED

• **Medical Rate Control**
  - Common short-term strategy used in the ED
  - Calcium channel blockers or beta-blockers
  - Some patients will be transitioned to oral rate control
  - Anticoagulation considered during long term rate control
Stable Patients in the ED

• **Cardioversion**
  – Risk of stroke correlated to duration of atrial fibrillation
  – Anticoagulation vs. transesophageal echo to reduce risks
  – Cochrane database review: Non-significant increase in stroke risk and improvement in 3 quality of life measures when compared to rate control strategy

• **Options for cardioversion**
  – Electrical
  – Pharmacologic
    • Class IA antiarrhythmics (*e.g.*, procainamide)
    • Class III antiarrhythmics (*e.g.*, amiodarone)
References


# Appendix C

## Unstable Atrial Tachycardia Simulation Evaluation

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<th>Participant Name ____________________________</th>
<th>Date ______________</th>
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<table>
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<td>Complete pertinent physical examination</td>
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<td>Arrange appropriate consultation and admission to hospital</td>
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<td>Follows ACLS protocols as needed</td>
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## Overall

**KEY:**

- **PR:** professionalism
- **IPS:** interpersonal skills
- **PC:** patient care
- **MK:** medical knowledge
- **SBP:** systems-based practice
- **Un:** unsatisfactory
- **Sat:** satisfactory
- **Ex:** excellent
- **N/A:** not applicable