HISTORY

50-year-old man.

CHIEF COMPLAINT: Chest pain of three days duration.

PRESENT ILLNESS: The patient struck his chest on the steering wheel in a serious automobile accident and was immediately hospitalized. An extensive chest wall contusion was initially observed but he was otherwise stable for 48 hours. In the last 24 hours, his pain has increased and changed in character, with radiation to his back and with associated shortness of breath.

Question: What cardiac diagnosis is suggested by this history?
Answer: Cardiac trauma resulting in myocardial contusion, valve injury, and aortic tear and/or a dissecting hematoma of the aorta are the most common diagnoses. Pain radiating to the back is most consistent with the latter.

**PHYSICAL SIGNS**

a. GENERAL APPEARANCE - An acutely ill, dyspneic man.

b. VENOUS PULSE - The CVP is estimated to be 6 cm H₂O.

**JUGULAR VENOUS PULSE**

![JUGULAR VENOUS PULSE Diagram]

Question: How do you interpret the venous pulse?
**Answer:** The mean central venous pressure and wave form are normal.

c. **ARTERIAL PULSE - (BP = 130/50 mm Hg)**

**Question:** How do you interpret the blood pressure and arterial pulse?
**Answer:** The blood pressure shows a wide pulse pressure with a normal systolic level and a low diastolic component. The arterial pulse is bounding (hyperdynamic) with a large amplitude and a brisk upstroke that rises to a single systolic peak. In this patient, an arterial “runoff” lesion such as aortic regurgitation is suggested.

In other settings, patent ductus arteriosus and high output states (e.g., chronic anemia and thyrotoxicosis) may also cause these changes. In many cases of acute aortic regurgitation, this arterial pulse contour is not seen, as adaptive hemodynamic changes have not had time to occur.

**Proceed**
d. PRECORDIAL MOVEMENT

**Question:** How do you interpret the patient’s apical impulse?
**Answer:** The apical impulse is hyperdynamic and non-sustained. This is consistent with significant mitral or aortic valvular regurgitation with an increased stroke volume associated with an increased preload and an increased velocity of contraction due to a reduced afterload.

The normal location and size of the impulse suggest that these changes are acute, i.e., over time the ventricle dilates and the apical impulse in chronic valve regurgitation is often inferolaterally displaced. In many cases of acute valvular regurgitation, the apical impulse is also normal in contour, as adaptive changes have not had time to occur.

**Proceed**
e. CARDIAC AUSCULTATION

**Question:** How do you interpret the acoustic events at the upper right sternal edge?
Answer: There is an early diastolic decrescendo murmur consistent with aortic regurgitation (AR). Its medium frequency and short duration are consistent with an acute lesion. In acute AR, the ventricle has not had time to “stretch” and accommodate the increased diastolic volume. This results in a rapid rise in ventricular pressure that shortens the duration of the murmur and decreases its frequency.

An early systolic crescendo-decrescendo murmur is also present. The fact that this murmur is short suggests that it is due to increased flow across a non-stenotic aortic valve, as it occurs only during maximum ejection, and may be related to turbulence alone.

Proceed
e. CARDIAC AUSCULTATION (continued)

Question: How do you interpret the acoustic events at the upper left sternal edge?
**Answer:** The murmurs are similar to those at the URSE and likely radiate from that area. Note that the second sound is single and loud. It likely represents an accentuated P2, consistent with some degree of pulmonary hypertension.

**e. CARDIAC AUSCULTATION (continued)**

**Question:** How do you interpret the acoustic events at the lower left sternal edge?
**Answer:** The murmurs are nearly identical to those at the base. The diastolic murmur is particularly well heard in this area, typical of AR.

e. CARDIAC AUSCULTATION (*continued*)

![Waveform](image)

**Question:** How do you interpret the acoustic events at the apex?
Answer: The soft systolic murmur likely radiates from the base. S1 is absent and there is a short, low frequency early diastolic murmur.

In this clinical setting, the absent first heart sound is likely due to the rapid increase in left ventricular diastolic pressure associated with acute AR causing premature closure of the mitral valve in diastole.

The early diastolic murmur is also likely due to early closure of the mitral valve. While mitral stenosis must be considered, the absence of both the first heart sound and an opening snap is evidence against this diagnosis.

f. PULMONARY AUSCULTATION

Question: How do you interpret the acoustic events in the pulmonary lung fields?

Proceed
**Answer:** In the lower lung fields, there are inspiratory and expiratory crackles bilaterally, reflecting pulmonary congestion. In all other lung fields, there are normal vesicular breath sounds.

**ELECTROCARDIOGRAM**

![ECG Diagram]

**Question:** How do you interpret this ECG?
**Answer:** The ECG is normal. This is common with an acute hemodynamic abnormality, as there has not been time for ECG changes to evolve.

**CHEST X RAYS**

[Image of a chest X-ray]

**Question:** How do you interpret this portable chest X-ray?
**Answer:** The chest X ray shows a prominent mediastinum consistent with dilation of the aortic root. There is mild venous congestion, and the left ventricle may be mildly dilated. The size of the left ventricle can be overestimated in a portable chest X ray.

**Question:** Based on the history, physical examination, ECG and chest X ray, what is your diagnostic impression and plan for further evaluation?
**Answer:** The history, physical examination, ECG and chest X rays are diagnostic of acute, severe aortic regurgitation, most likely due to a traumatic dissection of the aorta. This is a medical emergency that demands urgent evaluation and therapy.

**Question:** What non-invasive laboratory procedure is likely to help further define this patient’s diagnosis?
**Answer:** Echocardiography. Since aortic regurgitation was suspected, a color flow study was also carried out.

**LABORATORY - COLOR DOPPLER ECHOCARDIOGRAM**

**Question:** How do you interpret this echocardiogram?

LV = Left Ventricle  
LA = Left Atrium  
Ao = Aorta

**APICAL LONG AXIS**
**Answer:** The color flow Doppler echocardiogram shows severe aortic regurgitation (solid arrow). Left ventricular size is normal, consistent with an acute lesion. On the real-time study, estimated left ventricular systolic function was normal.

**LABORATORY (continued)**

**M-Mode ECHOCARDIOGRAM**

**Question:**
What are the diagnostic features of this M-Mode echocardiogram?
**Answer:** M-Mode echocardiography is particularly useful for timing of cardiac events, and in this case clearly documents that the mitral valve closes prematurely (arrow). This correlates well with the bedside finding of a soft and/or inaudible first heart sound. This is one of the few lesions where M-Mode echocardiography is of value.

Transesophageal echocardiography provides very useful information regarding the aortic root. The following transesophageal study specifically defines a dissecting hematoma as the etiology of this patient’s acute aortic regurgitation.
Views of the aorta showing intimal flap (arrow), true lumen (TL) and false lumen (FL)

Proceed
LABORATORY (continued)

Cardiac catheterization with angiography was performed to define the anatomy of the dissecting hematoma and of the coronary arteries.

A cine frame of an aortic root injection in this patient follows.
Question: How do you interpret this angiographic view?
**Answer:** This aortic root angiogram shows that the true lumen (solid arrow) at the level of the ascending aorta is narrowed. The false lumen (broken arrow) is also visualized. The point of entry of the dissection is not apparent on this cine frame. Additional injections confirmed severe aortic regurgitation and revealed normal coronary arteries.

The left ventricular pressure tracings revealed a marked and early rise in left ventricular diastolic pressure, exceeding that of the left atrium. Pulmonary pressure tracings revealed moderate pulmonary hypertension, the result of the sudden changes in left ventricular pressure.

**Question:** How would you treat this patient?
Answer: Because of the proximal location of the dissection and the severity of the associated AR, this patient with acute traumatic dissecting hematoma of the aorta was treated surgically. Vasodilator therapy to reduce afterload and beta blockade to reduce aortic shearing forces were initiated prior to surgery. The patient’s aorta was repaired, and his valve was successfully replaced.

Proceed
Acute aortic regurgitation most often results from infectious endocarditis, prosthetic valve dysfunction or a dissecting aortic hematoma. The latter may be secondary to trauma, hypertension or connective tissue disease.

Serious cardiac and great vessel injury may be overlooked in patients with trauma, in part because clinical manifestations may be delayed from the time of the traumatic event. These injuries may range from myocardial contusion to laceration or rupture of the aorta or the cardiac valves.
SUMMARY (continued)

In acute AR, the central and peripheral compensatory adaptations that are seen in chronic AR may not have time to evolve. The result is a marked elevation of left ventricular diastolic pressure and a limited forward stroke volume. This may produce a striking difference in the clinical presentation of the acute and chronic forms of this disease.

A diagram of simultaneous hemodynamic, echocardiographic and phonocardiographic features of acute aortic regurgitation follows.
ACUTE AORTIC REGURGITATION
Hemodynamic, Echo and Phono features

Ao = Aorta
LV = Left Ventricle
LA = Left Atrium
SM = Systolic Murmur
DM = Diastolic Murmur

Proceed
The left ventricular pressure tracing reveals a marked and early rise in left ventricular diastolic pressure, exceeding that of the left atrium (solid arrow). This results in premature closure of the mitral valve, as illustrated by the M-Mode echocardiographic tracing (broken arrow). This premature closure results in a low frequency diastolic flow rumble as shown on the apex phonocardiogram (double arrows).

The most helpful clinical features that differentiate acute and chronic aortic regurgitation follow.
# AORTIC REGURGITATION

<table>
<thead>
<tr>
<th>CLINICAL FINDING</th>
<th>ACUTE</th>
<th>CHRONIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>Early, sudden</td>
<td>Late, insidious</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Variable</td>
<td>Wide pulse pressure</td>
</tr>
<tr>
<td>Pulse contour</td>
<td>Single</td>
<td>Bisferiens</td>
</tr>
<tr>
<td>LV impulse</td>
<td>Near normal</td>
<td>Displaced</td>
</tr>
<tr>
<td>S1</td>
<td>Reduced</td>
<td>Normal</td>
</tr>
<tr>
<td>AR murmur</td>
<td>Short, medium frequency</td>
<td>Long, high frequency</td>
</tr>
<tr>
<td>Peripheral arterial signs</td>
<td>Frequently absent</td>
<td>Usually present</td>
</tr>
</tbody>
</table>

Proceed
This is a specimen of the heart and aorta. The arrows point to a dissecting hematoma in the ascending and transverse aorta, visible through the thin aortic adventitia.
This is an external view from the base of the heart. The arrow points to a dissecting hematoma between the adventitia and the media of the aorta. The loss of support of the aortic valve results in acute aortic regurgitation.

Proceed for Case Review
To Review This Case of Acute Aortic Regurgitation:

The **HISTORY** is consistent with this diagnosis, i.e., severe pain radiating to the back associated with acute dyspnea following serious non-penetrating chest trauma.

**PHYSICAL SIGNS:**

a. The **GENERAL APPEARANCE** reveals an acutely ill man.

b. The **JUGULAR VENOUS PULSE** is normal in mean pressure and wave form.

c. The **ARTERIAL PULSE** is rapid rising with an increased pulse pressure, consistent with an arterial “run off” lesion.

Proceed
d. The **PRECORDIAL MOVEMENT** at the apex reveals a non-displaced, brief, hyperdynamic impulse due to an acutely volume loaded left ventricle.

e. **CARDIAC AUSCULTATION** reveals the characteristic features of acute severe aortic regurgitation.

   1. A short, medium pitched, early, diastolic decrescendo murmur
   2. A short, low frequency, mid diastolic murmur at the apex
   3. A diminished first sound

f. **PULMONARY AUSCULTATION** reveals inspiratory and expiratory crackles in the lower lung fields bilaterally, reflecting pulmonary congestion. In all other lung fields, there are normal vesicular breath sounds.

Proceed
The **ELECTROCARDIOGRAM** is normal.

The **CHEST X RAY** shows pulmonary congestion and an enlarged mediastinum due to a dilated aorta.

**LABORATORY STUDIES** include echocardiography that shows severe aortic regurgitation, premature closure of the mitral valve and a dissecting aortic hematoma. Angiography further defines the dissection, confirms the aortic regurgitation and reveals normal coronary arteries. Pressure tracings reveal a marked early rise in LV diastolic pressure consistent with severe acute AR, along with moderate pulmonary hypertension.

**TREATMENT** consists of emergency surgical repair of the dissection and, if necessary, aortic valve replacement. Initial medical treatment designed to reduce afterload and aortic shearing forces is often indicated.