MEDICAL GRAND ROUNDS
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THE DIFFERENTIAL DIAGNOSIS OF PERICARDIAL EFFUSION

THE DIAGNOSIS OF PERICARDIAL EFFUSION IS ALMOST NEVER A SIMPLE MATTER EXCEPT IN CASES OF HEMOPERICARDIUM WHERE THE PHENOMENON OCCURS RAPIDLY FOLLOWING OBVIOUS TRAUMA. IT MUST BE DISTINGUISHED PRIMARILY FROM CARDIAC DILATATION, ALTHOUGH OTHER ITEMS SUCH AS PERICARDIAL CYSTS, VENTRICULAR ANEURYSMS, AND MEDIASTINAL TUMORS SOMETIMES CAUSE CONFUSION. THE FACT THAT MASSIVE PERICARDIAL EFFUSION AND GROSS CARDIAC DILATATION HAVE SO MANY CLINICAL FEATURES IN COMMON IS HARDLY TO BE WONDERED AT. IN BOTH, CENTRAL IMPAIRMENT OF CIRCULATORY FUNCTION IS PRESENT WITH THE RESULT THAT VENOUS ENGORGEMENT, DIMINISHED SYSTEMIC PULSE PRESSURE, DECREASED SYSTEMIC OUTPUT, AND PULSUS PARADOXUS ARE USUALLY PROMINENT FEATURES. THE ROENTGENOLOGIC CARDIAC CONTOUR MAY BE QUITE SIMILAR SINCE, IN BOTH, A DISTENDED SAC OF FLUID IS VISUALIZED; IN CARDIAC DILATATION THE WALL OF THE SAC IS REPRESENTED BY THE DILATED VENTRICULAR MYOCARDIUM AND IN PERICARDIAL EFFUSION BY THE DISTENDED PERICARDIUM.

UNFORTUNATELY, CLINICAL SITUATIONS IN WHICH PERICARDIAL EFFUSION IS A DIAGNOSTIC POSSIBILITY ARE OFTEN VERY PRESSING INDEED. IF ONE FAILS TO RECOGNIZE EFFUSION WITH CARDIAC TAMPONADE, AS HAPPENED IN 11 OF 17 CASES IN ONE SERIES (21), A NEEDLESS FATALITY MAY BE THE RESULT. ON THE OTHER HAND, UNNECESSARY PERICARDIAL ASPIRATION IS ITSELF HAZARDOUS ESPECIALLY IF THE VENTRICULAR MYOCARDIUM IS THIN AND IRRITABLE; IN SUCH INSTANCES ONE MAY ACTUALLY PRECIPITATE TAMPONADE.

CLINICALLY SIGNIFICANT PERICARDIAL EFFUSION OCCURS IN ASSOCIATION WITH NEOPLASTIC INVASION OF THE PERICARDIUM, INFECTION, PENETRATING CARDIAC WOUNDS MYOCARDIAL RUPTURE, AND DISSECTING ANEURYSM. IT IS USUALLY THE FIRST TWO ETIOLOGIC GROUPS THAT CAUSE DIAGNOSTIC CONFUSION. THEIR ONSET IS OFTEN INSIDIOUS AND PERICARDIAL EFFUSION MAY BE THE PRESENTING SIGN. ONE AUTHOR (10) ESTIMATES THAT AT LEAST 300 CC. OF EFFUSIVE FLUID MUST BE PRESENT BEFORE ALTERATION IN THE ROENTGENOLOGIC CONTOUR OF THE HEART IS RECOGNIZABLE. BUT HE ALSO POINTS OUT THAT AS LITTLE AS 150-250 CC. MAY PRODUCE TAMPONADE IF THE ACCUMULATION IS RAPID. IN SOME INSTANCES, HOWEVER, THE PERICARDIUM, WHICH IS NORMALLY NOT VERY DISTENSIBLE, MAY ACCOMMODATE VERY LARGE QUANTITIES OF FLUID WITH REMARKABLY LITTLE CHANGE IN CIRCULATORY DYNAMICS PROVIDED ACCUMULATION IS SLOW.

CASE I. [redacted]

A 51-YEAR-OLD WOMAN WAS ADMITTED ON [redacted]-59 BECAUSE OF FALLING-OUT SPELLS. MILD HYPERTENSION WAS FOUND IN 1952 AND SEVERAL YEARS BEFORE ADMISSION SHE HAD A MILD STROKE. FOUR DAYS BEFORE ENTRY, SHE ACCIDENTALLY

FELL BUT SUSTAINED NO SERIOUS INJURY. SEVERAL HOURS BEFORE ENTRY SHE SUDDENLY BECAME APHASIC AND HAD DIFFICULTY USING THE RIGHT HAND. THERE WAS A QUESTIONABLE HISTORY OF DYSPNEA FOR SEVERAL WEEKS BEFORE ENTRY.

PHYSICAL EXAMINATION DISCLOSED AN APHASIC COLORED WOMAN WHO LOOKED OLDER THAN HER STATED AGE. SHE WAS NOT ORTHOPNEIC AND THERE WAS NO OBVIOUS DISTENSION OF THE NECK VEINS. THE HEART WAS ENLARGED TO THE ANTERIOR AXILLARY LINE AND THE APEX BEAT WAS EASILY PALPABLE. THERE WERE NO MURMURS BUT THE HEART SOUNDS WERE OF NORMAL INTENSITY. THE BLOOD PRESSURE WAS 130/90. THE LIVER WAS NOT ENLARGED OR TENDER AND THERE WAS NO EDEMA OR ASCITES. COORDINATION WAS POOR BUT THERE WERE NO DISTINCTIVE NEUROLOGICAL SIGNS OTHER THAN WEAKNESS OF THE RIGHT HAND.

VENOUS PRESSURE WAS 118 MM. OF WATER AND CIRCULATION TIME (ARM-TO-TONGUE) WAS 17 SECONDS. EXAMINATION OF BLOOD AND URINE SHOWED NO ABNORMALITY. THE BUN WAS 11 MG., SERUM SODIUM WAS 145 AND CHLORIDES 96 MEQ/L. THE PBI WAS 7.8. THE ECG SHOWED DEEP Q WAVES IN ALL 3 LIMB LEADS AND IN LEADS V_4 TO V_6. ST SEGMENTS WERE ELEVATED IN ALL 3 LIMB LEADS AND THE LATERAL PRECORDIAL LEADS. SEGMENT ELEVATIONS WERE ASSOCIATED WITH FLAT OR DIPHASIC T WAVES. THE RHYTHM WAS NORMAL SINUS. XRAY FILMS SHOWED A HUGE, BOTTLE-SHAPED CARDIAC SHADOW.

AN ATTEMPT AT PERICARDIAL TAP VIA THE SUBXIPHOID APPROACH YIELDED SMALL AMOUNTS OF WHOLE BLOOD. SEVERAL DAYS LATER A TAP JUST BELOW THE APEX IN THE ANTERIOR AXILLARY LINE YIELDED ABOUT 700 CC. OF BLOODY FLUID. THE FLUID WAS FOUND TO CONTAIN WELL-DIFFERENTIATED TUMOR CELLS FORMING ACINI OR DUCT-LIKE STRUCTURES.

COMMENT

THE PATIENT PRESENTED WITH NEUROLOGICAL COMPLAINTS, AND MASSIVE ENLARGEMENT OF THE CARDIAC SHADOW WAS UNEXPECTED. ALTHOUGH XRAYS SUGGESTED MASSIVE PERICARDIAL EFFUSION THERE WAS NO EVIDENCE OF CARDIAC TAMPONADE. THE ECG IS CONSISTENT WITH PERICARDITIS AND RATHER ACUTE MYOCARDIAL DAMAGE OF UNKNOWN ETIOLOGY. THE PRESUMPTION IS THAT THE PATIENT HAS WIDESPREAD NEOPLASTIC DISEASE, PROBABLY CARCINOMA, WHICH HAS INVADED THE HEART AND WHICH INDUCED SLOW ACCUMULATION OF PERICARDIAL EFFUSION. PHYSICAL SIGNS, VENOUS PRESSURE, AND CIRCULATION TIME WERE INITIALLY CONSISTENT WITH NEITHER GROSS CARDIAC DILATATION NOR CARDIAC TAMPONADE.

CASE 2. [redacted]

A 39-YEAR-OLD MAN WAS FOUND TO HAVE AN INTERVENTRICULAR SEPTAL DEFECT 5 YEARS AGO. ABOUT 3 YEARS AGO, HE BEGAN TO DEVELOP SYMPTOMS OF CARDIAC FAILURE AND HAS BEEN INCREASINGLY DISABLED SINCE THEN. HE WAS ADMITTED FOR SURGERY ON [redacted]-59.

He was acutely ill and markedly orthopneic. There were crepitant rales at the base of the right lung. The heart was huge by percussion. Murmurs were consistent with interventricular septal defect. The blood pressure was 140/100 and the pulse rate 116. The liver was slightly enlarged and tender. There was pronounced edema of the lower extremities.

Venous pressure was 220 mm. of water and circulation time was 26 seconds. The BUN was 19 mg., serum sodium 136 and chlorides 97 mEq/L. The ECG showed RBBB. The cardiac shadow was markedly enlarged roentgenologically and there was a small effusion at the base of the right lung.

The patient responded fairly well to diuretic measures and was subjected to operation on [redacted]-59. The pericardial sac was huge and contained 2,200 cc. of clear fluid. The interventricular defect was closed and the patient did well post-operatively in spite of transient AV dissociation.

Comment

The patient's history and signs suggested cardiac dilation on entry [redacted]-59). Subsequently, he responded somewhat to treatment but the cardiac shadow did not appreciably diminish in size. As in the previous case, the slow accumulation of pericardial fluid (for reasons unknown) did not produce tamponade and was unsuspected until it was discovered at operation. In retrospect, the shape of the cardiac shadow and its failure to decrease in size with therapy might have provided a clue pre-operatively. The conviction, gained on entry that the heart was grossly dilated served, however, to discourage consideration of other possibilities.

Changes in Circulatory Dynamics

It would be difficult to improve significantly on the description of the dynamic changes induced by pericardial effusion presented by Starling (17). He showed that stepwise injection of oil into the pericardial sac of dogs caused little or no change at first. Then, slight rise in caval pressure, but no change in arterial pressure was noted. Finally, a point was reached in which marked rise in caval pressure was seen, arterial pressure remaining about the same. This he considered to be a critical point. Beyond it, further increments of pericardial fluid produced pronounced decrease in arterial systolic and pulse pressures and rapid deterioration of the animal. Starling attributed the changes to restriction of diastolic ventricular expansion. These, in essence, have been the findings of later workers. High right atrial pressures, the same changes in arterial pressure, and diminution in systemic cardiac output have been regularly found in human beings with cardiac tamponade (4, 9, 19). Characteristic right ventricular pressure pulses have been reported in constrictive pericardial disease and in pericardial effusion. The changes (elevated diastolic pressure plateau, sharp, early diastolic pressure dip) are identical with those seen in right ventricular failure but are said to be more marked in pericardial effusion

AND CONSTRICTIVE PERICARDIAL DISEASE (29, 22). HOWEVER THIS MAY BE, THE ONLY PATHOGNOMONIC CATHETERIZATION SIGN OF PERICARDIAL EFFUSION HAS TO DO WITH THE POSITION OF THE CATHETER: IF THE TIP CANNOT BE MADE TO TOUCH THE RIGHT BORDER OF THE CARDIAC CONTOUR, AN EFFUSION OR SOME OTHER SPACE-OCCUPYING MATERIAL IS PRESENT. IN A NEGATIVE SENSE, A NORMAL RIGHT ATRIAL PRESSURE RULES OUT EFFUSION THAT IS SIZABLE ENOUGH TO PRODUCE TAMPONADE, EARLY OR LATE. BEYOND THIS, CARDIAC CATHETERIZATION HAS LITTLE TO OFFER.

PHYSICAL SIGNS

"IN MOST INSTANCES OF GENERALIZED DILATATION OF THE HEART VERSUS PERICARDIAL EFFUSION," SAYS ONE AUTHORITY (14), "THE DIFFERENTIAL DIAGNOSIS CAN BE ESTABLISHED REASONABLY WELL WITH A CAREFUL CLINICAL EXAMINATION." THIS STATEMENT IS APPROXIMATELY TRUE ONLY IF TAMPONADE IS PRESENT. IF IT IS ABSENT, (ALTHOUGH THE EFFUSION MAY BE QUITE LARGE) DIFFERENTIAL DIAGNOSIS IS DIFFICULT. THE SIGNS USUALLY ASSOCIATED WITH PERICARDIAL EFFUSION ARE, IN PART, THOSE OF CARDIAC TAMPONADE.

EWART LISTED 12 SIGNS OF PERICARDIAL EFFUSION (3) MOST OF WHICH, BY HIS OWN STATEMENT, ARE NON-SPECIFIC AND ONE OF WHICH IS ACTUALLY IN ERROR. THE SIGN THAT BEARS HIS NAME, HOWEVER, IS USEFUL IF NOT ABSOLUTELY DIAGNOSTIC, ESPECIALLY SINCE IT MAY BE PRESENT BEFORE TAMPONADE DEVELOPS. THE SIGN (DULNESS AND TUBULAR BREATHING ON THE LEFT, BELOW THE INFERIOR ANGLE OF THE SCAPULA), IS THE RESULT OF BACKWARD DISPLACEMENT OF THE HEART BY FLUID WHICH COLLECTS IN THE FREE PERICARDIAL SPACE ANTERIORLY (18). IT IS ALSO (AND MOST UNFORTUNATELY) SOMETIMES SEEN IN PATIENTS WITH GROSS DILATATION OF THE HEART ITSELF. OTHER SIGNS INCLUDE MARKED ("ABSOLUTE") STERNAL DULNESS, INFERIOR DISPLACEMENT OF THE LIVER AND DIMINUTION OF THE INTENSITY OF THE APEX BEAT AND HEART SOUNDS. THE PULMONIC SECOND SOUND IS OFTEN ACCENTUATED.

DISTENSION OF NECK VEINS AND ELEVATED VENOUS PRESSURE ARE PRESENT IF ENOUGH FLUID HAS ACCUMULATED TO LIMIT DIASTOLIC VENTRICULAR FILLING. THE CIRCULATION TIME IS PROLONGED UNDER THE SAME CONDITIONS BUT MAY BE NORMAL EARLIER.

THE PULSE PRESSURE IS DIMINISHED IF TAMPONADE IS PRESENT. PARADOXICAL PULSE (10) MAY ALSO BE FOUND BUT IS NOT TOTALLY SPECIFIC.

THE ELECTROCARDIOGRAM

LOW VOLTAGE AND SIGNS OF PERICARDITIS ARE OFTEN SEEN IF THE EFFUSION IS LARGE. TOTAL ELECTRICAL ALTERNATION (SIMULTANEOUS ALTERNATION OF ATRIAL AND VENTRICULAR COMPLEXES) HAS RECENTLY BEEN FOUND TO ACCOMPANY TAMPONADE (8). THE PHENOMENON DISAPPEARS WHEN THE TAMPONADE IS RELIEVED AND IS NOT RELATED TO THE RESPIRATORY CYCLE.

Roentgenologic Findings

The standard PA and lateral views are suggestive only if the effusion is relatively large. In extreme cases, such films are virtually diagnostic (as in case 1). Angiocardiography may also be diagnostic (6, 18), but the procedure is not often applicable for technical reasons. Fluoroscopy and electrokymography may be helpful but often do not differentiate between moderate effusion and moderate dilatation.

The most promising radiologic technique available involves the injection of tagged albumin followed by careful scanning of the anterior chest. It has been shown by Bonte and colleagues to distinguish accurately between pericardial fluid and cardiac dilation, but the limits of its accuracy are not yet known.

Paracentesis and Pericardial Biopsy

Paracentesis is indicated in emergency situations where tamponade constitutes a threat to the patient's life. Pericardial biopsy is usually preferable where the aim is etiologic diagnosis.

Pericardial paracentesis is a hazardous procedure but is less so if the effusion is large (15). The preferred sites of needle injection are (7):

1. Just below the apex in or near the anterior axillary line (patient sitting).

2. Subxiphoid (patient recumbent).

Approaches along the left or right sternal margin, and posterior approaches, are less effective or more dangerous or both. Injection of air to replace fluid may help to visualize the pericardial sac but is itself not without danger.

Pericardial biopsy is a job for the thoracic surgeon but is not difficult and is less hazardous than blind paracentesis (20). It is also more effective in that fluid removal is easy and certain, and in that the pericardium (and even the myocardium) are readily available for biopsy under direct vision. The technique is described by Effler and Proudfit (2b, 13).

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