CLINICOPATHOLOGIC CORRELATIONS

Uremic Pericarditis as a Cause of Cardiac Tamponade

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SUMMARY  Uremic pericarditis may complicate either acute or, more commonly, chronic renal failure. When dialysis is not employed, uremic pericarditis is usually a preterminal event and is characterized by a serofibrinous exudation of an amount inadequate to cause cardiac tamponade. Nevertheless, cardiac tamponade may uncommonly be observed in nondialyzed patients. Cardiac tamponade, which may be life-threatening, is more common in dialyzed than in nondialyzed patients with chronic renal failure.

The primary causes of cardiac tamponade in uremic pericarditis in order of decreasing frequency are (1) pericardial effusion, usually of the serosanguineous type, (2) massive hemorrhage into the pericardial sac and (3) collagenization of pericardial exudate.

From pathologic evidence, the following forms of therapy appear appropriate to manage uremic pericarditis that has reached the stage of causing cardiac tamponade. For effusion, pericardiocentesis or parietal pericardectomy are logical procedures. Massive hemorrhage into the pericardial sac is usually attended by clotting and requires pericardiotomy and evacuation of clot. Collagenization of exudate yields an encasing, fibrous shell over the heart and requires decortication, as is practised in classical constrictive pericarditis.

The cases show the usual pathologic picture of pericarditis in the nondialyzed uremic patient. This is represented by an acute process without exudate sufficient to cause cardiac tamponade.

Case 1

The patient was a 61-year-old man in whom carcinoma of the prostate had been established four years previously. Initially, he was treated with diethylstibesterol. Three years later, a transurethral resection of the prostate and a bilateral orchectomy were done and the diethylstibesterol therapy was continued.

The patient was readmitted to the hospital two months following the surgical procedures complaining of nausea and backache. Upon admission, the level of blood urea nitrogen was 110 mg/100 ml. This rose to a level of 220 mg, at which time the patient became comatose. Nine days later, he died.

The pericardial cavity contained about 100 ml of serous fluid. Thick layers of fibrin were deposited on the pericardial surfaces (fig. 1). Histologically, a distinct zone of granulation tissue intervened between the fibrin and the underlying pericardial tissues (fig. 1).

Case 2

A 62-year-old man presented with traumatic rupture of the aorta at the junction of the arch and descending portion, for which he was treated surgically by resection of the rupture site and end-to-end anastomosis of the aorta. Postoperatively, renal failure developed and the patient died 13 days following the operation.

At autopsy, the pericardial surfaces were covered by thick layers of fibrin but no excess pericardial fluid was present (fig. 2). Histologically, the pericardium showed minor degrees of lymphocytic infiltration but no evidence of organization of fibrin was apparent. Mesothelial cells showed proliferation yielding formations of gland-like structures.

PERICARDITIS may complicate renal failure of either the acute or the chronic type. In acute renal failure this complication is less common than in chronic renal failure. Wacker and Merrill observed that 18% of patients with acute renal failure exhibited pericarditis, while in chronic failure the incidence of this complication occurred in 51% of cases.

Classically, in the nondialyzed patient, uremic pericarditis is a preterminal event characterized by fibrinous exudation upon the pericardial surfaces. The effusion of fluid is usually of limited amount and the pericarditis causes no significant hemodynamic disturbance.

In contrast, among dialyzed patients chronic effusion with varying degrees of cardiac tamponade is recognized as a not uncommon complication.

While there exists the contrasting situation regarding the pericardium between nondialyzed and dialyzed patients, there are some patients with chronic renal failure who, without dialysis, nevertheless present with a picture of cardiac tamponade.

The material chosen for this presentation illustrates a pathologic profile of the pericardial reaction that may occur in patients with renal failure while emphasizing that significant pericardial disease may be observed in the absence of dialytic therapy.

Classical Uremic Pericarditis in Nondialyzed Subjects

The two cases of classical uremic pericarditis in nondialyzed patients chosen for presentation represent the occurrence of this complication in chronic renal failure, as well as in acute renal failure.

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Pericarditis in Dialyzed Subject

Case 3

A 59-year-old, hypertensive woman had been maintained on hemodialysis for four years because of chronic renal failure. She died suddenly at home.

The chief cardiovascular lesion observed at necropsy was characterized by a diffuse, organizing pericarditis and effusion. The kidneys showed nephrosclerotic changes secondary to hypertension.

The pericardial cavity was distended by 400 ml of bloody fluid. The pericardial surfaces showed shaggy, fibrinous deposits (fig. 3). Histologically, the principal picture was one of a fibrinous pericarditis undergoing organization. This process was characterized by ingrowth of highly vascular granulation tissue into the fibrinous deposits. Some ex vacuo of blood was present around the capillaries of the organizing granulation tissues. No significant production of collagen was evident. The picture was one of a fairly recent process suggesting that, although the patient had been on hemodialysis for four years, the pericarditis in this particular case was of fairly recent origin.

Pericardial Effusion and Hemorrhage in Nondialyzed Subjects

Uncommonly, in nondialyzed subjects, the extent of pericardial involvement may be comparable to that observed in dialyzed subjects. Two such cases are presented below.

Case 4

A 40-year-old woman with chronic glomerulonephritis and hypertension had been hospitalized frequently for evaluation and treatment of the hypertension which was difficult to manage medically during the six years preceding her death. On the final admission, she entered the hospital in a semicomatose state. The level of blood urea nitrogen was 110 mg per 100 ml of blood. She became listless, continued in a progressively downhill course and died three weeks after admission.

The autopsy showed typical chronic glomerulonephritis and cardiomegaly. The pericardial cavity was distended with about 500 ml of bloody fluid under pressure. The surfaces of the pericardium were shaggy and hemorrhagic. Histologically, the picture was one of active organization of fibrin with some tendency toward formation of collagen (fig. 4). Hemorrhage was present in the fibrin.

It was evident that cardiac constriction had resulted principally from the accumulation of bloody fluid in the pericardial cavity. The amount of collagen formed in the granulation tissue appeared to be of only minor influence, if any, in causing cardiac constriction.

Case 5

A 32-year-old man was ill with chronic glomerulonephritis, anemia and congestive cardiac failure. The patient refused dialysis. In the two months prior to his death, the levels of blood urea nitrogen and creatinine, each in mg per...
100 ml of blood, ranged from 162 to 238 and 26 to 37, respectively. Death occurred suddenly.

At autopsy, the heart was encased by a thick layer of blood clot present in the pericardial cavity. Histologically, the parietal and visceral layers of the pericardium were each thickened by a layer of collagen (fig. 5). Extending from the surface of this zone was a layer of granulation tissue actively organizing the fibrin of the blood clot.

Cardiac constriction appeared to have resulted from a combination of the shell of blood clot encasing the heart and from the collagenous layer that involved the visceral layer of the pericardium. The latter represented older phases of organization of pericardial exudate.

Comment

There is still considerable uncertainty as to the etiology of uremic pericarditis but the most likely cause appears to be a response to abnormalities in serum electrolytes engendered by the renal failure. Support for this theory is given by the observation that pericardial effusion may be reversed by intensification of dialysis in most patients. For those situations in which such results do not occur, it has been suggested that a viral etiology may pertain. The latter concept awaits further testing before it can be accepted.

In classical cases of uremic pericarditis, cardiac tamponade does not occur. This may be understood from the fact that death usually occurs shortly after the onset of pericarditis, and this probably accounts for the fact that the usual amount of fibrinous deposit is too small to affect constriction of the heart. Also, while the amount of fluid exudation varies, it is usually hemodynamically insignificant. Nevertheless, it is significant that uremic pericarditis in nondialyzed patients may, in some cases, be of such extent as to cause cardiac tamponade, as reported by Goodner and Brown in 1956. Guild and associates credit Jones-Evans' describing, in 1922, a case of massive hemopericardium in a uremic patient. These authors also described two cases of hemopericardium with cardiac tamponade in nondialyzed uremic patients. Pericardiocentesis was lifesaving in one patient. The second patient, although relieved of cardiac tamponade by pericardiocentesis, died of potassium intoxication.

The pathologic changes observed in our Cases 4 and 5, in neither of which had dialysis been done, suggest that cardiac tamponade had been present.

It is recognized that among patients maintained on programs of hemodialysis, cardiac tamponade is more common than among nondialyzed subjects with uremic pericarditis. The difference may perhaps be explained by prolongation of life by the use of dialysis and that this prolongation, in turn, allows for progression of the pericardial disease. The use of anticoagulants as part of the technique of dialysis may favor accentuation of the pericarditic process through bleeding.

Regardless of whether dialysis is or is not used in treating patients with renal failure, once pericarditis has developed its potential for cardiac tamponade is qualitatively the same in both groups.

There are three possible primary causes of cardiac tamponade, namely, (1) pericardial effusion, (2) major hemorrhage into the pericardial cavity and (3) collagenization of the granulation tissue that organizes the fibrinous component of the pericardial exudate. A secondary cause may be through bacterial infection of pericardial exudate.

The primary type of fluid present in uremic pericarditis is not hemorrhagic, but it is nevertheless common that when effusions are present they will exhibit varying degrees of

FIGURE 2. Case 2. Uremic pericarditis complicating acute renal failure. No excess fluid was associated. a) Fibrinous deposits on exterior surface of the heart. b) Photomicrograph of pericardium showing fibrinous deposit upon surface. No organization is yet apparent. (H & E, × 51.) c) Pericardial surface. There is proliferation of mesothelial cells yielding gland-like formations. (H & E, × 100.)
UREMIC PERICARDITIS/Baldwin, Edwards

Figure 3. Case 3. Chronic pericardial effusion in hemodialyzed patient. a) A portion of the heart and parietal pericardium. The cavity was distended with serosanguineous fluid. Pericardial surfaces are shaggy. b) Photomicrograph. The myocardium lies below. Extending from the epicardium is granulation tissue which organizes fibrin. Collagenous production is not significant in amount. (H & E; × 73.)

Figure 4. Case 4. Chronic pericardial effusion in nondialyzed patient with chronic renal failure. The pericardial cavity was distended with 500 ml of serosanguineous fluid. a) Exterior of heart. The pericardial surfaces are shaggy by virtue of the presence of fibrin and undergoing organization. Hemorrhage is present in the exudate. b) Photomicrograph. The myocardium appears below. Extending from the epicardial surfaces is a layer of granulation tissue which proceeds into the overlying fibrin (upper portion of the illustration). In the center of illustration, representing the oldest reaction to the fibrin, early collagenous formation is present. (H & E; × 73.)
hemorrhagic character. The hemorrhagic nature of the fluid is probably derived primarily from rupture of the capillaries involved in organization of the fibrin. This complication of organization of pericardial fibrin is not peculiar to uremic pericarditis and has been observed in other forms of fibrinous pericarditis such as that complicating acute transmural myocardial infarction or following cardiac operations. The bleeding tendency accompanying uremia may, perhaps, make bleeding from pericardial granulation tissue more likely than in other states. Also, in dialyzed patients, the use of anticoagulants may have a compounding influence in causing hemorrhage into the pericardial effusion.

The literature contains many references to recurrence of hemorrhagic pericardial effusion following pericardiocentesis in dialyzed subjects. This phenomenon is probably to be explained by two factors, the first being that which causes the pericarditis initially. The second is recurrent hemorrhage from the granulation tissue that organizes the fibrinous exudate.

**Figure 5.** Case 5. Pericardial blood clot associated with collagenous thickening of pericardium causing cardiac compression in nondialyzed patient with chronic renal failure. a) Interior of right side of heart and overlying visceral and parietal pericardium. The pericardial cavity contains blood clot forming a shell around the heart. b) Left side of heart. The process of blood clot within the pericardial cavity causing constriction upon the heart is also evident on this side of the heart. c) Photomicrograph of visceral pericardium and reaction to pericarditis. Over the epicardial fat (E), at the base of the lesion, the granulation tissue, which had organized fibrin, is now collagenous (C) and represents, in addition to the accumulation of blood clot in the pericardial cavity, a constricting effect upon the heart. More superficially, fibrin (F) is still present and undergoing organization. (Mallory connective tissue stain; × 20.) d) Superficial level of pericardial reaction illustrated in c showing granulation tissue unorganizing fibrin. Some hemorrhage is present in relation to the capillaries of the granulation tissue. (H & E; × 100.)
Cardiac constriction by blood clot as observed in our Case 5 appears to occur when effusion is of minor degree while significant bleeding occurs from hemorrhage of organization of exudate that is predominantly fibrinous. Young and associates described a case in which cardiac tamponade principally affecting the right side of the heart resulted from the presence of loculated blood clot over the right ventricle.

Collagenous thickening of the pericardium develops with time in the older layers of granulation tissue. Such a process seems to have been underway in our Case 5 (in addition to the accumulation of blood clot). This process is not usually significant in uremic pericarditis but may, when it exists, present peculiar problems in therapy.

In the usual example of cardiac tamponade complicating uremic pericarditis, the constriction results primarily from accumulation of fluid as in our Cases 4 and 5. The life-threatening character of this condition has been treated either by pericardiocentesis or by direct surgical intervention. While pericardiocentesis has achieved successful results, there is commonly recurrence of fluid. This feature, and the chance of certain accidents resulting from pericardiocentesis, has led some to favor performance either of a "pericardial window" or pericardiectomy. The latter usually consists of removal of some of the parietal pericardium.

In those uncommon cases in which cardiac tamponade is caused either by accumulation of blood clot or by collagenization of the pericardial reaction, more extensive procedures seem indicated. For accumulation of blood clot, it is obvious that pericardiotomy should be done and the blood clot removed.

When either alone or with accumulation of blood clot there is collagenization of the exudate, it may be necessary to decorticate the visceral pericardium, as is done in classical chronic constrictive pericarditis.

References
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