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Original Article

Incidence of Arrhythmias and Myocardial Ischaemia During Haemodialysis and Haemofiltration

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Abstract. Thirty-two patients (10 male, 22 female; age 37–82 years) undergoing maintenance haemodialysis or haemofiltration were studied by means of Holter device capable of simultaneously analysing rhythm and ST-changes in three leads. Twenty-five patients were on haemodialysis, seven on haemofiltration, mean duration of haemodialysis/haemofiltration being 3.4±3 years. Incidence of ventricular tachycardia was low, being detected only in 1 of 32 patients. Ventricular premature beats in excess of 10/h during a period of 2 h were found in 8 of 32 patients and 100 supraventricular premature beats for 2 h or more in 4 of 32 patients. Both ventricular premature beats and supraventricular premature beats were most frequently recorded during the last hour of haemodialysis/haemofiltration. ECG signs of ischaemia were detected in eight patients, four of whom were asymptomatic. Ischaemia also occurred predominantly during the last hour of haemodialysis/haemofiltration. Two symptomatic patients displayed neither arrhythmias nor ST-changes while being monitored. The study shows that silent ischaemia and arrhythmias in patients undergoing chronic haemodialysis/haemofiltration may not be infrequent. Recognition of these events could be of importance in the management of these patients.

Key words: Arrhythmias; Cardiac ischaemia; Haemodialysis; Haemofiltration; Silent ischaemia

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Introduction

About 50% of patients on chronic haemodialysis die from cardiovascular disease, 16% dying suddenly [1]. The incidence of cardiac arrhythmias during haemodialysis and haemofiltration has recently been investigated extensively. Several authors found the incidence of complex cardiac arrhythmias to be correlated closely to the duration of haemodialysis/haemofiltration [2–4]. In the field of cardiology, asymptomatic myocardial ischaemia has recently become a topic of major interest. It is now evident that patients with silent ischaemia are also at greater risk of coronary events and sudden death [5].

Because chronic renal failure contributes to a higher morbidity due to coronary artery disease, patients with chronic renal diseases should be examined for signs of coronary artery disease in order to treat ischaemia and complex ventricular arrhythmias [6–12]. New Holter technology with the possibility of ST analysis provides the tool to study these problems during haemodialysis/haemofiltration.

The aim of our study was therefore, first, to show the practicability and efficacy of continuous rhythm and ST analysis, and second, to evaluate the incidence of arrhythmia and ischaemic events during haemodialysis/haemofiltration as well as their correlation to pre-existent coronary artery disease.

Patients and Methods

Thirty-two patients with a median age of 63 years (range 37–82 years, 10 male, 22 female) who had been on maintenance haemodialysis/haemofiltration for 3.4±3 years were studied. During haemodialysis/haemofiltration

Holter recordings with CCU-Compas were performed in three leads with on-line analysis of arrhythmias and ST changes. The arrhythmias were differentiated by a three-channel comparative algorithm in supraventricular and ventricular aetiology, and registered. Algorithm for ST analysis takes into account ST depression in 0.1 mV below zero, simultaneously assessing slope and a duration of at least 40 beats. QRS duration must be less than 120 msec. ST depression is reported to the nearest mm, and duration is given to the nearest minute. To eliminate false positive results only ST depression of 2 or more mm was taken to indicate ischaemia in our study. Heart rate at the beginning and the end of the episode was documented. A report of the Holter study was plotted at the end of the recording for arrhythmias and ST analysis. The registration was then evaluated independently by two cardiologists. Discrepancies were discussed by reviewing in order to reach a final evaluation by consensus. Figure 1 shows a typical example of an ischaemic event in a 75-year-old female patient during haemodialysis.

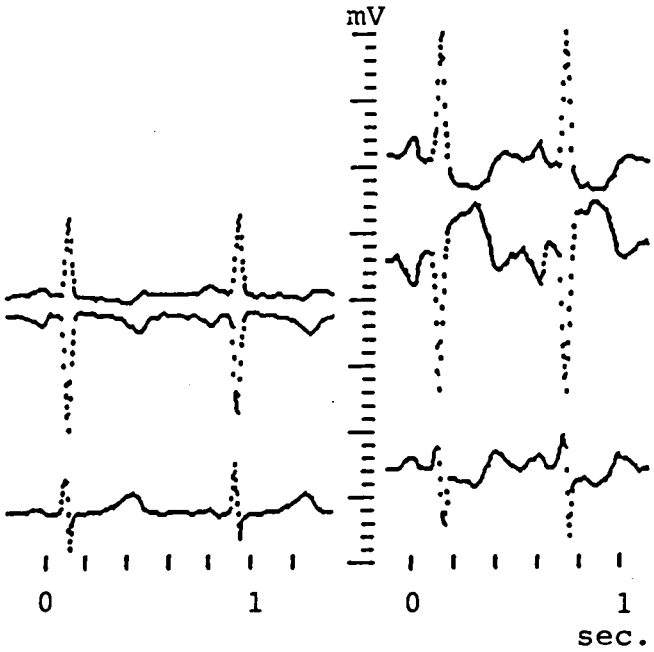

Fig. 1. Example of an ischaemic episode during haemodialysis in a 75-year-old female patient. On the left side is the ECG tracing at the beginning of haemodialysis, and on the right is shown the tracing of the same patient during asymptomatic ischaemia during haemodialysis.

The single patient on digitalis who also developed clear cut ischaemic changes during Holter recording was excluded from the statistical analysis. Five of eight patients who developed ECG signs of ischaemia did not receive cardioactive drugs, while three patients with ischaemia had anti-ischaemic treatment either with calcium antagonists, nitrates, or beta-blockers. Coronary artery disease was assumed to be present in eight of the 32 patients with documented Q-wave infarction in the ECG, scars or ischaemia in thallium or technetium scans, or presence of significant coronary stenosis by angiography. Fisher's exact test was used for statistical evaluation.

Results

1. *Cardiac Arrhythmias*

Only one of 32 patients had ventricular tachycardias. Frequent ventricular premature beats during 2 h, defined as 10 or more ventricular premature beats per hour, were found in 8 of 32 patients during haemodialysis/haemofiltration. Ventricular premature beats increased significantly in frequency during the last 2 h of haemodialysis/haemofiltration.

Supraventricular premature beats of 100/h or more during 2 h could be detected in four of the 32 patients. Similarly to ventricular premature beats, supraventricular premature beats also occurred more frequently during the last 2 h of haemodialysis/haemofiltration. No correlation between arrhythmias and presence of proven coronary artery disease was found ($P > 0.2$).

2. *Ischaemia*

Eight of 32 patients developed ECG signs of ischaemia. Only four of these eight patients were symptomatic. The ST depression lasted from 40 to 90 min and occurred mostly during the last 2 h. No patient with ST depression had previously known objective signs for coronary artery disease. Nevertheless a statistical difference between patients with and without proven coronary artery disease was not found ($P > 0.1$). Two additional patients who developed symptoms suggestive of coronary artery disease displayed neither arrhythmias nor ischaemic ST changes.

3. *ECG at Rest*

Nineteen of the 32 patients had an abnormal ECG at rest. The most frequent abnormality was left ventricular hypertrophy, followed by pathological Q-waves, atrial fibrillation and conduction blocks. Twelve of these patients with a pathological ECG at rest showed either significant ST depression, arrhythmias, or both. On the other hand only four of the 13 patients with normal ECG at rest showed significant ST depression or arrhythmias. The correlation between abnormal ECG findings at rest and occurrence of arrhythmias and/or ST depression during Holter monitoring did not reach statistical significance ($P = 0.07$).

Discussion

Our study shows that simple ventricular premature beats occur frequently during haemodialysis/haemofiltration (25%), especially during the last 2 h, indicating that dialysis has an arrhythmogenic effect. We did not observe a burst of complex ventricular arrhythmias, as recently published from a multicentre, cross-sectional Italian study [1], which describes ventricular arrhythmias in 79% with 21% Lown class 4A or B from the 3rd hour during haemodialysis up to at least 5 h after dialysis. ST depression, indicative of ischaemic episodes, could be demonstrated in a quarter of our patients, and occurred predominantly in the last 2 h of haemodialysis or haemofiltration. Fifty per cent of all patients remained entirely asymptomatic.

No observation has been published demonstrating myocardial ischaemia or ischaemia-like ST changes during haemodialysis/haemofiltration. Such phenomena could be due to electrolyte disturbance during the end phase of treatment, as demonstrated for arrhythmias in hypokalaemic and hypomagnesaemic states due to diuretic therapy or during the acute phase of myocardial infarction [14–15]. Another explanation could be volume depletion as a result of ultrafiltration, which is more likely to occur during the last hours of the procedure [16].

The search for silent ischaemic events and arrhythmias is of importance because of the high prevalence of coronary artery disease (up to 64%) in patients with end-stage renal disease [17]. The high proportion of asymptomatic patients in our study (50%) and in others demonstrates the low sensitivity of clinical symptoms in patients with coronary artery disease [18–20]. Ischaemia can be proven either by stress ECG, thallium or technetium scintigraphy, or Holter monitoring. Because stress testing is often not feasible in patients with end-stage renal disease, Holter ST monitoring provides a good alternative tool and allows long-term analysis during the whole haemodialysis/haemofiltration session. Furthermore, this method helps to separate symptomatic patients without coronary artery disease from patients with ischaemia and atypical chest pain. Patients with pathological resting ECG might be the first to profit from Holter ST/arrhythmia investigation, because they tend to have more ischaemic and arrhythmic episodes.

The study shows that silent ischaemia and arrhythmias are likely to occur in patients undergoing chronic haemodialysis/haemofiltration. Recognition of these events could be of importance in the management of these patients.

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