Salivary gland function in continuous ambulatory peritoneal dialysis patients by $^{99m}$Tc-pertechnetate scintigraphy

Abstract

The purpose of this study was to evaluate the alterations in salivary gland function in patients who receiving continuous ambulatory peritoneal dialysis (CAPD) for chronic renal failure (CRF) using technetium-99m pertechnetate ($^{99m}$Tc-P) salivary gland scintigraphy. The study population consisted of 36 CAPD patients (16 males and 20 females, ranging in age from 19 to 73 years, mean age 44.94±15.01 years) and 20 healthy controls (11 males and 9 females, ranging in age from 31 to 51 years, mean age 41.25±5.62 years). All patients and healthy controls underwent salivary gland scintigraphy. After the intravenous administration of 185MBq of $^{99m}$Tc-P, dynamic salivary gland scintigraphy was performed for 25min. On the basis of the time-activity curves, the following glandular function parameters were calculated for the parotid and submandibular salivary glands: uptake ratio, maximum accumulation, and ejection fraction. Our results showed: All functional parameters obtained for CAPD patients were significantly lower than for healthy controls (P<0.05). In conclusion, this study demonstrated that salivary gland function, an important determinant of oral health, is impaired among the CRF patients treated with CAPD compared with healthy controls, as evaluated by $^{99m}$Tc-P salivary gland scintigraphy.

Introduction

Chronic renal failure (CRF) is a process that expresses a loss of functional capacity of the nephrons, independently of its aetiology. Although acute renal failure is reversible in the majority of cases, CRF presents a progressive course towards terminal renal failure, even if the cause of the initial nephropathy disappears [1, 2].

When the function of the kidneys is severely impaired, either haemodialysis or peritoneal dialysis treatment or renal transplantation may be applied [3]. Haemodialysis leads to variations in the flow and composition of the saliva [1, 4-6]. It has been shown that the parenchymatous and excretory functions of salivary glands were decreased in dialysis patients [7, 8].

Salivary gland scintigraphy with $^{99m}$Tc-P is a routine test with low dosimetry and does not interfere with normal physiology [8-11]. In addition, by using this method, quantitative data about the major functions of salivary glands can be obtained [12-15].

We found no report in the literature about the evaluation of salivary function using $^{99m}$Tc-P salivary gland scintigraphy, in patients receiving CAPD for CRF.

Subjects and methods

Patients

The study population consisted of 36 patients with CRF (16 males and 20 females, ranging in age from 19 to 73 years, mean age 44.94±15.01 years) and 20 healthy controls (11 males and 9 females, ranging in age from 31 to 51 years, mean age 41.25±5.62 years) (Table 1). All patients with CRF have received CAPD routinely since 5 to 84 months, mean 22.39±20.37 months. The duration of CRF was 30.11±21.83 months (range 6-86 months). The levels of serum creatinine and 24h urine volume of patients were 9.33±3.18 mg/dL (range 2.30-14.70mg/dL) and 616.67±328.19mL (range 200-1500mL), respectively. No patient or healthy control had a history of head or neck surgery or radiation treatment, a connective tissue or other systemic disease. All patients and healthy controls gave informed consent for the study, which was approved by the ethical committee of your university.
Dynamic salivary gland scintigraphy was performed after intravenous administration of 185 MBq of 99mTc-P using a single-head gamma camera with a parallel-hole, low-energy, high-resolution collimator (GE-Starcam 4000 XR/T, St Albans, Hertfordshire, UK). The photopeak was centered at 140keV with a 20% window. A total of 25 frames of 60s each were acquired in the anterior position of the head and neck during the 25min study with a zoom 1.33 and matrix of 128×128 (Fig. 1).

Salivary gland secretion was stimulated with 3mL concentrated lemon juice instilled orally with a syringe at 20min. Similar protocols have been used by others [11, 12, 14, 15]. All patients and healthy controls tolerated the study well.

Semi-quantitative analysis

For semi-quantitative analysis, regions of interest (ROI) were drawn around the right and left parotid glands and the right and left submandibular glands on summation images of dynamic scintigraphy (Fig. 2). A background ROI was placed in the temporal region. A time-activity curve of each salivary gland was created (Fig. 3A and 3B). As shown in Fig. 4, the following points were designated on the time-activity curve: a) vascular perfusion, at 1 min; b) the maximum count before stimulation; c) the background count at the time of peak activity; d) the minimum count after stimulation.

The following glandular function parameters were calculated using the time-activity curves for each salivary gland:

- Uptake ratio (UR) = b/c,
- Maximum accumulation (MA%) = (b – a) / b × 100,
- Ejection fraction (EF%) = (b – d) / b × 100.

### Table 1. Characteristics of patients and healthy controls groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Sex (male/female)</th>
<th>Mean age ± SD (range in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPD patients</td>
<td>36</td>
<td>16 / 20</td>
<td>44.94 ± 15.01 (19-73)</td>
</tr>
<tr>
<td>Healthy controls</td>
<td>20</td>
<td>11 / 9</td>
<td>41.25 ± 5.62 (31-51)</td>
</tr>
</tbody>
</table>

CAPD, continuous ambulatory peritoneal dialysis.
Research Article

scintigraphy in CRF [8]. Our study evaluated salivary function in patients with CRF undergoing hemodialysis not CAPD.

In our study, a lower salivary flow rate was found in CAPD patients compared with healthy controls and the differences were statistically significant. The salivary glands can also be evaluated through computerized tomography (CT) and sialography. We found no other papers studying patients with CRF tested with CT or scintigraphy. However, neither CT nor sialography allow quantification of the salivary gland function and obstruction [14]. Furthermore, in the diagnosis of functional obstruction by sialography, cannulization of all four salivary gland ducts is difficult and often painful for the patients [14]. On the other hand, salivary gland scintigraphy is easy, non invasive and enables a functional evaluation of the salivary glands, making it a valuable diagnostic tool. It is also well tolerated by patients, has a low dosimetry and does not interfere with normal physiology [8-11, 15]. A review of previous reports on quantitation of salivary gland function showed that most functional indices such as percent uptake, concentration and excretion fractions were derived from individual salivary gland time-activity curves [12-14, 19].

In conclusion, results of our study indicate that salivary gland function, an important determinant of oral health, is impaired among the CRF patients treated with CAPD compared with healthy controls, as evaluated by 99mTc-P salivary gland scintigraphy. Further studies involving larger cohorts of patients should be performed to confirm these findings.

Bibliography

Research Article


