

## —Originals—

## Elimination of non-ionic contrast medium by hemodialysis in patients with impaired renal function

Kazutaka Horiuchi<sup>1)</sup>, Kazuhiro Yoshida<sup>1)</sup>, Narumi Tsuboi<sup>1)</sup>,  
Masao Akimoto<sup>1)</sup>, Hiroyuki Tajima<sup>2)</sup>, Tatsuo Kumazaki<sup>2)</sup>

<sup>1)</sup>Department of Urology and <sup>2)</sup>Department of Radiology, Nippon Medical School

### Abstract

The elimination rate of iohexol, a non-ionic contrast medium, from the blood by hemodialysis, and the elimination rate of iohexol by a dialyzer were studied in 15 patients with chronic renal dysfunction who required angiography or enhanced CT. The elimination rate of iohexol was 19.8% at 15 min after the start of hemodialysis, 30.6% after 30 min, 44.2% after 1 hour, 62.1% after 2 hours and 72.9% after 3 hours. The dialyzer elimination rate was maintained at about 75% from 1 to 3 hours after the start of hemodialysis. If only about 70% of iohexol in the blood needs to be eliminated, hemodialysis for 3 hours with a blood flow rate of 120 ml/min and a dialysate flow of 500 ml/min using a 0.7 m<sup>2</sup> cellulose triacetate membrane is sufficient. (J Nippon Med Sch 1999; 66: 305–307)

**Key words:** hemodialysis, elimination, non-ionic contrast medium, renal dysfunction

### Introduction

In recent years, non-ionic low-osmolar contrast media have been developed to replace ionic high-osmolar contrast media. However, since contrast media administered intravascularly are mainly excreted via the kidneys, there is a possibility that renal function will be further impaired by accumulation of contrast medium as a result of delayed excretion in patients with renal dysfunction. Therefore, it may be necessary to eliminate contrast media rapidly by hemodialysis in order to minimize the effect on renal function. Thus, the extent to which contrast media can be eliminated by hemodialysis is an important question, but there

have been few studies on iohexol, a non-ionic low-osmolar contrast medium<sup>1,2</sup>.

In the present study, we investigated the elimination of iohexol by hemodialysis in patients with impaired renal function.

### Material and Methods

The subjects were 12 men and 3 women with chronic renal dysfunction (serum creatinine  $\geq 1.5$  mg/dl and 24-hour creatinine clearance  $< 50$  ml/min) who required angiography or enhanced CT and who gave informed consent to the procedure (Table 1).

As soon as possible after enhanced imaging using Iohexol 300 (647 mg/ml as iohexol, iodine content: 300

Table 1 Patients' characteristics

Age (Mean $\pm$ SD)	50–80 (66.9 $\pm$ 6.5) years
Serum creatinine (Mean $\pm$ SD)	1.5–2.8 (2.2 $\pm$ 0.5) mg/dl
24-hour creatinine clearance (Mean $\pm$ SD)	12–50 (24.5 $\pm$ 12.4) ml/min

mgI/ml) or Iohexol 350 (755 mg/ml and 350 mgI/ml), hemodialysis was performed at a blood flow rate of 120 ml/min and dialysate flow rate of 500 ml/min using a cellulose triacetate membrane (0.7 m<sup>2</sup>). The mean dose of contrast medium was 88.9 ± 44.2 g iohexol (range: 22.6 to 158.5 g).

The blood level of iohexol was measured at the start of hemodialysis as well as 15 and 30 min and 1, 2, and 3 hours (completion of hemodialysis) after the start of hemodialysis, and the elimination rate of iohexol from the blood was obtained by the following equation after correction for the hematocrit :

$$\text{Elimination rate of iohexol from the blood} = (\text{CBa} - \text{CBb}) / \text{CBa} \times 100 (\%)$$

CBa: blood concentration of iohexol at the start of hemodialysis

CBb: blood concentration of iohexol during hemodialysis

The elimination rate of iohexol by the dialyzer was determined at the start of hemodialysis as well as 30 min and 1, 2, and 3 hours after the start of hemodialysis using the following equation :

$$\text{Dialyzer elimination rate} = (\text{CBI} - \text{CBo}) / \text{CBI} \times 100 (\%)$$

CBI: blood concentration of iohexol in the inflow side of the hemodialysis circuit

CBo: blood concentration of iohexol in the outflow side of the hemodialysis circuit

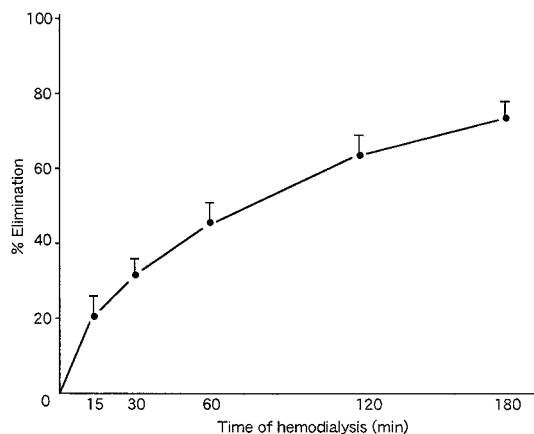


Fig. 1 Time course of the elimination rate of iohexol from the blood. The elimination rate of iohexol was 19.8% at 15 min after the start of hemodialysis, 30.6% after 30 min, 44.2% after 1 hour, 62.1% after 2 hours and 72.9% after 3 hours.

Blood samples were obtained and serum was frozen for storage immediately after separation. Measurements were made using high performance liquid chromatography. The results were tested statistically using the paired Student's t-test, and  $p < 0.05$  was considered to indicate a significant difference.

## Results

### 1. Time course of the elimination rate of iohexol from the blood

The elimination rate of iohexol was 19.8 ± 5.5% at 15 min after the start of hemodialysis, 30.6 ± 4.8% after 30 min, 44.2 ± 6.2% after 1 hour, 62.1 ± 5.2% after 2 hours and 72.9 ± 4.7% after 3 hours (Fig. 1). There were significant differences between the rate at the start of hemodialysis and 15 min, 30 min, 1 hour, 2 hours, and 3 hours after the start of hemodialysis ( $p < 0.01$ ).

### 2. The elimination rate of iohexol by the dialyzer

The elimination rate of iohexol by the dialysis circuit decreased significantly from 83.3 ± 5.7% immediately after the start of hemodialysis to 76.5 ± 1.9% at 30 min ( $p < 0.01$ ), but an elimination rate of about 75% was maintained from 1 to 3 hours after the start of hemodialysis (i. e., 75.8 ± 2.0% after 1 hour, 75.1 ± 2.5% after 2 hours and 74.6 ± 3.7% after 3 hours) (Fig. 2).

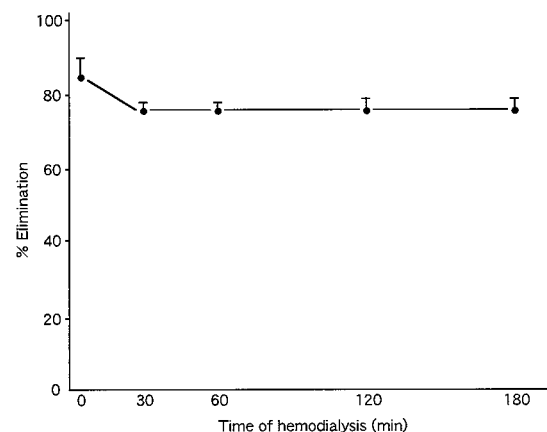


Fig. 2 The elimination rate of iohexol by the dialyzer. The elimination rate of iohexol by the dialysis circuit was 83.3% immediately after the start of hemodialysis, 76.5% after 30 min, 75.8% after 1 hour, 75.1% after 2 hours and 74.6% after 3 hours.

## Discussion

In recent years, non-ionic low-osmolar contrast media have been developed to replace ionic high-osmolar contrast media, and have shown less renal toxicity than the ionic media because they cause less protein binding and a lower osmotic pressure<sup>3-6</sup>. However, there have still been reports of renal dysfunction being caused by non-ionic contrast media<sup>7,8</sup>.

The blood half-life of iohexol, a non-ionic low-osmolar contrast medium, is prolonged by mild to moderate renal dysfunction, but the half-life in patients on hemodialysis is about the same as that in individuals with normal renal function<sup>2</sup>. Therefore, rapid elimination of the contrast medium by hemodialysis can minimize its effects on renal function. In this study, we investigated the extent to which iohexol was eliminated from the blood by hemodialysis.

Nakamura and others<sup>2</sup> performed hemodialysis for 4 to 5 hours after administration of 10 g of iohexol (240 mgI/ml) to three patients on hemodialysis, and reported that 75% of the dose was eliminated on average. Moon and others<sup>1</sup> performed hemodialysis for 6 hours at a blood flow of 190 ml/min and a dialysate flow of 500 ml/min in seven hemodialysis patients who were administered an average of 89 g of iohexol (300 or 350 mgI/ml) and 13 patients with chronic renal dysfunction who were administered an average of 102 g of the same contrast media. They reported that 77.7% or 76.1% of the dose was eliminated, respectively. We performed hemodialysis for 3 hours with a blood flow of 120 ml/min and a dialysate flow of 500 ml/min using a 0.7 m<sup>2</sup> cellulose triacetate membrane to minimize the hemodynamic and other effects of the procedure, since the subjects were patients with chronic renal dysfunction who were not on regular hemodialysis. An average of 72.9% of the iohexol dose was eliminated from the blood, which was about the same as the clearance reported by Moon and others<sup>1</sup> and Nakamura and others<sup>2</sup>. Therefore, if only 70 to 80 % of iohexol in the blood needs to be eliminated, hemodialysis for 3 hours with a blood flow rate of 120 ml/min and a dialysate flow of 500 ml/min using a 0.7 m<sup>2</sup> cellulose triacetate membrane is sufficient.

However, because of the possibility of further wors-

ening of renal function caused by accumulation of contrast medium associated with delayed excretion in patients with renal dysfunction, more complete removal of iohexol would be desirable. In the present study, the dialyzer elimination rate of iohexol was stable at about 75% from 1 to 3 hours after the start of hemodialysis. According to Moon and others<sup>1</sup>, the dialyzer elimination rate of iohexol showed no significant difference at 2 hours (48%) and 4 hours (46%) after the start of hemodialysis, and prolonged dialysis did not alter the elimination rate. In the future, it will be necessary to study hemodialysis conditions, such as the membrane area of the dialyzer, blood flow, dialysis frequency, and dialysis time, in order to achieve more complete elimination of contrast medium. A large-scale long-term study is also required to determine the role of elimination of contrast medium by hemodialysis in the preservation of renal function in patients with chronic renal impairment.

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