

## HAEMODIALYSIS: ONLY SIX HOURS ONCE A WEEK

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### Summary

With a system using  $5\text{m}^2$  surface,  $Q_B$  of 500ml/min and  $Q_D$  of 1000ml/min for only six hours/week we obtain the same clinical and biochemical results as those on conventional dialysis.

We have used three schedules: 2hours/3 days/week, 3 hours/2 days/week and 6 hours/1 day/week. The results are the same for all, and in schedule III surprisingly, the blood levels of urea and creatinine after seven days without dialysis are very similar to those of conventional dialysis. The total extraction of urea is higher, about 25 per cent more than the total urea of the patient at the beginning of dialysis.

### Introduction

Shortening the time of dialysis for patients in end-stage renal failure has been the aim of physicians, but until now there have only been three papers published using large surface dialysers to obtain this. Daugirdas et al [1] in 1981, used  $5\text{m}^2$  with two dialysers connected in series and a  $Q_B$  of 250ml/min and a  $Q_D$  of 1000ml/min. Von Albertini et al [2,3] in 1984, haemodiafiltrated using  $3.5\text{m}^2$  with a  $Q_B$  of 500ml/min and a  $Q_D$  of 1000ml/min. In these studies the number of patients has been few (11 patients in the first study and 4 in the second) and the time of study short (2 weeks and 4 weeks respectively).

Our study has involved 25 patients in schedule I, 10 in schedule II and six in schedule III, and each schedule has been undertaken for over a year.

### Patients and methods

We modified the conventional haemodialysis in the following way: surface area:  $5\text{m}^2$ ;  $Q_B$ : 500ml/min;  $Q_D$ : 1000ml/min, and time: six hours/week.

Figure 1 shows the device we have used, each dialyser works at the same

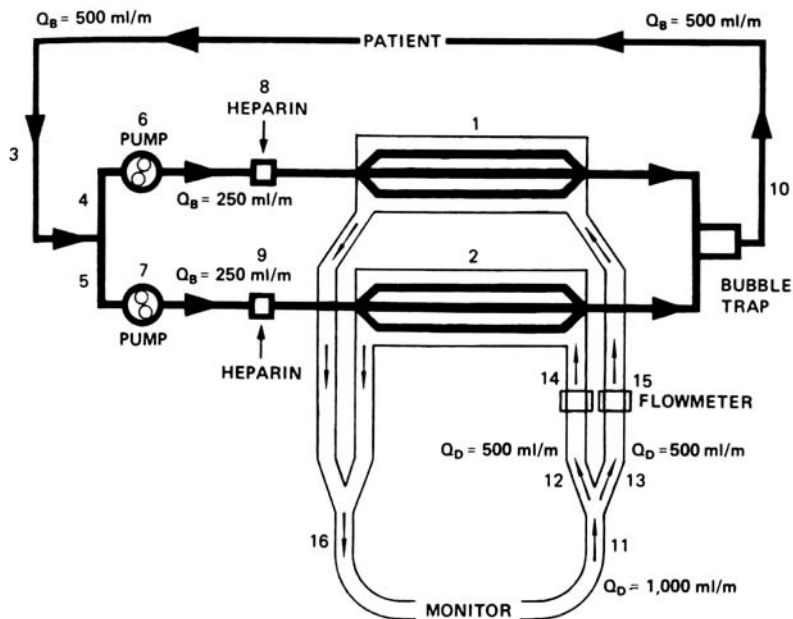


Figure 1. Diagram of our system

time in the same conditions as conventional dialysis; thus we dialyse double the quantity of blood within the same time.

Dialysis this rapid can produce patient discomfort. Therefore, we have modified the dialysate to avoid this: we always use bicarbonate; the potassium content is increased to  $2.5 \text{ mEq/L}$ , the sodium content is maintained at  $138 \text{ mEq/L}$  and the glucose content is increased to 5 or  $10 \text{ g/L}$ . With these modifications the patients did not experience discomfort during the dialysis.

We use this technique with three schedules: Schedule I: 2 hours, 3 days/week, Schedule II: 3 hours, 2 days/week and Schedule III: 6 hours, 1 day/week. Table I shows the characteristics of the patients in each schedule.

TABLE I. Characteristics of the patients in each schedule

|                             | Schedule I              | Schedule II             | Schedule III            |
|-----------------------------|-------------------------|-------------------------|-------------------------|
| Patients (numbers)          | 25                      | 10                      | 6                       |
| Sex                         |                         |                         |                         |
| Male                        | 15                      | 6                       | 3                       |
| Female                      | 10                      | 4                       | 3                       |
| Age                         | 23–69 years             | 23–55 years             | 25–66 years             |
| Weight                      | 51–81.50kg              | 56.50–70kg              | 52–69kg                 |
| Height                      | 1.50–1.79m              | 1.55–1.68m              | 1.52–1.77m              |
| Body surface                | 1.45–1.88m <sup>2</sup> | 1.62–1.83m <sup>2</sup> | 1.46–1.87m <sup>2</sup> |
| Residual function           |                         |                         |                         |
| $C_{Cr} < 0.5$ (ml/min)     | 20 patients             | 7 patients              | 3 patients              |
| $0.5 < C_{Cr} < 5$ (ml/min) | 5 patients              | 3 patients              | 1 patient               |
| $C_{Cr} > 5$ (ml/min)       | 0 patients              | 0 patients              | 2 patients              |

All followed a free diet and lead normal lives. We can see that there are large variations in age and weight, and that residual renal function was very low in the majority of them.

## Results

Figure 2 shows the weekly clearances compared with those of conventional dialysis.

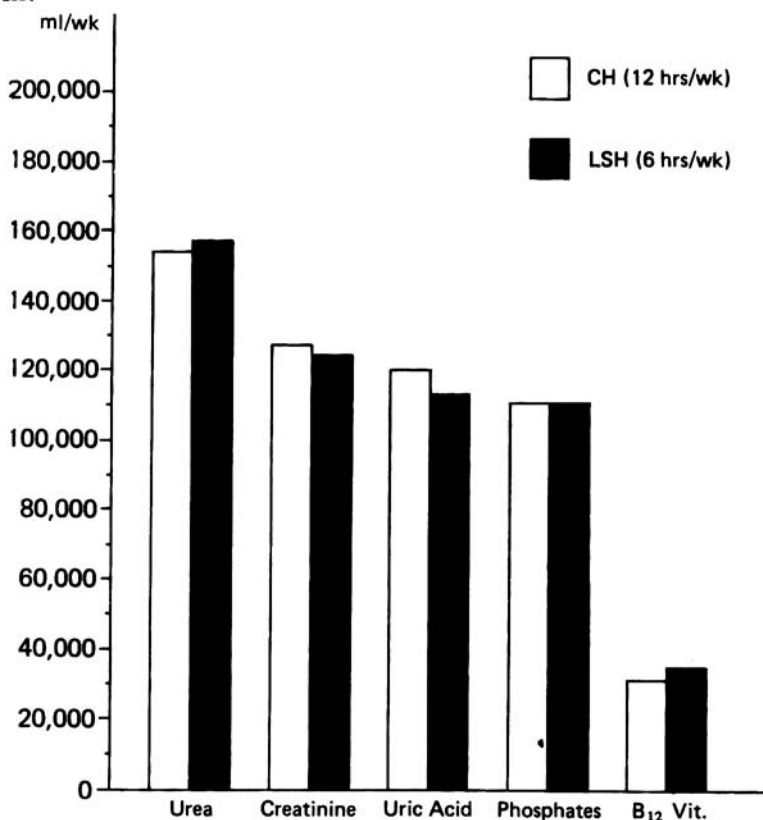


Figure 2. Comparison of the weekly clearances of distinct solutes with conventional haemodialysis (CH) and with large surface haemodialysis (LSH)

After one year in each of the three schedules the clinical, biochemical and neurological status of the patients are the same as with conventional dialysis, but we have avoided 312 hours of dialysis.

We now present in detail the results of schedule III.

Figure 3 shows the total extraction of urea and creatinine in the same patient using each method in two successive weeks. The total quantity of urea and creatinine extracted are the same.

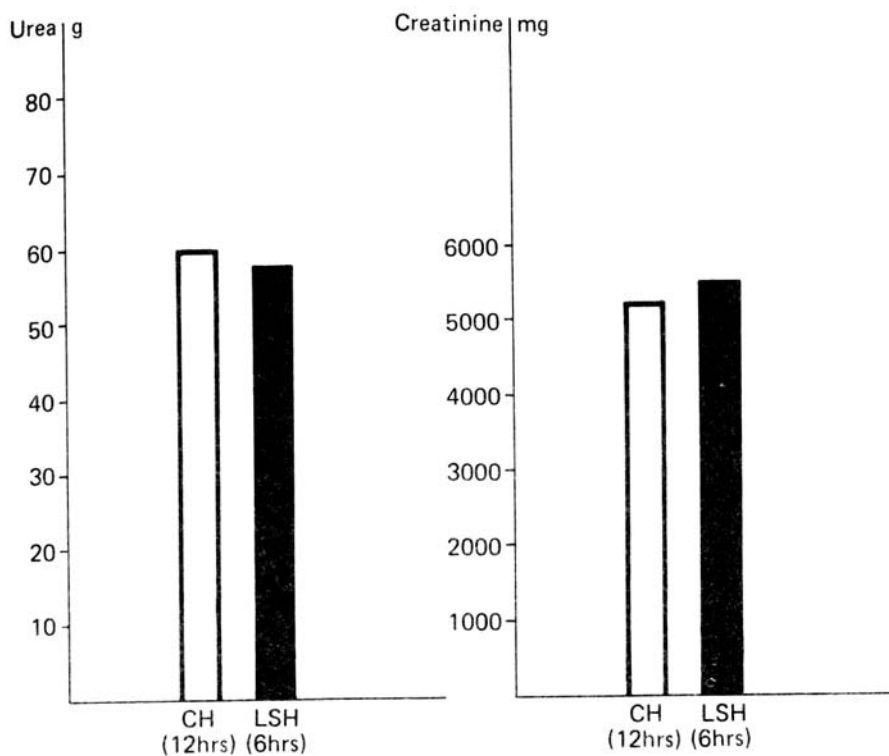


Figure 3. Comparison of the total weekly extraction of urea and creatinine from a patient weighing 59kg, using conventional haemodialysis and large surface haemodialysis. The initial urea was 1.28g/L in conventional haemodialysis and 1.37g/L in large surface haemodialysis. The initial creatinine was 11.4mg/dl in conventional haemodialysis and 13.8mg/dl in large surface haemodialysis

Figure 4 shows the reduction of blood urea and creatinine in comparison with conventional haemodialysis.

Figure 5 shows the immediate rebound of urea and creatinine. The curves of both methods parallel each other, demonstrating that there has not been a major retention of these solutes in the intracellular space.

Figure 6 shows the increase of the patient's urea through the seven days without dialysis: surprisingly, from the fourth day on, a plateau appears and the patient reaches the same level of urea that he obtained from conventional haemodialysis of four hours/three days weekly.

Table II shows the annual variations of the mean pre- and post-dialysis values for urea, creatinine, calcium, phosphorus and alkaline phosphatase, and the state of the nervous system.

All patients have a good general clinical status and continue to lead a normal life.

The practical advantages for the patient, with this method and this schedule, are a saving of 104 dialyses each year, i.e. 208 trips and 8,500 dollars.

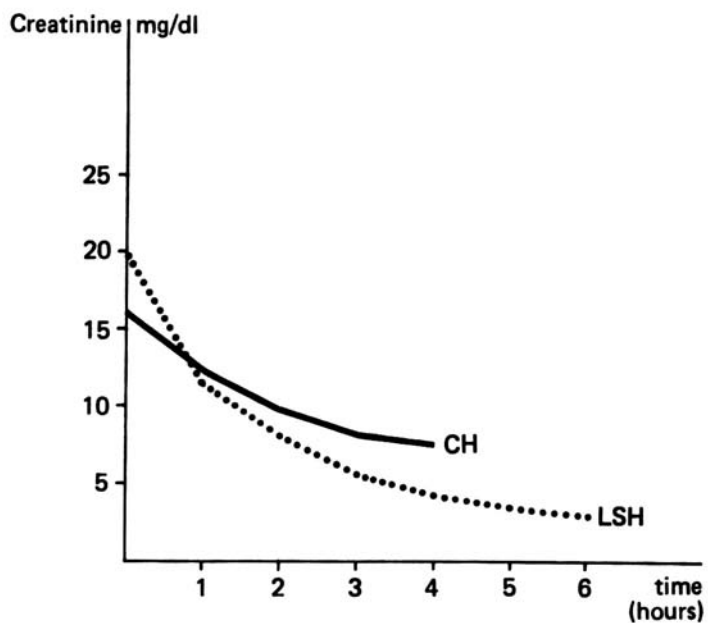
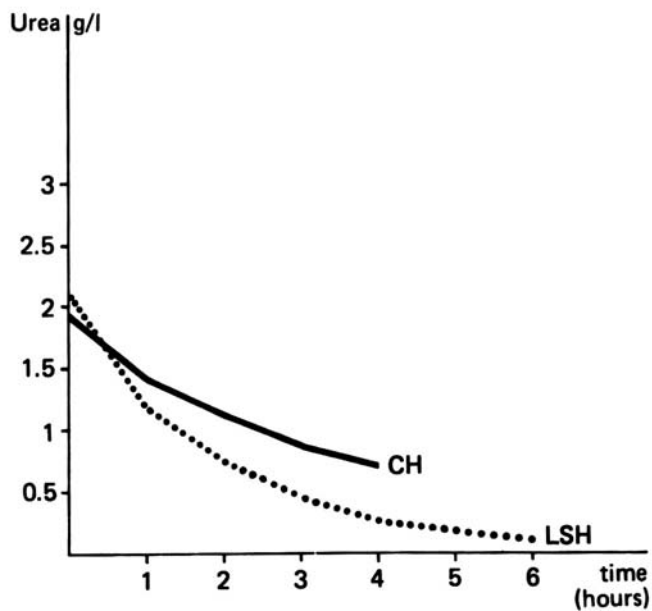


Figure 4. Comparative reduction of blood urea and creatinine with conventional haemodialysis and with large surface haemodialysis in schedule III: 6 hours/1 day/week

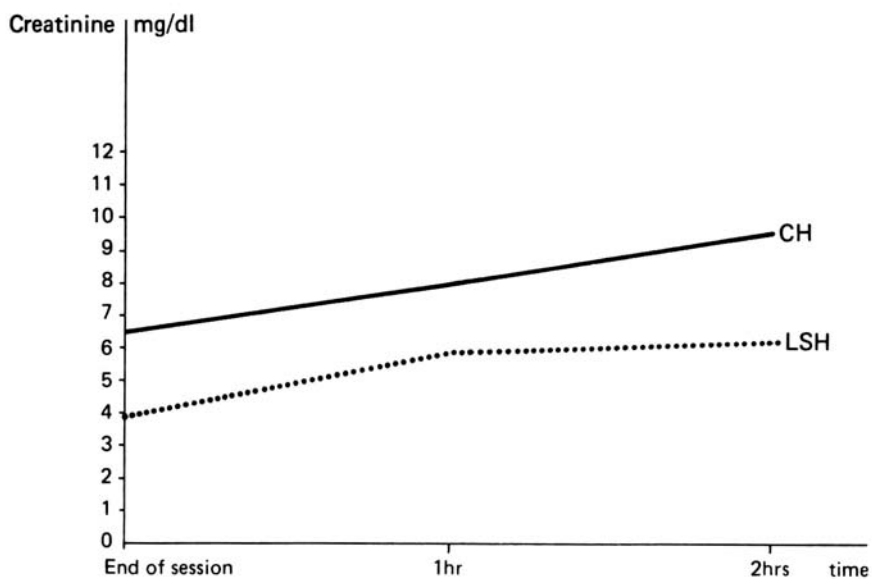
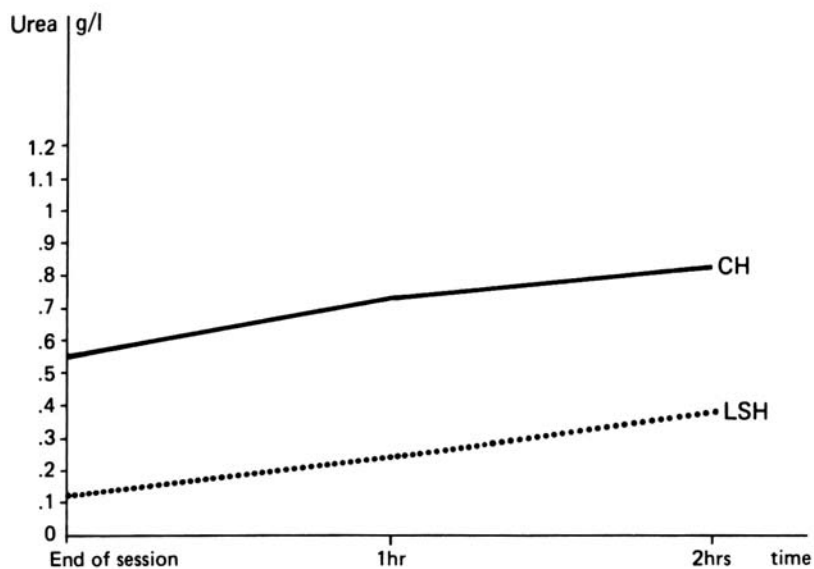


Figure 5. Comparison of immediate urea and creatinine rebound after conventional haemodialysis and with large surface haemodialysis in schedule III

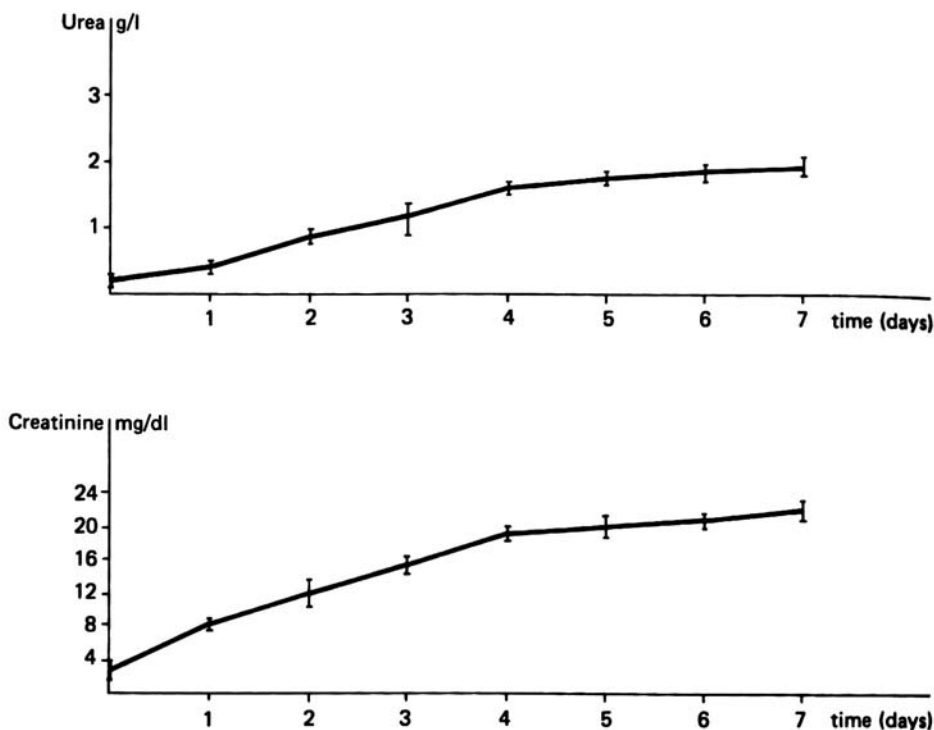


Figure 6. The weekly ascent curve of urea and creatinine in schedule III patients

TABLE II. Mean values of six patients with one year in each method

|                                  | Schedule III – 6 hours/1 day/week |             |      |
|----------------------------------|-----------------------------------|-------------|------|
|                                  | CH                                | LSH         | SS   |
| Pre-dialysis urea (g/L)          | 1.87±0.29                         | 2.18±0.31   | S*   |
| Post-dialysis urea (g/L)         | 0.69±0.16                         | 0.30±0.55   | S*   |
| Pre-dialysis creatinine (mg/dl)  | 14.40±1.49                        | 15.71±2.67  | NS** |
| Post-dialysis creatinine (mg/dl) | 6.11±1.24                         | 3.07±0.68   | S*   |
| Calcium (mg/dl)                  | 10.24±0.74                        | 10.57±1.10  | NS** |
| Phosphates (mg/dl)               | 5.99±1.13                         | 5.79±1.95   | NS** |
| Alkaline phosphatases (U/L)      | 56.49±17.49                       | 62.11±26.59 | NS** |
| PTH (µg/L)                       | 3.50±1.42                         | 4.54±1.47   | NS*  |
| Nerve conduction velocity        |                                   |             |      |
| sensory (m/sec)                  | 46.40±5.81                        | 48.48±4.55  | NS*  |
| motor (m/sec)                    | 45.12±6.48                        | 42.59±5.22  | NS** |
| EEG (Hz)                         | 9.83±5.63                         | 10.17±0.90  | NS†  |
| VEP – IV (msec)                  | 91.00±5.63                        | 90.67±7.45  | NS*  |

continued

TABLE II (continued)

|             |       | CH        | LSH       | SS   |
|-------------|-------|-----------|-----------|------|
| BAEP (msec) |       |           |           |      |
| Left ear    | I-III | 2.23±0.19 | 2.30±0.12 | NS†† |
|             | III-V | 1.98±0.13 | 1.95±0.11 | NS†† |
| Right ear   | I-III | 2.22±0.28 | 2.30±0.06 | NS†† |
|             | III-V | 1.95±0.20 | 1.95±0.17 | NS†† |

CH=conventional haemodialysis; LSH=large surface haemodialysis; SS=statistical significance; SD=standard deviation; S=significant; NS=non-significant; \*=Sign test; \*\*=Wilcoxon 't' test; †=Binomial test; ††=Student's 't' test

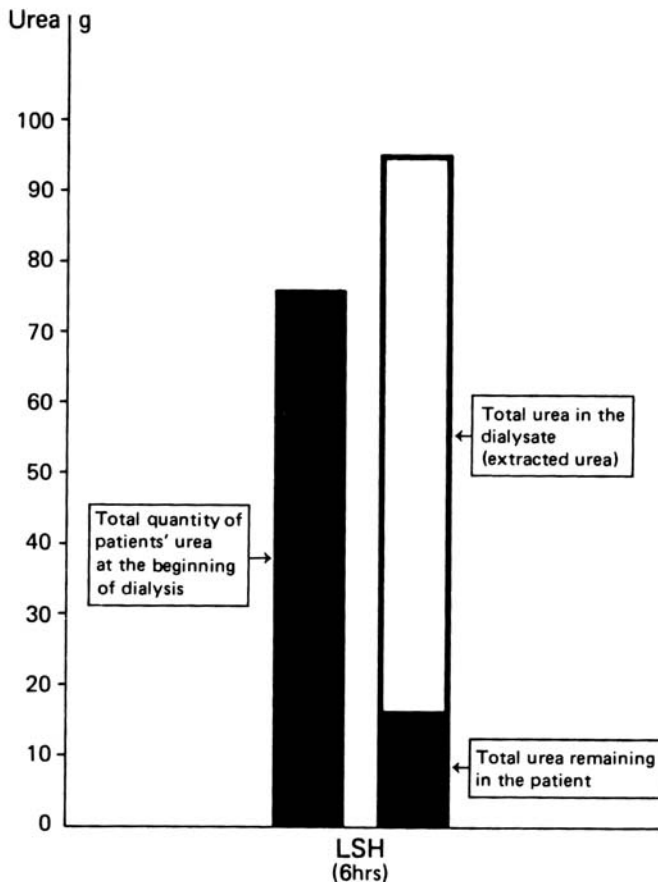


Figure 7. Differences between the total quantity of urea, that which remains in the patient, and the total extraction during a haemodialysis of six hours with large surface haemodialyser



The total quantity of extracted urea in one dialysis of six hours with large surface haemodialyser (Figure 7: white zone of the second column) is greater than the total patient load at the start of the dialysis (first column). If to this extracted quantity we add the quantity of urea remaining in the patient at the end of dialysis (black zone of the second column), it appears that there has been a generation of urea during dialysis of an amount about 25 per cent of the body load at the commencement of dialysis.

## Conclusion

In conclusion, we consider that large surface haemodialysis is a method of dialysis that produces the same results as conventional dialysis and avoids for the patients 312 hours of haemodialysis per year, by all three schedules. In schedule II we avoided 52 dialyses and 104 trips, and in schedule III 104 dialyses and 208 trips. Also in schedule II we saved 2,500 dollars per patient per year, and 8,500 dollars with schedule III.

## References

- 1 Daugirdas JT, Ing ST, Humayn HH et al. *Int J Artif Organs* 1981; 4: 13
- 2 Von Albertini B, Miller JH, Gardner PW, Shinaberger JH. *Trans ASAIO* 1984; 30: 227
- 3 Miller JH, Von Albertini B, Gardner PW, Shinaberger JH. *Trans ASAIO* 1984; 30: 377