6. INTERMITTENT PERITONEAL DIALYSIS AS RENAL REPLACEMENT THERAPY

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I. HISTORICAL PERSPECTIVE

The first report on peritoneal lavage in 1877 by Wegner[1] described the effect on body temperature of altering peritoneal temperature by cold peritoneal lavage and noted that hyperosmolar solutions containing sugar or glycerine resulted in increased outflow. The ensuing 40 years saw a number of further studies on changes in outflow volume using solutions of different concentrations. The ability of the peritoneum to absorb fluid was first used clinically in 1918 to treat children with gastrointestinal problems which precluded oral intake.

Throughout the 1920's and 1930's, studies were made on diffusion of various substances across the peritoneal membrane and the effect on blood levels, the mechanism of increased outflow volume using hypertonic glucose, and the effect of vasodilation and vasoconstriction on diffusion. References to these and other early reports are found elsewhere in this book.

Peritoneal dialysis was first used to remove uremic toxins by Ganter in 1923[2] in rabbits and guinea pigs made uremic by ureteric ligation. After 2–4 h the concentrations of nonprotein nitrogen in peritoneal fluid and blood were similar, and the animals showed marked clinical improvement following dialysis. Ganter also was the first to report use of peritoneal dialysis in the human, studying the effects of physiological saline solution intraperitoneally in a patient with ureteral obstruction due to uterine carcinoma, and noting that her clinical condition showed slight improvement.

Peritoneal dialysis was used clinically for a few patients during the 1930's and further reports began to appear following the Second World War. By 1950, Odel, Ferris and Power collected 101 patients from the literature who had been treated by peritoneal dialysis[3] using both intermittent and continuous techniques. During the following 10 yr peritoneal dialysis began to be used for the treatment of acute renal failure in both adults and children, and was also successfully used in the treatment of hypercalcemia and various poisonings.

The modern era of peritoneal dialysis was ushered in by publication in Holland of a monograph by Boen in 1959. In this classic work, published in
the United States in 1964 [4], Boen described detailed studies on the kinetics of peritoneal dialysis and discussed the indications, technique, and complications of this treatment. This, together with the report of Maxwell and co-workers from the United States [5], demonstrated the use of peritoneal dialysis in the treatment of acute renal failure. At that time hemodialysis was not widely available and so peritoneal dialysis began to be used by some centers.

In 1960 the teflon arteriovenous shunt for hemodialysis was developed in Seattle [6]. As a result, Scribner and co-workers at the University of Washington began studying the practical problems of long-term treatment of patients with chronic renal failure by hemodialysis. Scribner invited Boen to Seattle in 1962 to continue his work on peritoneal dialysis, and, in particular, to extend its application to the treatment of chronic renal failure. Equipment used previously for experimental treatment of chronic renal failure by gastrodialysis was modified by Boen to make the first closed-system peritoneal dialysis cycler [7] using dialysate sterilized in 40 l glass bottles (Figure 1). This closed system dramatically reduced the frequency of peritonitis because it eliminated repeated connections to fresh dialysate containers during the course of a dialysis [8]. In 1963, Boen started treatment of a 28 year old woman with chronic renal failure by outpatient peritoneal dialysis, and this was continued successfully for four years until the patient was transferred to home hemodialysis. This patient is alive today, having had a successful transplant several years later.

Development of a practicable closed system for peritoneal dialysis solved one of the two major problems posed by longterm peritoneal dialysis. The other problem, that of repeated access to the peritoneal cavity, was the subject of intensive study at this time, and various indwelling ‘buttons’ and other devices were developed. Generally these were not successful, due to infection, flow problems, and because of lack of a closed system for dialysis.

Tenckhoff, who became associated with Boen in Seattle in 1964, addressed himself particularly to the access problem. The need was to develop an indwelling access device which would minimize the risk of infection. Palmer [9] had described a permanently implanted silastic catheter with a long subcutaneous track. Working from this concept, Tenckhoff attached dacron felt cuffs to the catheter at levels just below the skin and immediately outside the peritoneum. Tissue ingrowth into these cuffs fixed the catheter in place and provided an effective barrier against bacterial invasion of the sinus tract around catheter. This, the Tenckhoff catheter [10, 11], implanted using a special trocar, has become the standard access device for longterm peritoneal dialysis. A modification with a single cuff is widely used for patients with acute renal failure.

Tenckhoff also began work on development of peritoneal dialysis equipment which would eliminate the need for 40 l containers of sterile fluid. Such