PERITONEAL DIALYSIS

An appraisal

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Introduction

PERITONEAL dialysis is playing an increasing part in the management of acute renal failure and this technique could be life-saving in the early treatment of military personnel and their dependents who develop renal failure whilst serving in overseas commands, since it will sustain life until facilities for haemodialysis are available.

Historical survey

Ganter, in 1923, was the first to attempt peritoneal dialysis in the human (13). Though he had very little success other reports appeared over the next 25 years and 101 dialysis were reviewed by Odel, Ferris and Power in 1950 (25). In nearly all these early cases continuous irrigation was used and the complications of overhydration, electrolyte disturbance and peritonitis were frequent.

By this time Kolff's haemodialysis (18) was becoming more fashionable and it seemed that peritoneal dialysis might be doomed. However, in 1951, Grolman et al. reported the use of intermittent peritoneal dialysis in dogs and humans (14) and this technique was developed by Maxwell et al. (23) and used by Boen (4). Commercial firms had by then produced suitable peritoneal catheters and solutions and peritoneal dialysis has since become increasingly popular both in America and in Britain.

Indications and Contra-indications

Peritoneal dialysis is of value in any case of acute (4, 7, 8, 9, 10, 12, 20, 21, 23, 24, 26, 27, 29, 30) or chronic (1, 2, 5, 9, 11, 15, 16, 26, 27) renal failure and will preserve life. It is of special value in those patients with overhydration (4, 7, 22, 28, 30) and has been used with success in the management of intractable cardiac failure and for the dialysis of barbiturates and salicylates (9, 11, 31).

There is no absolute contra-indication except fluid retention by absorption in those with a posterior peritoneal defect, e.g. after aortic surgery. This does *not* mean that one should never use the technique in this situation but only that it must be stopped if fluid balance cannot be controlled.

Many cases are now recorded of successful dialysis within a few days of major abdominal surgery including cholecystectomy, appendicectomy, suture of perforated peptic ulcer, Caesarean section, and aortic resections (7, 8, 10, 23, 30) and neither wound infection nor peritonitis prevents success (4). Indeed Burnett et al. have advocated peritoneal lavage with antibiotic solutions as a treatment for peritonitis of various causes (6).

Technique

(for details of equipment and solutions, see Appendix A)

Two litres of fluid are warmed to body temperature and 1,000 i.u. heparin is injected through the rubber cap of one. The bladder is emptied and the patient placed flat if possible. The catheter is then inserted through the avascular linea alba 1-2" below the

umbilicus (or in either iliac fossa or rarely above the umbilicus should this seem better) under local anaesthesia. There is a definite "give" as the linea is pierced and another as the catheter passes through the peritoneum. It is then directed downwards keeping close to the anterior abdominal wall to avoid loops of bowel until it lies deeply in the pelvis. Once in this position fluid will usually flow in and out with ease but if it lies elsewhere drainage of fluid may be obstructed by the omentum or mesentery.

A purse string suture is placed around the catheter to seal the opening in the skin and the fluid is run in through a Y drip set suspending the fluid from a drip stand three feet or more above the patient. This will take 15-20 minutes. The fluid remains in the peritoneum for one hour by which time its urea content will be 80% of that of the blood (10). Both litre bags are then placed in their original cardboard boxes on the floor and the fluid is allowed to drain out. This takes 40-45 minutes after which the volume drained is recorded and the cycle is repeated using fresh solutions. There is therefore a two hour cycle of 15-20 minutes inflow, 60 minutes equilibration and 40-45 minutes outflow.

The drip set is changed eight hourly to minimise the possibility of infection and hourly pulse and blood pressure and details of fluid balance for each exchange are recorded and daily cultures of the peritoneal fluid are carried out. Antibiotics are not added to the irrigation fluid unless there is evidence of peritonitis. The patient may receive a normal diet if he wants it and is given fluid each day of 500 ml. plus urine volume and an amount equivalent to the excess of peritoneal drainage over input.

Results

This technique depends upon the fact that the peritoneum is a semi-permeable membrane and that the fluid used has an electrolytic composition similar to that of normal plasma but contains an excess of lactate and neither urea nor potassium.

Within a few hours of starting the dialysis the serum potassium falls to normal and the acidosis is corrected. The blood urea falls by 30-50% each 24 hours (dependent upon the size of patient and rate of urea production) and will eventually stabilise at 50-150 mg.%, again depending on the rate of urea production. If the patient is overhydrated 3-6 litres of fluid can be removed in any 24 hour dialysis by using the hypertonic solution (containing 6.36% instead of 1.36% Dextrose). Though it is desirable to follow the progress of the dialysis by a daily chemical examination of the blood this is by no means essential as long as one remembers to add potassium to the solution after the first 24 hours to prevent hypokalaemia. This technique is safe, simple and is easily supervised by the nursing staff.

Complications

These are uncommon now that presterilised catheters and fluids of standard composition are available but are well documented (3, 7, 19, 23, 30) and include pain, bleeding, leakage of fluid, peritonitis, hypotension, fluid retention hypokalaemia, hypoproteinaemia, metabolic alkalosis and perforation of the bowel.

Pain sometimes occurs especially with the first inflow and when using the hypertonic solution. It is relieved by 5 ml. 1-2% procaine. The early exchanges may be blood stained but usually become clear within a few hours. Bleeding from the wound is seldom seen if the linea alba is used but if it occurs and continues another site should be chosen. Leakage may occur around the catheter and is minimised by the purse string suture. Occasionally oedema of the abdominal wall or scrotum may occur but it can be ignored. Peritonitis

is rare despite the occasional positive culture and can be treated by adding an appropriate antibiotic to the irrigating fluid, continuing the dialysis if required (4). Hypotension may follow removal of an excessive quantity of fluid due to a reduction in the circulating blood volume and the blood volume should be restored to normal with blood, plasma or albumen as may be indicated. Fluid retention can be corrected by manipulation of the catheter except in patients with a posterior peritoneal defect when absorption of fluid may occur and such cases are better treated with haemodialysis. Hypokalaemia sometimes follows prolonged dialysis and is prevented by adding 0.5 G. potassium chloride (6.5 mEq.) to each two litre exchange when the serum potassium is less than 4.5 mEq./L. Hypoproteinaemia with oedema may follow prolonged dialysis but 100-200 G. albumen i.v. will correct this. Metabolic alkalosis is found on occasions and is not harmful unless the patient is in liver failure when he cannot metabolise the lactate and one should then use fluid containing sodium bicarbonate instead. Perforation of the bowel is a theoretical possibility. It has not occurred in this series* and only one case appears to have been recorded (19).

Discussion

Peritoneal dialysis is now safe, simple and effective. The clearance of urea and the correction of hyperkalaemia and acidosis is slower than after haemodialysis but with two advantages in that the dysequilibrium syndrome is less common and a 48 or 72 hour dialysis not only corrects the uraemia but leaves the patient **at the end of this time** in a relatively normal state whereas many patients require a second haemodialysis within 2-3 days of their first.

This technique would be of particular value in the military sphere if the equipment were available in each base hospital overseas since treatment could be started as soon as the diagnosis was made thus avoiding unnecessary death in transit (17) or inconveniencing home commands by flying artificial kidneys and trained personnel from U.K. After peritoneal dialysis the patient could be flown home before his uraemia again endangered his life and if necessary any nursing sister could supervise a continuing dialysis during the flight.

Summary

The development and technique of peritoneal dialysis is discussed with particular reference to its value in controlling acute renal failure in military personnel. Appendix A contains details of the equipment and solutions required and it is suggested that these be made available in base hospitals of all overseas commands. No specialised knowledge is required to undertake or supervise this procedure and the only desirable additional information is a daily blood chemistry to monitor the serum potassium and the blood urea as other electrolyte abnormalities are automatically corrected. The cost would be approximately £12 per day per patient.

Appendix A

Materials required for Peritoneal Dialysis

1. *Peritoneal Dialysis Fluid.* The Dialaflex Peritoneal Dialysis Solution containing 1.36% or 6.36% glucose made by Allen and Hanbury Ltd., is satisfactory.

*Detail of 16 patients treated March—July 1965 at Leeds have had to be omitted owing to space restrictions—Ed.

2. *Peritoneal Catheter.* We have used the M 128 Dialysis Catheter produced by Baxter Laboratories and the Trocath Peritoneal Dialysis Catheter made by McGaw Laboratories. The M. 128 catheter must be passed down a trocar—an Oschner gall bladder trocar and cannula being suitable for this purpose. The trocath however has a pointed stillete for use in insertion of the catheter and thus fits more snugly and subsequent leakage of fluid around the catheter is probably less likely.
3. *Drip Sets.* The Plexitron R 61 Y type Dianeal Solution Administration Set made by Baxter Laboratories, is suitable.
4. *Other materials.* Swabs: hibitane or spirit to clean skin; local anaesthetic; syringe and needles; scalpel; purse string suture; dressings.

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