

PERITONITIS IN PATIENTS UNDERGOING

PERITONEAL DIALYSIS

KENYATTA NATIONAL HOSPITAL

NAIROBI

KENYA

A dissertation presented in part fulfilment
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by

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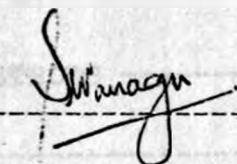


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ABSTRACT:

This study was undertaken between January 1980 and September 1984 and was to try to map out the incidence of peritonitis in patients undergoing peritoneal dialysis at Kenyatta National Hospital and to see how best to manage this crippling complication of peritoneal dialysis.

A total of 192 patients were studied in two groups namely a retrospective group 1980-1982 and a prospective group 1983 to September 1984. Out of 192 patients admitted to Intensive Care Unit (I.C.U.) for dialysis, 108 had peritoneal dialysis, 4 did not get dialysed as they improved on conservative management and 3 died soon after admission to I.C.U. 77 Patients had haemodialysis.

53.7% of the patients undergoing peritoneal dialysis (PD) suffered from peritonitis and Klebsiella was the commonest causative organism accounting for 54.8%. This certainly is surprising as literature from the industrialised countries reveals that gram negative organisms comprise only 25% whilst gram positive organisms comprise 68.5% of peritonitis.

Peritonitis developing during peritoneal dialysis is best managed conservatively by appropriate antibiotics and this study revealed that the infection cleared by

about the seventh day. It also became quite clear that peritonitis caused prolonged hospital stay thus increasing the cost, the morbidity and to some extent the mortality of the patients involved.

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INTRODUCTION:

According to the census, 1979 ⁽¹⁾ Kenya had 17 million people. The incidence of renal disease in this population has not been mapped out although Kioko ⁽²⁾ thinks that the mortality per year from all primary and secondary renal disease is about 1500. Owing to better medical services and awareness of the disease, increasing number of patients with renal diseases are being seen in the renal clinic and in the wards at K.N.H. K.N.H. being the only government referral hospital, has a renal unit (R.U.) and I.C.U. for management of seriously ill patients. Before 1982, there was only one haemodialysis machine to cater for haemodialysis alongside intermittent peritoneal dialysis. Patients needing dialysis were admitted to the I.C.U. where the dialysis machine was stationed and these patients were dialysed and then sent back to the wards. Patients needing peritoneal dialysis were also admitted to the I.C.U. for intermittent peritoneal dialysis as they needed laboratory monitoring on daily basis by the laboratory technologist in the I.C.U.

Selection of patients for dialysis has not been standardised though most nephrologists at K.N.H. ⁽³⁾ agreed that only those patients with acute renal failure mainly should be sent for dialysis because of lack of financial and personnel support. At times, patients with acute

on chronic renal failure were dialysed to get them out of the acute phase although mortality in this group was high.

The functions of the kidney include making, acidification and concentration of urine, excretion of certain toxins and endocrine functions which include calcium metabolism, stimulation of red cell production and autoregulation.

Acute renal failure is defined as sudden onset of poor kidney function where the urine output in 24 hours falls below 400ml. (4). It is characterised by oliguria or anuria, hyperkalaemia, elevation of toxins like urea and creatinine and metabolic acidosis. Clinically the patients are usually lethargic and may have acidotic breathing. There may be pulmonary oedema, pericardial rub and electrocardiographic tracings may show peaked T waves.

Chronic renal failure patients on the other hand are usually cachexic with uraemic frost and they are invariably anaemic. These patients may also have features of secondary hyperparathyroidism with bones showing

radiologic features of translucencies alternating with radiodensities (4). There may also be features of peripheral neuropathy with biochemical features of high urea and creatinine out of proportion to the clinical features of the illness. Creatinine clearance is usually low and specific gravity low and fixed. The available modalities of management of chronic renal failure include intermittent peritoneal dialysis (IPD); chronic peritoneal and continuous ambulatory peritoneal dialysis (CAPD) and, finally, renal transplant. Peritoneal dialysis in its various forms is usually indicated in extremes of ages (<20 years and above 60 years), in patients with arrhythmias and in those with diabetic nephropathy (5).

As earlier stated, we could not offer haemodialysis to all of the patients. The reasons, amongst others, include frequent mechanical failure of the only machine available, positive australian antigen in patients to be dialysed and constraints in trained personnel. Therefore most of our patients had P.D. and these, as in other centres were associated with many complications including peritonitis, (chemical, bacterial, fungal, viral), protein loss, perforation of the gut, confusional state loss of libido and hypotension. Sclerosing peritonitis recently described by Oreopoulos and his group 6 was not seen in any of our patients.

Peritonitis is by far the commonest complication of peritoneal dialysis ⁽⁵⁾. Its morbidity and mortality ranges between 0.15% and 12.1% ⁽⁵⁾. It is also known that peritonitis occurs more commonly when P.D. fluid is in prepacked glass bottles than when the fluids are packed in polyvinylchloride (P.V.C.) bags. The incidence of peritonitis is much lower when reverse osmotic diuresis machines are used and also when iodine-saline flush after dialysis has been used ⁽⁷⁾. Although this hospital now has many haemodialysis machines, their maintenance and operation costs are still high. We shall therefore continue to depend on P.D. as it is cheaper and easier to handle; the expertise needed is less and therefore more people can be trained to handle P.D. locally. It was with this in mind that this study was undertaken.

The aims of the study include establishing the incidence of peritonitis and protein loss in P.D. and comparing them with those in the literature from the industrialised countries mainly of the Western world. The objectives were, firstly, to make recommendations on ways to reduce the incidence of peritonitis and protein loss during P.D. and to recommend drugs useful in the treatment of peritonitis and, secondly, to outline future research areas in P.D. which can make the art more useful and less harmful to the patients.

It should be noted that it became apparent during the study that protein loss during P.D. could not be adequately assessed because of existing technical reasons at that time. Since peritoneal dialysis appears to be the more suitable method for dialysing our patients at the present time, bearing in mind the scanty human, financial and material resources, it is pertinent to highlight the principles of peritoneal dialysis.

Dialysis through peritoneal membrane consists of diffusion and ultrafiltration. Some substances like acetate and lactate diffuse from dialysate into the blood whilst others like urea and creatinine diffuse from blood to dialysate along a concentration gradient.

Three forms of peritoneal dialysis are used commonly especially over the last seven years (1977-1984) and these are:-

- a) intermittent peritoneal dialysis which can be performed using automated equipment, or manually. Patients are dialysed 3-7 times in a week usually overnight and in between when the abdomen is empty.

- b) Continuous ambulatory peritoneal dialysis in which peritoneal cavity is filled with fluid and emptied 3-5 times a day, seven days in a week (8).
- c) Continuous cyclor peritoneal dialysis which combines cyclor dialysis every night with a single installation of 2 litres of fluid into the peritoneal cavity during the day.

In all these methods, suitable catheters (9) are inserted surgically or by Trocath under local anaesthesia into the peritoneal cavity and the tip of the catheter must lie in the pelvis where its pores would not be blocked by the omentum. Suitable commercially prepared dialysis fluid is delivered into the peritoneal cavity through the catheter and it is allowed to remain there. for some time to equilibriate and is then drained out by gravitational force. The time the fluid remains in the peritoneal cavity is known as dwelling time and may be minutes or a few hours in I.P.D. or several hours in C.A.P.D. The volumes of dialysis fluid commonly used in the peritoneal cavity are 300cc in children and 1000cc to 2000cc in adults.

The dialysis fluid may be delivered from prepacked bags or from dialysis machines at a predetermined flow rate. There are two types of dialysis machines namely the cyclor designed by Lasker and the reverse dialysis designed by Tenckhoff ⁽⁵⁾. The latter is preferable since it is a closed system and the incidence of peritonitis is considerably lower. During dialysis, diffusion ⁽¹⁰⁾ depends on various factors namely:-

- a) thickness of peritoneal membrane.
- b) effective surface area exposed to dialysate.
- c) peritoneal capillary blood flow.
- d) dialysate flow rate.
- e) intraperitoneal volume of dialysate.
- f) temperature of dialysate.
- g) amount of ultrafiltration..
- h) body solute distribution volume.
- i) extent of protein binding of certain solutes.
- j) intracellular solute binding.

Transfer of the solutes will also depend on the mass transfer coefficient ⁽¹¹⁾ of the said solutes. The smaller the molecular weight of the solute the more it is cleared. Diffusion of small molecules is flow dependent whereas that of larger molecules is dependent on surface area.

Peritoneal membrane is more permeable than the cellulose semipermeable membranes because the pores are larger (12). It therefore can clear solutes of middle molecular weights (500-5000 Daltons) more readily especially if the peritoneal dialysis continues for six weeks (13). This would explain the general well being and improvement patients on P.D. experience after sometime since middle molecules are partly incriminated (14) in causation of anaemia, peripheral neuropathy, high blood pressure and generalised catabolism in renal failure. Some substances are used to increase peritoneal membranes capillary blood flow rates. These substances include isoprenaline, nitroprusside, tolazoline, prostaglandin PGE_2 , hormones like glucagon and even glucose present in dialysis fluid (15).

Peritoneal dialysis is contraindicated in those patients with severe chronic obstructive lung disease, pulmonary fibrosis, severe hypotension, recurrent abdominal wall hernias, severe malnutrition and in those with chronic back problems (16).

MATERIALS AND METHODS:

This was both a retrospective and prospective study.

Retrospective Study January 1980-December 1982:

The files for study were obtained from Kenyatta National Hospital after obtaining permission from the Director, KNH, with the help of the Chief Medical Records Officer. Relevant material on each patient was obtained and recorded according to age, sex, diagnosis, date of admission and outcome, length of stay in the I.C.U. and days of dialysis. Those patients with peritonitis had their symptoms, signs and a culture report of the peritoneal fluid recorded and results analysed.

Prospective Study (January 1983-September 1984):

All patients admitted to Intensive Care Unit (ICU) for dialysis from January 1983 to December 1984 were included in the study. All the patients except 8 had all their peritoneal catheters inserted by the author using the standard straight Tenckhoff catheter through the procedure developed by Tenckhoff in 1968 and described

below. Age, sex, time of admission, diagnosis, symptoms and signs of peritonitis and bacteriology were recorded as described by Golper and his group in 1978 (5). The dialysate for microbiological examination was collected on day 0, day 3, day 7 and thereafter once weekly and transported to laboratory immediately for analysis.

Catheter insertion methodology was as follows:-

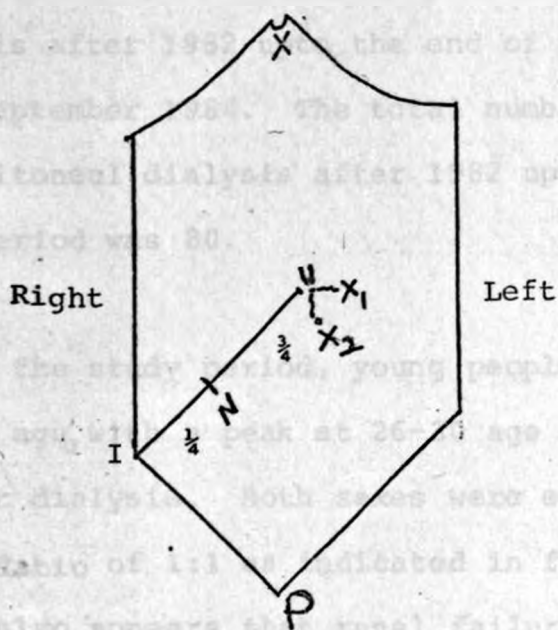
The patient's abdomen was exposed, cleaned with eusol and spirit by the author after scrubbing and draping in a sterile gown. A sterile mask and gloves were worn. After cleaning the abdomen as above with eusol and spirit, a position was chosen below or just to the left of the umbilicus as indicated in figure 1 below. 10ml of 1% lignocaine was infiltrated into this site through the skin into the subcutaneous tissue, linea alba and into the peritoneal membrane. A 1cm longitudinal incision was made 2cm below the umbilicus or to the left of the umbilicus following on the track of the lignocaine infiltration mentioned above through the skin to the peritoneal space. The abdomen was sufficiently distended before this procedure using 21 gauge needle inserted into the peritoneal space through the right iliac fossa. This needle was connected to an infusion set which was further connected to one litre normal saline or Hartmann's solution. 1.5 litre

fluid was delivered to the peritoneal cavity after expelling the air in the infusion channels. This needle was then removed and Tenckhoff straight catheter with introducer inserted into the peritoneal cavity via the track infiltrated before with 1% lignocaine. Once the catheter was safely in the peritoneal cavity, the introducer was removed and the catheter connected to the prepacked dialysing fluid (peritofundin I & II) hanging up in bottles or bags via standard peritoneal fluid sets. The catheter was then steadied and fixed in position using 2.0 silk purse suture. The fluid put into the peritoneal cavity for dialysis was usually 350cc in young children and 1000-2000cc in adults.

A cycle of dialysis usually consisted of running fluid into the peritoneal cavity in 10-20 minutes and it remained there for 30-45 minutes and was then drained out. Between 8 to 12 cycles were usually required for each dialysis session.

Figure 1

Schematic diagram of the abdomen to show positions of the P.D. Catheter and the site through which artificial ascites is created prior to catheter insertion.

**Index:**

X = Xiphoid process

U = Umbilicus

I = Anterior Superior Iliac Spine

P = Pubis

N = Position of 21 Gauge needle in
Right iliac fossa used to
distend abdomenX₁ and X₂ = Position of the Tenckhoff peritoneal catheter
2 cm. below or to the left of the
umbilicus.

RESULTS:

During the study period, a total of 192 patients were admitted to the Intensive Care Unit for dialysis. 77 patients had haemodialysis and some 108 patients had peritoneal dialysis. Only 20 patients had haemodialysis after 1982 upto the end of the study period in September 1984. The total number of patients who had peritoneal dialysis after 1982 upto the end of the study period was 80.

Under the study period, young people mainly under 45 years of age, with a peak at 26-30 age group, were admitted for dialysis. Both sexes were equally represented in the F.M Ratio of 1:1 as indicated in figures 1 and 2 below. It also appears that renal failure at Kenyatta National Hospital occurred mainly in the young people below 45 years.

The total number of patients who had peritoneal dialysis was 108 and out of these, 58 patients developed peritonitis. The commonest symptoms and signs of peritonitis in our patients are shown in Tables 1 and 2 respectively herebelow. Abdominal pain and tenderness were present in 72.4% and 67.2% respectively. Cloudy dialysate appeared in all the patients who developed peritonitis. Fever and diarrhoea occurred less frequently.

Fig. 1 Showing relationship between age groups of patients and number of patients

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Fig. 2: Showing distribution of sex of patients undergoing dialysis

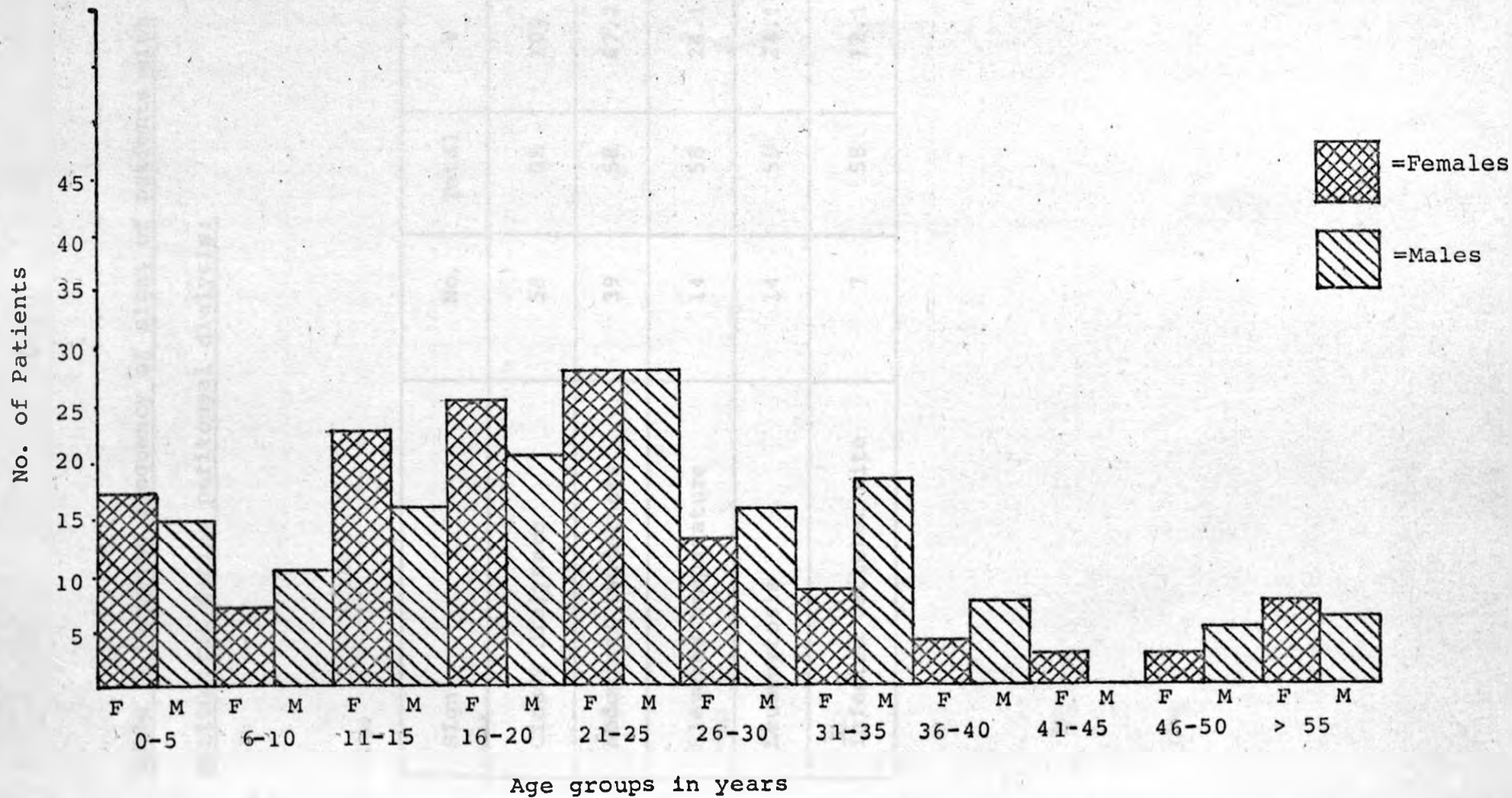


Table 2 showing frequency of signs of patients with peritonitis during peritoneal dialysis:

Sign	No.	Total	%
Cloudy dialysate	58	58	100
Abdominal tenderness	39	58	67.2
Elevated temperature	14	58	24.1
Leucocytosis	14	58	24.1
Infected catheter site	7	58	12.1

Table 1 showing frequency of symptoms of patients with peritonitis during peritoneal dialysis:

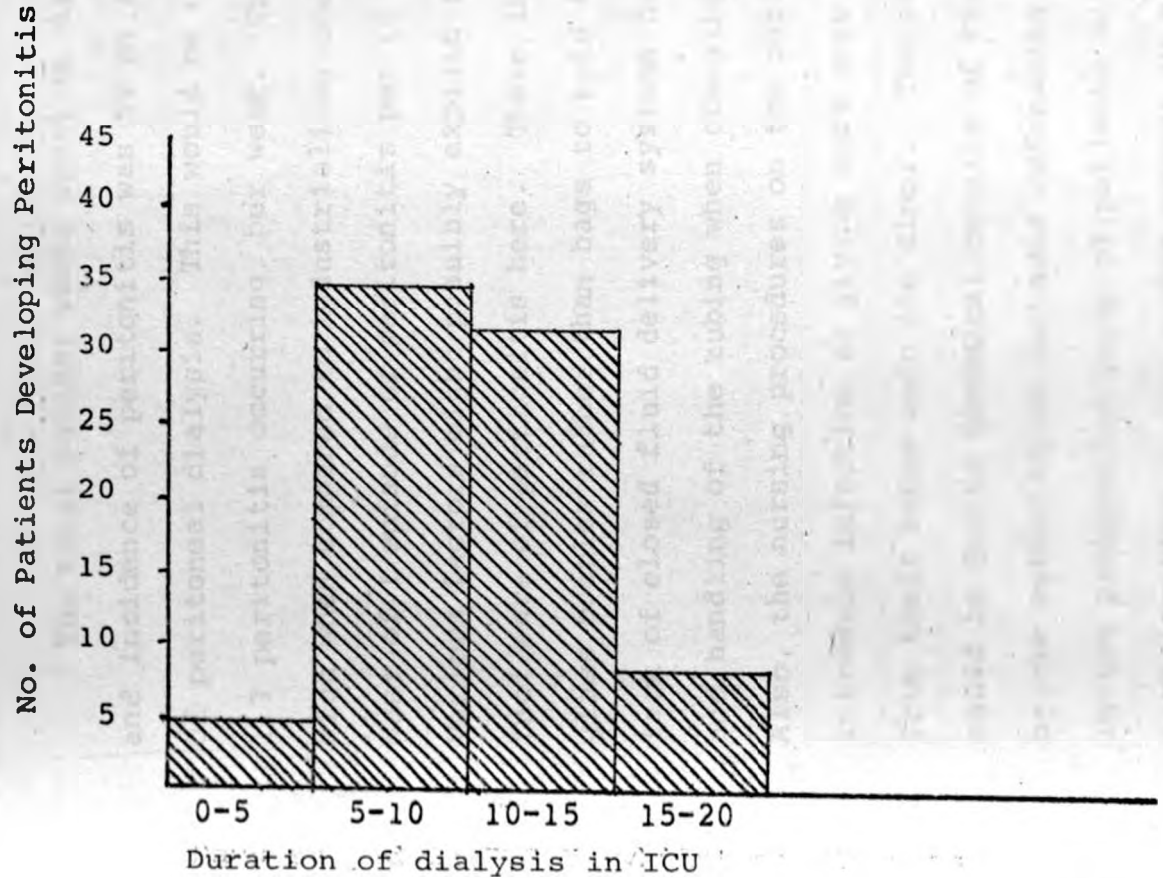
Symptom	No.	Total	%
Abdominal pain	42	58	72.4
Poor catheter drainage	32	58	55.2
Fever	17	58	29.1
Total catheter block/change	15	58	25.9
Diarrhoea	8	58	13.8

A distinctive finding in this study was that 25% of the patients with peritonitis had fever and leucocytosis of more than 8000 per ml.

Figure 3 below shows that the longer the patient stayed in the ICU the more were chances of getting peritonitis. The average period of stay was nine days under dialysis and peritonitis occurred in all the patients who stayed for more than seven days.

The overall mortality of the patients admitted to ICU for dialysis was 74.1% regardless of whether the patients had peritonitis or not. It is difficult to work out the proportion of patients dying as a result of peritonitis. There was only one patient out of the 58 with peritonitis who had small and large bowel perforation when an attempt was made to refix the catheter. Surgery had to be done to repair the gut but the patient died 48 hours after surgery. During the laparotomy a lot of pus and adhesions in the peritoneal cavity were found as well as perforation of the terminal ileum and ascending colon. This patient had peritonitis before the catheter change. Klebsiella and Proteus species of bacteria had been cultured and the patient put on intraperitoneal as well as systemic amikacin. The total duration of stay in ICU for this patient was thirty five days.

Figure 3 Showing number of patients and duration of dialysis in I.C.U.



The total patient weeks spent on dialysis was 100.7 and incidence of peritonitis was 58 in 100.78 weeks of peritoneal dialysis. This would be equivalent to 1.7 peritonitis occurring per week. This figure is very high when compared to industrialised countries of the West of 1 episode of peritonitis per 10 patient weeks. Various factors might possibly explain this high incidence of peritonitis here. These include use of glass bottles rather than bags to hold the fluid, lack of closed fluid delivery systems during dialysis and handling of the tubing when changing the fluids. Also, the nursing procedures on the patients could introduce infection as giving sets were often displaced from their sites onto the floor. The other factor could be due to technical details of the procedure adopted by the author which may need refreshing in the future. In the prospective group of patients all the catheters were inserted by the author except in eight patients. One would expect a higher incidence of peritonitis if a subjective error was made during the period under study.

Bacteriologic findings of our patients with peritonitis are interesting. Klebsiella was the commonest organism isolated comprising 54.9% followed by staphylococcus aureus accounting for 22.6%. The other bacteria isolated but to a lesser extent were

streptococcus faecalis, Escherichia Coli, pseudomonas and acinitobacter as can be seen in Table 3.

Comparing these results with Western figures as shown in Table 4, one clearly sees that the gram negative organisms especially Klebsiella were the commonest causes of peritonitis as opposed to Western literatures where gram positive organisms comprised 68.5% but gram negative organisms comprised only 25.0%, fungal 2.2% and aseptic 4.3%. In none of our patients was a fungus isolated and aseptic peritonitis comprised 46.6% of the cases.

In this study group, there was no advantage accruing from antibiotic prophylaxis. 53 patients who received gentamicin prophylactically out of 54 had peritonitis and 54 patients who did not get intraperitoneal gentamicin out of 54 got peritonitis. As it has been observed in other series, prophylactic antibiotics have no place in P.D. as they did not seem to prevent peritonitis.

All cases with evident peritonitis were treated by flushing the peritoneal cavity with normal saline or Hartmann's solution till the effluent was clear and the frequency of dialysis was increased by reducing the dwelling time to between 15 and 20 minutes from the standard 30-45 minutes. In addition, broad spectrum antibiotics comprising an aminoglycoside (gentamicin)

Table 3:

Showing organisms causing peritonitis in patients
undergoing PD at Kenyatta National Hospital

Bacterium	No of patients with positive growth	Frequency in % age
Klebsiella sp.	17	54.8
Staph. aureus	7	22.6
Staph. epidermidis	0	-
Streptococcus faecalis	2	6.4
Escherichia coli	2	6.4
Pseudomonas species	2	6.4
Acinitobacter	1	3.2
Salmonella species	0	-
Mycobacteria species	0	-
Fungal species	0	-
Mixed organisms	4	12.8
Sterile	27	46.5

Table 4:

Bacteriology in peritonitis:

REFERENCE	19	20	21	22	23	24	Total	%
Acinetobactor	2	-	1	1	2	1	7	8
Diphtheroid	-	1	-	-	1	-	2	2
Enterobacter species	1	-	-	-	-	-	-	1
Enterococcus	-	-	-	5	-	1	6	7
Escherichia coli	2	1	1	-	-	1	5	8
Klebsiella	-	-	-	2	2	1	5	3
Pseudomonas	1	5	-	3	-	2	11	13
Salmonella species	-	-	-	-	1	-	1	1
Serratia species	1	4	-	1	-	1	7	8
Staphylococcus aureus	5	1	3	5	8	5	27	31
Staphylococcus epidermidis	-	-	-	-	1	4	5	6
Sterile /unknown	1	-	-	2	-	-	2	3
Non-enterococcus	2	-	2	-	-	-	4	5
Streptococcus species	-	-	-	-	-	-	-	-
Fungi	-	-	-	2	1	-	3	3
Total	15	12	7	21	16	16	86	99

and ampicillin (ampicillin) or cephalosporins (cephatoxime) were used in calculated doses according to the creatinine clearance and glomerular filtration rates. 5mls of a local anaesthetic, (2% lignocaine), was instilled into the peritoneal cavity with each litre of dialysis fluid to reduce the pain and when culture results were available usually in two to three days time, the antibiotics were switched to the appropriate ones going by sensitivity results.

In this series 80% of the organisms were sensitive to amikacin and reported to be resistant to gentamicin and or ampicillin. 75% of the organisms were sensitive to cephalothin. Cotrimoxazoles were not used routinely in the sensitivity discs and therefore it is difficult to assess how effective they were though the reports from elsewhere indicate their effectivity (17) in the management of peritonitis taking into account also the predominance of gram positive organisms in the cultures. Once the antibiotic had been started, 98% of the patients had negative cultures by day seven though the leucocytosis persisted upto day fourteen.

Reinfections were difficult to assess because of the overall high mortality rate in our patients but this was noticed in one patient aged thirteen years who had acute-on-chronic renal failure who had stayed in ICU for forty days in the first instance and was readmitted three weeks later and stayed in ICU for twenty eight days before death. In the first instance, the patient had Klebsiella and in the second instance he had staphylococcus aureus infection and on both occasions appropriate antibiotics were used. He improved and was discharged first time but deteriorated during the readmission and died. Autopsy revealed evidence of peritonitis, many adhesions with features of left chronic glomerulonephritis with agenesis of the right kidney. Peritonitis here accelerated his renal failure and both the infection and renal failure contributed to his death.

The other findings in this study was that all the patients who developed peritonitis stayed longer in Intensive Care Unit usually fifteen to twenty days whereas those without peritonitis stayed for an average of ten days. The statistical significance of this difference has not been worked out.

Table 5:

Distribution of organisms in peritonitis in the Western
Countries (25)

Organism isolated	Number of episodes	percentage
Gram positive	64	68.5
Gram negative	23	25.0
Fungal	2	2.2
None	4	4.3

SUMMARY OF RESULTS:

A total number of 198 patients were admitted to Intensive Care Unit for dialysis and out of this, 108 had peritoneal dialysis. Out of 108 patients, 58 developed peritonitis and Klebsiella species accounted for 54.8%. Staphylococcus aureus accounted for 22.6% and these figures are inclusive of retrospective and prospective groups.

DISCUSSION:

Ever since peritoneal dialysis was started and used by Ganth in 1923 and revolutionised by Tenckhoff and others (27), peritonitis has been a major problem lessening the efficacy and acceptability of this mode of replacement therapy. Indeed it has been described by Tenckhoff himself as a constant preoccupation for nephrologists and other physicians using peritoneal dialysis. Though various methods have been used in an attempt to reduce the high incidence of peritonitis in patients undergoing peritoneal dialysis the incidence of 1-10% (28) generally and in the best centres of 0.1%-1.5% is still unacceptable.

From this study, 58% of our patients undergoing dialysis developed peritonitis, a figure which is 10-50 times higher than in industrialised world. This could be due to many factors all related to shortages in money, materials and personnel.

Most of the dialysis fluid used in this study was prepacked in 500ml glass bottles and not in polyvinylchloride (P.V.C.) bags as routinely used in the industrialised countries. There was also shortage of sterile bags to collect the fluid after drainage

and the dialysate was therefore collected in open 2 litre glass or polyurethane bottles. None of our patients had a closed system delivery of dialysing fluid as machines to do so were unavailable at the time of the study.

Golper and his group in 1978 ⁽⁵⁾ clearly showed that occurrence of peritonitis was higher when glass bottles were used instead of plastic bags or P.V.C. bags to hold the commercially prepared dialysis fluid. The incidence of peritonitis was 1-10% when using bottles and when closed systems were used the incidence remarkably came down to 0.1-1.5% a tenfold fall.

In all our patients the Tenckhoff catheter was left hanging outside the abdominal wall as opposed to the practice in Western countries of burying this end of the catheter subcutaneously. To gain access to the catheter thus positioned would entail cleaning the abdominal wall with antiseptics and then use a 21-23 gauge needle and remove the needle after the procedure. This ensures that the catheter is handled very rarely and hence the chances of infection are very low.

The bacteria responsible for peritonitis here were mainly Klebsiella whereas in most series in the West as shown in table 4 were mainly gram positive organisms. This is quite difficult to explain at this stage as no other study to my knowledge has been undertaken under similar conditions. The other possibility is that this study was conducted in the ICU where resistant strains of bacteria would be expected to contribute to the majority of the infections. This would only be important if a bacteriological survey was conducted for our I.C.U. to know the organisms responsible for the majority of the infections there.

Occasionally there was a problem of getting the appropriate antibiotic going by culture and sensitivity report either because the antibiotic was not available in the hospital pharmacy or there was no money to buy the drug from the private pharmacies. I think this factor has a very small part to play in the high incidence of peritonitis here as it occurred in only 4 peritonitis patients. Lameire and Ringor ⁽²⁹⁾ in 1979 in their series showed that peritonitis increased hospital stay by 173 days out of a total of 509 due to other complications. Golper and his group in 1978 ^(5,25,26) and Oreopoulos and many other investigators have all remarked that peritonitis certainly causes further stay in the hospital in patients undergoing peritoneal

dialysis. They also have agreed, and scientific data support them, that peritonitis responds well to medical treatment if discovered early. They have demonstrated no benefit from antibiotic prophylaxis. They rightly assert that since peritonitis is caused by so many types of organisms (viruses, bacteria, fungi, protozoa and even chemicals), one would have to use a combination of antibiotics in prophylaxis and in an already compromised renal function, this would be unsuitable. The high cost of antibiotics and their side effects are all other reasons why they should not be used prophylactically. All these workers stress that prevention of peritonitis by meticulous aseptic techniques when inserting or handling catheters and other tubing, early recognition of peritonitis and its treatment with the appropriate antibiotic would be the best approach. Here in Kenya, this study also confirms that peritonitis increases morbidity and mortality and also the cost in maintaining the patient for the extra days to overcome the infection.

As has been mentioned above, 90.7% of the total 192 patients studied were less than 45 years of age and 20.9% were between 26-30 years of age. This implies that most of the patients with renal diseases who will end up in the dialysis unit are young people. These are the very people charged with the responsibility

of working, building and sustaining a better Kenya for the children they are producing. Efforts must therefore be made to look for causes of renal disease in Kenya and to treat them. Urgently needed also are the equipment and personnel for the renal unit and asepsis should be practised there during all procedures.

The pathogenesis of peritonitis in peritoneal dialysis is multifactorial as listed herebelow though the list is not exhaustive by any means.

- a) Septic methods when inserting the peritoneal catheter and thus introducing bacteria into the peritoneal cavity. This may explain staphylococcus species of bacteria accounting for a majority of peritonitis as they are normally commensals on the skin.
- b) Faulty disconnection procedure (5) from standard percutaneous catheters at the end of dialysis and therefore organisms gaining access to the peritoneum.

- c) Multiple dialysis fluid exchanges encouraging the introduction of organisms into the peritoneal cavity where they may not be flushed. There is usually some 100-200ml dialysate fluid ⁽²⁸⁾ left in the peritoneum at the end of fluid drainage at body temperature. This climate is conducive to growth and multiplication of bacteria resulting in peritonitis. Vaamonde et al ⁽²⁸⁾ have shown that most dialysis positive cultures account for 25.3% and of this fraction, 6.3% contracted clinical peritonitis. In their series there was an overall incidence of 1.6%.
- d) The patients undergoing dialysis have uraemia, a condition in which there is immunosuppression ⁽¹³⁾ of cellular immunity especially T cell production. There is also poor chemotaxis of polymorphs supposedly due to middle molecules in uraemia. All these factors play an important role in the evolution and perpetuation of peritonitis in patients undergoing peritoneal dialysis.

- e) Unavailability of appropriate antibiotics especially in developing countries can worsen the already poor situation.
- f) Aseptic peritonitis which may result from low pH of fluids, particulate matter, endotoxins, pyrogens and plasticizers leaking out from the tubing (30).

Various methods are being used and new ones continue to be sought for in an attempt to reduce the very high incidence of peritonitis during peritoneal dialysis.

These include:-

- a) Bacteriological filter (25) on the dialysate infusion lines.
- b) Using silicone Tenckhoff (18) catheters used in straight implantation method than the bent subcutaneous tunnelling used previously.
- c) Using Toronto Western Hospital (9) permanent peritoneal catheters and connectors specially designed to prevent organisms access to the peritoneum.

- d) Use of Titanium material ⁽³¹⁾ in the catheter connecting system which prevents cracking of the connector and therefore prevents organisms entry through this route.
- e) Use of Iodine-saline flush ⁽⁷⁾ after dialysis to kill organisms that may be in the peritoneal cavity and not flushed out by the effluent.

Bacteriological filters are commercially prepared filters of low base 0.22µm in diameter and dialysate has to traverse the filter before getting on into the peritoneal cavity. The arrangement would be as indicated in the schematic representation below:-

1 - Dialyzer

2 - Peritoneal catheter

3 - Small plastic bag

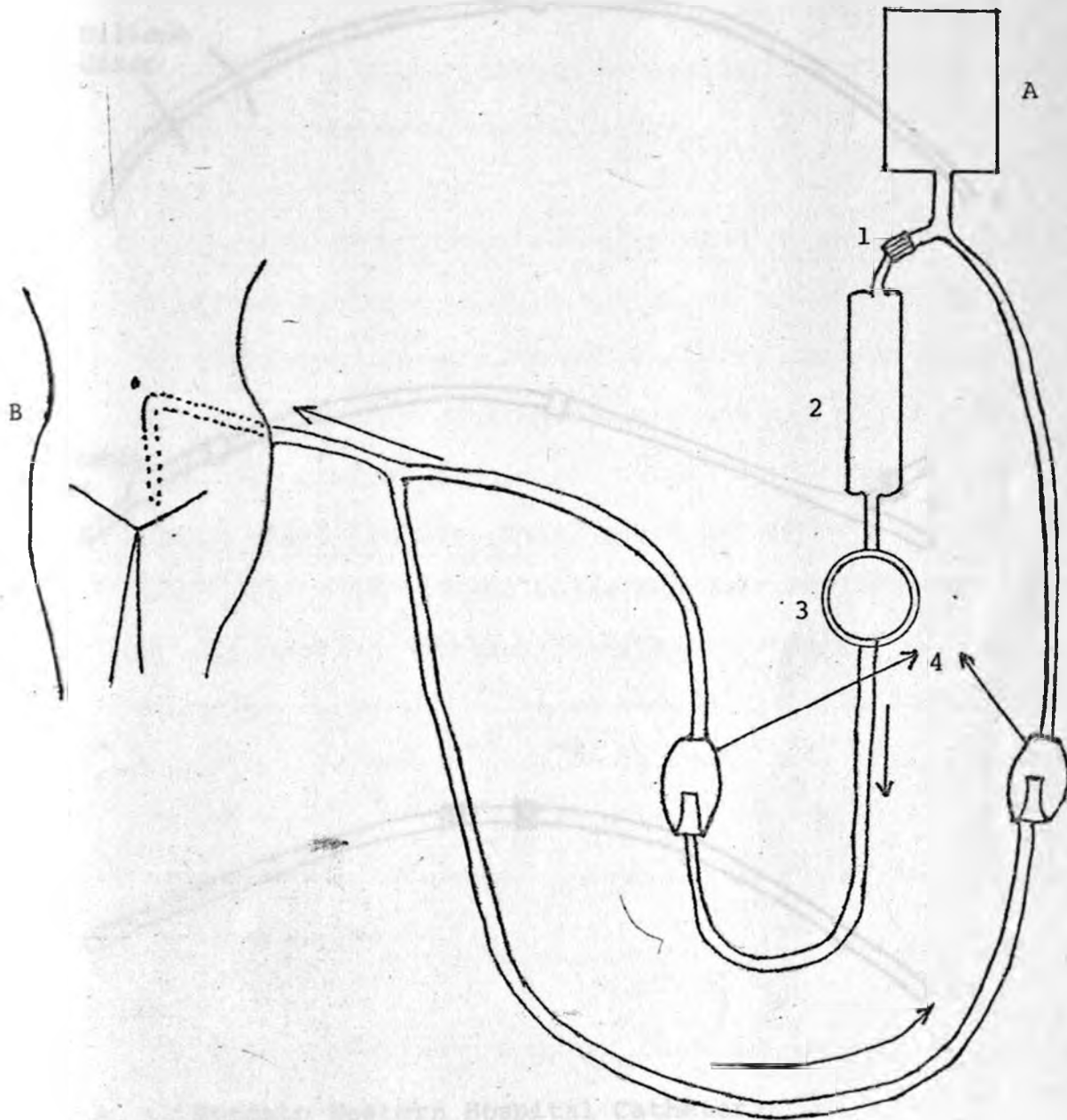
4 - Iodine-saline flush

5 - Bacteriological filter

6 - Iodine-saline flush

Diagram 2:

To show the position of bacterial filter during peritoneal dialysis:



A = Dialysate plastic bag.

B = Patient with Tenckhoff catheter.

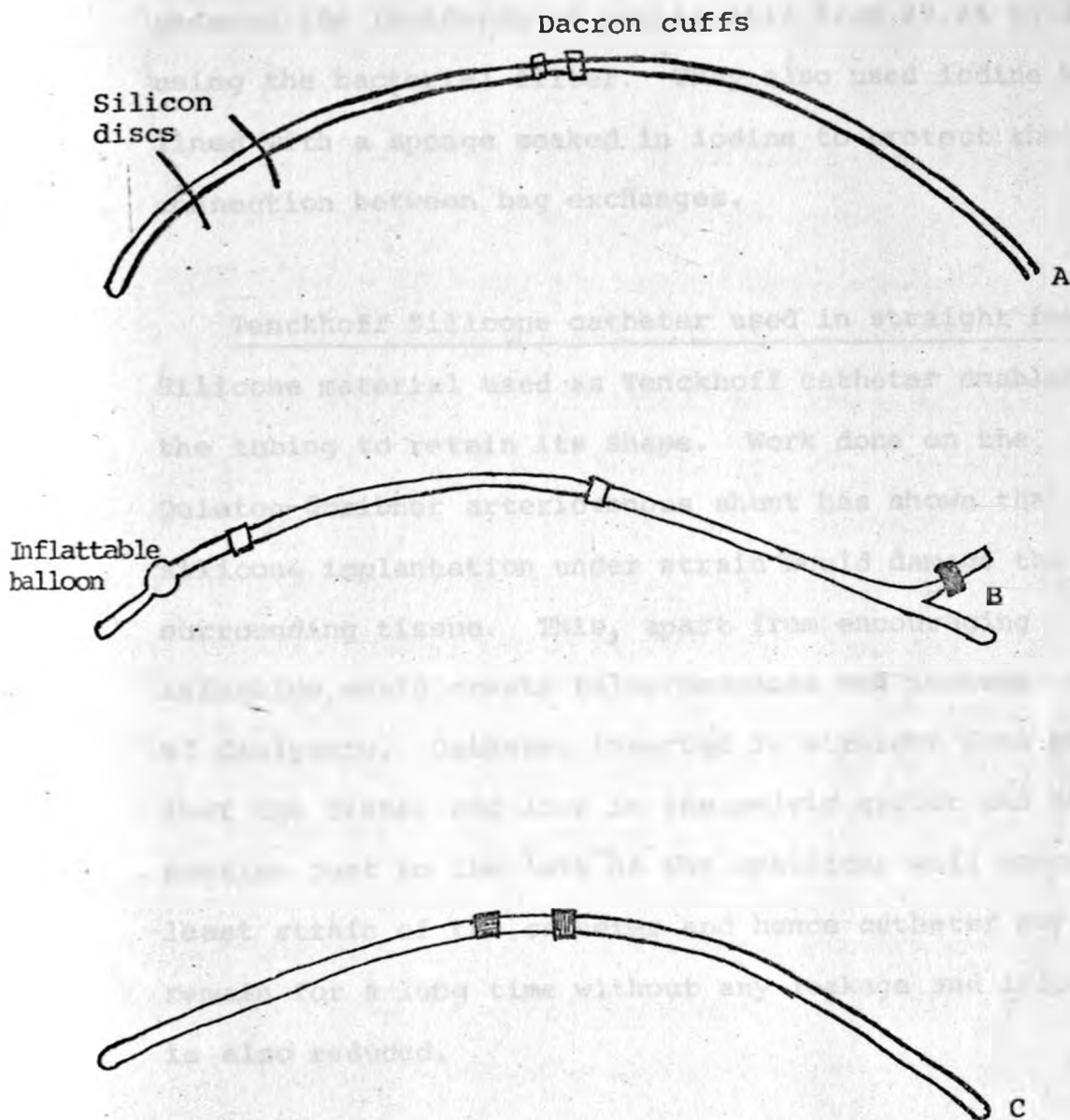
1 = Manual plastic clamp.

2 = Bubble trap.

3 = Bacteriological filter.

4 = Flap valves.

To show three types of peritoneal catheters:



A = Toronto Western Hospital Catheter.

B = Goldberg Catheter.

C = Tenckhoff Catheter.

Slingeneyer and Liendo-Liendo and Mion in 1979 (32) reduced the incidence of peritonitis from 27.8% to 22% using the bacterial filter. They also used iodine boxes lined with a sponge soaked in iodine to protect the Luer connection between bag exchanges.

Tenckhoff Silicone catheter used in straight form.

Silicone material used as Tenckhoff catheter enables the tubing to retain its shape. Work done on the Quaton-Scribner arteriovenous shunt has shown that silicone implantation under strain would damage the surrounding tissue. This, apart from encouraging infection, would create false passages and leakage of dialysate. Catheter inserted in straight form so that the distal end lies in the pelvic gutter and outer portion just to the left of the umbilicus will ensure least strain of the catheter and hence catheter may remain for a long time without any leakage and infection is also reduced.

Toronto Western Hospital catheter is basically a Tenckhoff catheter with two silicon discs measuring 1mm thick and 28mm in diameter and they stabilise the catheter tip in the pelvic gutter. Once the catheter tip is stable, catheter blockage and hence catheter change become improbable. Using this catheter and

and comparing it with others namely the Golberg and Tenckhoff catheters, Oreopoulos (9) et al in 1976 found that 28% of Tenckhoff catheter, 19% of Goldberg catheter and 8% of Toronto Western Hospital catheters had to be removed because of one way obstruction. In the same study, they radiologically showed that 33% Tenckhoff catheters, 23% Goldberg catheters and only 7% of Toronto Western Hospital catheters had migrated out of the pelvis. In this study, special connectors were used to prevent contamination of the dialysis fluid and the peritoneal catheter. A diagrammatic representation of the three catheters are reproduced here above. In Kenyatta National Hospital only Tenckhoff silicone catheters are available.

Titanium connectors do not crack even if they fall like those made of rubber or polyvinylchloride. These connectors therefore help in reduction of peritonitis because they do not serve as portals of entry of bacteria.

Saline iodine flush was first used by Robert et al in 1979 (7) in an attempt to reduce peritonitis in patients undergoing peritoneal dialysis. The rationale of using iodine in the infusion was because of its

broad spectrum antimicrobial activity in very small concentrations of 0.5 parts per million. The antimicrobial activity would be maximum in the initial 50-60 seconds after infusing into the peritoneal cavity. The only stumbling block to its use is its rapid inactivation by proteins and glucose. To counteract this effect, the peritoneum was drained off the dialysate. Normal saline 1-2 litres was then put into the peritoneal cavity to dilute the glucose and protein, then again drained out. Then 1 litre normal saline plus 0.1ml of 2% iodine solution would be instilled into the peritoneal cavity and iodine would remain bactericidal for two or three minutes thereafter and fluid would then be drained out. Using this method, they recorded one peritonitis in 16 patients studied over 425 patient weeks by thrice weekly manual exchanges. This would work up as one infection every 217 patient weeks or 0.15% of all dialysis so performed. The above method appears a safe, simple, cheap and an acceptable way of reducing the incidence of peritonitis and a comparative study using same method is recommended here. The other methods described appear exotic, expensive and are largely unavailable, and, although one does not condemn them, it may be a few years before our economy can allow their use.

In conclusion, peritonitis continues to be a major complication of peritoneal dialysis even upto the present moment. Prevention of peritonitis by using aseptic procedure, early recognition and treatment by appropriate antibiotics are the main modalities of reducing this crippling complication. All in all the incidence of peritonitis ranges between 0-15% in the Western industrialised world. In this study, the incidence of peritonitis was 10-50 times higher than the figures quoted by the West and the various factors that may explain this have been discussed above. Since Kenya is a developing nation with scarce resources and personnel, we have to look for a cheap but efficient method of dialysis. Peritoneal dialysis appears to be the one which we can afford. We therefore have to join the other countries in search for ways to reduce peritonitis whilst making use of peritoneal dialysis.

RECOMMENDATIONS:

1. Dialysis should be undertaken in a renal unit away from intensive care unit because hospital resistant strains of bacteria are more prevalent in the I.C.U.
2. Appropriate equipment like plastic bags for holding the dialysis fluid and sterile containers should be made available to the renal unit.
3. The tubing should never be allowed to dangle onto the floor and special connectors preventing touching of the Luer locks should be obtained.
4. Appropriate antibiotics should be administered as soon as possible depending on the culture and sensitivity results.
5. For the time being, amikacin and cephalosporins seem to be the drugs that most of the bacteria here are sensitive to and therefore these should be made available routinely in Intensive Care Unit or wherever the peritoneal dialysis is taking place.

FUTURE AREAS OF RESEARCH:

- a) Iodine-saline flush after dialysis in an attempt to prevent peritonitis.
- b) Protein loss and its association with peritonitis during peritoneal dialysis.
- c) Bacteriological survey and microbial sensitivity in Intensive Care Unit.

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