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Original Article

Rates and Causes of Peritonitis in a National Multicenter Continuous Ambulatory Peritoneal Dialysis Program in Sudan: First-year Experience

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ABSTRACT. This is a cumulative report of all patients in six centers in Greater Khartoum, all three cities that comprise the capital of Sudan, covering the first year of operation of the National Program. This study evaluates the rates, mechanisms, causative agents and clinical outcomes of peritonitis. We included the data of all 60 patients who underwent CAPD from June 2005 to June 2006. There were 15 episodes of peritonitis in 323 patient-months, which equates to an overall peritonitis rate of one episode every 21.5 months (0.55 episodes per year at risk). The individual center rates varied. There was a statistically significant age difference, with peritonitis being more common in the youngsters. All patients presented with abdominal pain and had cloudy effluents but none had a significant exit site or tunnel infection. Fluid cultures were available in 11 out of the 15 episodes of peritonitis. The cultures were positive for organisms in only 3 out of 11 (27%) cases. Two patients were infected by *Pseudomonas aerogenosa* and one patient by *Staphylococcus aureus*. Thus, the culture-negative peritonitis rate was 8/11 (73%). Touch contamination was the likely mechanism in 7/15 (46.7%) of the episodes. There were three cases of refractory peritonitis and only one case of relapsing peritonitis. None of the patients had a catheter removed because of peritonitis. We conclude that the first year of operation of the Sudan National Multi-centered PD program has proven that it is a promising project with multifaceted success. The cumulative peritonitis incidence is acceptable although there are several areas for improvement. Standardized laboratory techniques need to be implemented and pursued, particularly in the microbiology area.

Key Words: Peritoneal Dialysis, Africa, Sudan, Peritonitis, Adequacy

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Introduction

Regular peritoneal dialysis (PD) may be an excellent alternative for the Sudanese patients with end-stage renal disease (ESRD).[1,2] Accordingly, Continuous ambulatory peritoneal dialysis (CAPD) was introduced as a

Table 1: Distribution of Patients on CAPD in six Integrated Centers in Khartoum

Name of Center	Number of Patients*
Ribat University Hospital	18
Military Hospital	14
Soba University Hospital (pediatric unit)	12
Khartoum Teaching Hospital	9
Ibn-Sina Specialized Hospital	5
Ibn-Auf Pediatric Hospital	2
Total	60

*Number of patients enrolled up to 30th, June 2006

national service for the first time in Sudan in June of 2005.

Peritonitis remains a leading complication of PD. It contributes to technique failure and hospitalization, and sometimes is associated with death of the patient. Severe and prolonged peritonitis can lead to peritoneal membrane failure. Therefore, the PD community continues to focus attention on prevention and treatment of PD-related infections.[3-8]

In this study we evaluate the rates, mechanisms, causative agents and clinical outcomes of peritonitis.

Materials and Methods

This is a cohort study conducted in all six adult and pediatric CAPD centers in Khartoum state. The program is fully funded by the Federal State and the CAPD fluids are provided by the Central Medical Supplies (CMS) Corporation. As a national experiment, the program was sequentially launched in four adult and two pediatric centers in Greater Khartoum, which comprises the three cities that make the capital of the Country. Eligible individuals include all the 60 adult and children who were the first to undergo CAPD in Sudan carried out at different centers as shown, Table 1.

The majority of patients resided in Greater Khartoum, while a few were from different other states. Patients were longitudinally followed up for the first year of operation of the program (June 2005-June 2006).

Peritonitis was clinically diagnosed in patients presenting with cloudy effluent with compatible clinical setting. Blood and effluent samples were drawn and sent for analysis; and appropriate antibiotics were administered. A standardized questionnaire was filled out by the executing physicians. The questionnaire includes demographic information, clinical classification of peritonitis, clinical presentation, laboratory data, peritonitis mechanisms and outcomes of peritonitis and catheters.

In many patients, the information was retrospectively collected by chart reviews as well as personal interviews with patients, doctors and nurses from relevant centers.

The most recent International Society of the Peritoneal Dialysis (ISPD) guidelines were used for appraising the results.[9]

Limitations of the study include recall lapses especially regarding the mechanism of peritonitis and the rather incomplete documentation occasionally encountered.

Statistical analysis

Data was computerized and analyzed using SPSS version 13 (SPSS Inc, Chicago, IL). Results were cross-tabulated to examine relationships and association between the variables. Statistical analysis was performed using x^2 for test of association. p value of less than 0.05 was considered significant in all the statistical tests performed.

Results

The total period of participation for 60 patients was 323.11 patient-months (26.9 patient-years). Fifty of the 60 patients enrolled (83.3%) are still actively using CAPD at the end of one year. Their age range is 5-76 (median =41 years, SD =20.5). Table 2 shows

Table 2. Outcome of Ten patients who left the CAPD program

Number of Patients	Outcome	Comment
3	Shifted to hemodialysis	Catheter malfunction and refusal of re-insertion, abdominal tuberculosis, severe pain with acute cholecystitis
1	Transplanted	
1	Died: Possibly related to PD	Severe septicemia, failed to comply to treatment protocols
5	Died because of unrelated causes	Sepsis (secondary to bowel ischemia, pneumonia, lung abscess), liver cancer and congestive heart failure

the outcome of the ten patients who left the program.

There were 15 episodes of peritonitis. Accordingly, the overall incidence of peritonitis was one episode every 21.5 pt month (0.55 per year at risk). However, different center rates were variable (Table 3, Figure 1). There was a statistically significant age difference, with peritonitis being more common in the youngsters. The mean ± SD age for patients with peritonitis was 30.5 ±17.3 years, whereas that for peritonitis-free patients was 44 ± 20.6 years (P=0.025).

All patients presented with abdominal pain and cloudy effluent. About half of the patients (52%) had subjective fever, but in 75% of them, the temperature at presentation was > 37.7 ºC. Eighty percent had abdominal tenderness. All the peritonitis patients had cloudy effluent fluids. None of them had concurrent signs of infected exit site or tunnel infection.

Although obtaining a nasal swab prior to placing the catheter is recommended by our local guidelines, the compliance with this protocol was poor in our practice. Only one peritonitis patient had a prior nasal swab which was positive for *Pseudomonas spp*.

In 40% of patients the white blood cell count (WBC) was not obtained. However, 90% of the rest had diagnostic WBC counts (>100 cells/dL). Half of the WBC counts showed polymorphonuclear neutrophil cell counts of more than 50%. Gram stain was only performed in 20 % of cases with all of them being reported as “not showing any organism." Fluid cultures were available in 11 of 15 patients who developed peritonitis. The cultures were positive for organisms in only 3 out of the 11 cases (27%). Two patients were infected by *Pseudomonas* aerogenosa and one patient by *Staphylococcus* aureus. Thus, the culture-negative peritonitis rate was 8/11 (73%); It was higher than the minimal recommended by the ISPD[9] of 20% (Figure 2).

Touch contamination was incriminated in 7/15 (46.7%) of peritonitis episodes while 40% were unknown causes and 13.3% were due to perioperative causes.

Out of the 15 episodes, three were classified as refractory peritonitis (failure of the effluent to clear after five days of appropriate antibiotics) and one was classified as having relapsing peritonitis (recurrence of peritonitis with the same organism within four weeks of completion of therapy of the previous episode). None of our patients had their catheters removed because of peritonitis.

Discussion

This is a pilot study about the incidence of peritonitis among the initial group of patients who underwent CAPD in the Sudan. After a year of operation of the national program with a total of 60 patients, we encountered 15 cases of peritonitis. The cumulative peritonitis rate in this study (one episode per 21.5

Table 3. Peritonitis Data for Different CAPD Centers in Greater Khartoum

Center	Number of Patients	Peritonitis Episodes	Time of Participation in Patient-Months
Ribat Hospital*	18	4	93.6
Military Hospital	14	2	79.47
Khartoum Hospital	12	4	57.63
Soba Hospital (Peds**)	9	5	49.2
Ibn-Sina Hospital	5	0	30.9
Ibn Auf Hospital (Peds**)	2	1	12.3
Total	60	15	323.1

*Headquarters of the National PD Program, **Peds: Pediatric dialysis units

patient-month, or 0.55 episodes per patient-year) is within the acceptable range recommended by the ISPD guidelines (one episode per 18 patient-months or 0.67 episodes per year at risk),[9] although some individual center rates did not quite attain the recommended range. Since the system is an integrated program, the difficulties met by each center are discussed in detail and team-members give advice freely. Therefore, it is very likely that errors will be corrected and records improved. The appreciation incentive system has also proven very effective: the 'Center with Highest Number of Patients Cared for,' 'Center with Least Peritonitis Rate,' 'Best Research Publication' etc, were looked upon as achievements that were worth competing for.

Eighty seven percent of peritonitis patients are still active. This is satisfactory outcome since it is suggested that the initial cure rate of peritonitis should be more than 80% (without the necessity of removing the peritoneal catheter).[10] One patient was transferred to hemodialysis because of late catheter malfunction and refusal of re-insertion. A single patient died of septicemia following severe peritonitis, probably because of late reporting.

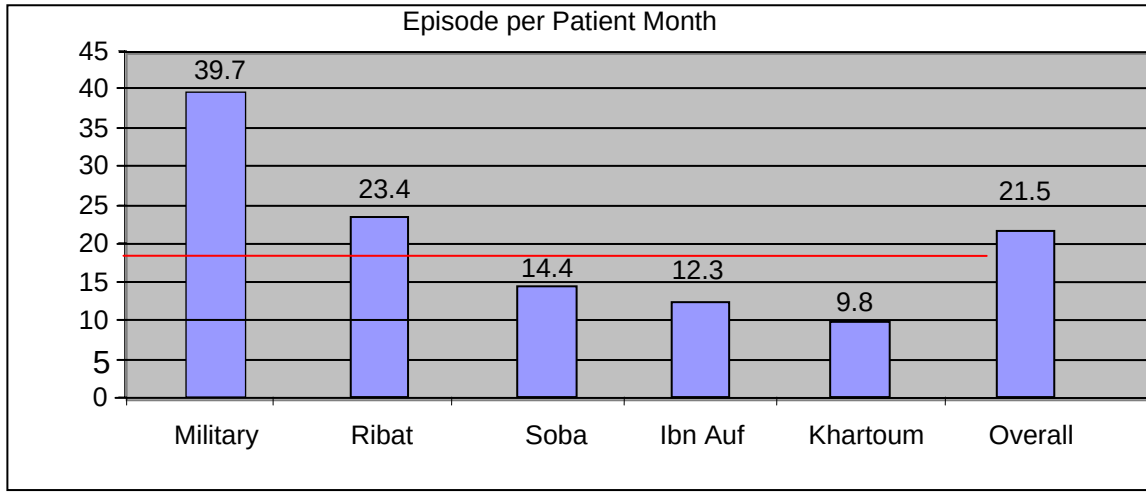
The high percentage of culture-negative peritonitis and inadequate laboratory data highlight the pressing need for standardizing and refining laboratory services for the national program.

Peritonitis was statistically more common in younger individuals. Possible reasons include performing dialysis by inadequately-trained helpers like family members and, in general, less adherence to meticulous hygiene. For logistical reasons, young children are trained to utilize appropriate portions of the same 2-liter adult bags for CAPD and discard the remainder. A future study to look more carefully into the possible causes is necessary.

All of our patients presented with the classical systems and signs of peritonitis with cloudy effluents in all of them. Patients should be well trained to recognize this feature as the most reliable sign of peritoneal inflammation as per the ISPD guidelines.[9] None of our peritonitis patients had a concurrent exit site or tunnel infection.

Coagulase-negative Staphylococci were the most common cause of peritonitis in CAPD, presumably due to touch contamination or infection via the pericatheter route.[11] Another common cause of peritonitis is *Staphylococcus* aureus, a more virulent pathogen that tends to be more resistant to therapy. Although peritonitis with S. aureus may be due to touch contamination, concurrent catheter infection is most frequent. One of the reservoirs for S. aureus is the anterior nares, with nasal carriers of S. aureus being at increased risk for S. aureus exit-site infections

Figure 1: Number of Peritonitis Episodes per Patient-Months for Different CAPD Centers in Greater Khartoum*

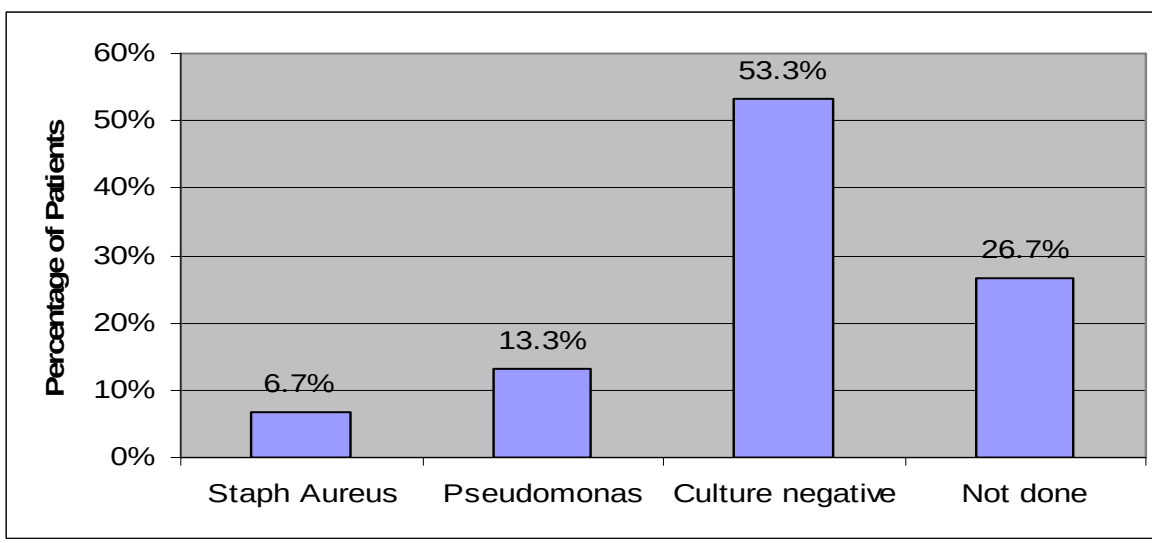


* The red line approximately represents the maximal peritonitis rate accepted by the ISPD of one episode per 18 patient months. Ibn-Sina Hospital is not included in this figure because of total lack of peritonitis during its 30.9 months of participation.

and possibly peritonitis.[12] Touch contamination was the likely mechanism in a sizable proportion of our patients. An important area for improving our outcome is proper hand hygiene that needs to be rigorously applied and observed. Although not supported by data to reduce the incidence of peritonitis,[13] our local program guidelines necessitate obtaining nasal swabs for culture prior to placement of the catheter, and treatment of *Staphylococcus* aureus nasal carriage with a five-day course of intranasal mupirocin if positive. Only one out of the fifteen peritonitis patients had a nasal swab performed pre-operatively. More studies are required to address the utility of this approach and link it with the incidence of peritonitis.

We had three cases of refractory and a

Figure 2: Effluent Culture Results for Sudanese CAPD Patients with Peritonitis



single case of relapsing peritonitis. Both conditions call for catheter removal as per the ISPD guidelines.[9] Although our patients with refractory and relapsing peritonitis eventually got better and are still active, the catheters were not timely removed as recommended. However, an important caveat that needs to be contemplated before removing the catheter for refractory peritonitis is to ascertain that it has been treated with appropriate antibiotic as the guidelines recommend. It occurred that both patients were classified initially as culture-negative and their antibiotic therapy was empirical. So, it may be argued that the administered antibiotic therapy might not have been 'appropriate.' Again, this underscores our need for more proficient and opportune laboratory support.

We conclude that the first year of operation of the Sudan National Multi-centered PD program has proven that it is a promising project with multifaceted success. The cumulative peritonitis incidence is acceptable although there are several areas for improvement. Standardized laboratory techniques need to be implemented and pursued, particularly in the microbiological area.

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