Prevention of peritonitis during CAPD

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More than 10 years after the introduction of CAPD, peritonitis still remains a major problem in most centers, being the most frequent complication and cause of drop-out. Thus the importante of preventing this complication in CAPD cannot be overemphasized.

It is probable that frequently bacteria enter the peritoneal cavity without causing peritonitis and that clinical peritonitis is the consequence of a combination of factors such as infectious dose, the virulence of the micro-organisms and the patients' resistance to infection [1]. Therefore, to develop a strategy for peritonitis prevention one should consider this complication to be the result of bacterial invasion of the peritoneal cavity combined with an inadequate response of the body's defences. In this case effective prevention will have to address one or both of these two aspects [2].

Routes of bacteria invasion

Bacteria can invade the peritoneal cavity through several routes so measures to prevent such entry should consider all of these routes. Thus bacteria can invade the peritoneal cavity through the lumen of the catheter-intraluminal, around the peritoneal catheter-periluminal, from the bowell wall-transmural, or it may spread hematogenously. On rare occasions invasion by such routes as vaginal-ascending, also have been described [3].

a) *Prevention of intraluminal infections*

The methods proposed for such prevention can be summarized as follows:

1. Patient selection and training

Although no one has defined the ideal patient for CAPD, there is universal agreement that the individual who is motivated for CAPD usually practices a better technique and has fewer episodes of peritonitis than one who is not motivated. Here, good training is of paramount importance, hence one should enlist specialized nurses, allocate a separate area for training and allow the patient sufficient time to learn and practice the various techniques. The technique of CAPD should be adjusted to the individual's capacities. It is also important to provide continuous supervision, with home visits, to guarantee the patient's expertise [3]. Moreover, subjective elements characterizing center experience and organization like physician and nurse commitment to peritoneal dialysis, quality clinical and training practices, ongoing challenging and upgrading of practices, and a full line of peritoneal dialysis therapeutic options (i.e., CAPD and automated peritoneal dialysis) are factors which appear to positively effect peritonitis prevention [4].

2. Dialysis solution composition and manufacturing method

Faller et al [5] reported that three groups of CAPD patients using different dialysis fluids showed different risk of peritonitis depending on the brand and the buffer (acetate or lactate) of the dialysate. Indeed, septic and 'aseptic' peritonitis were more frequent with Brand B lactate solution (3.7 episodes/patient-year) than with Brand A lactate (0.6 episodes/pt-yr) and Brand B acetate fluids (1.1 episodes/pt-yr). The results of this study clearly show that the kind of the peritoneal fluid used plays a role in the risk of developing peritonitis and that the composition and manufacturing method of the peritoneal fluid are the cornerstone of a successful long-term CAPD. Indeed, we have to be acutely aware of the possible presence of preservatives or stabilizing agents, trace chemicals, pyrogens and impurities in the solutions and use only solutions of the highest quality that technology can provide.

3. Connecting devices

The most accepted connecting technique for preventing intraluminal infections is that described by Oreopoulos et al. [6] However, to reduce the risk of dialysis fluid contamination, several workers have suggested modifications of the original system such as the Closter [7], in line bacteriological filter [8], the OZ connector [9], the splicer [10] and the UV connector [11]. The most significant reduction in peritonitis rates was shown by Buoncristiani et al. [12] with the use of a Y-shaped connector filled with sodium hypochlorite (Amuchina ®) solution during the dwelling time. In a prospective controlled trial which compared the standard set and a modified Y-set Maiorca et al. [13]

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showed that the Y-set reduced the infection rate to one episode every 33 patient-months compared to a rate of one episode every 11.3 patient-months in controls. Since that work, workers in Italy Have provided further evidence which suggests that indeed the Y-set with disinfectant can lower the infection rate dramatically (range 1/23-1/51 patient-months) [14-18]. More recently US and UK investigators using the 'O' set disconnect system with disinfectant (which is a further modification of the Y-set) were also able to report a significant reduction of peritonitis rate (range 1/23-1/33 patient-months) [19-21].

The Y-set is based on the sterilization of the connection site between the administration set and the bag with a disinfectant agent which, after the connection has been made, can be completely discharged to the outside through an outflow branch. In addition to the disinfectant effect, the flushing of the Y-connector reduces the risk of contamination [22]. Therefore, in clinical studies, it is difficult to separate the possible role of the flushing effect and the disinfectant efficacy. In an in vitro study Verger and Luzar proved that the flush effect in Y-line system is highly significant for preventing peritonitis [23], however this efficacy appears to be dependent upon specific microbial physiology interactions with plastic materials. Consequently, to prove the preventing effect on peritonitis incidence of the flush effect per se, French investigators undertook prospective studies to evaluate the efficacy of Y-set systems without in line disinfectant [24, 25] and were able to demonstrate that the Y-set reduced the infection rate to one episode every 23-61 patient-months compared to a rate of one episode every 8-12 patient-months in controls. According to these results they conclude that the Y connector even without in line disinfectant is extremely effective in reducing the rate of peritonitis in patients on CAPD.

Further studies are required to determine exactly the different roles played by the flushing effect and the disinfectants because even in these studies an antiseptic has been used at least at the level of the connector.

b) *Prevention of periluminal infections*

Methods under this heading involve chiefly those for prevention of skin-exit-site infections. Indeed, bacteria can invade the peritoneal cavity from around the catheter, as in those patients who have a skin-exit infection and then develop peritonitis with the same organism. No one has yet developed a device that provides a completely sealed, skin-catheter interface, which prevents bacteria invasion completely. Recently Twardowski et al. [26] have indicated that catheters, which exit downwards, may be associated with fewer infections than those exiting upwards. All will wait the results of their prospective studies with much interest. Infection at the exit-site is still a problem, solution to which is being extensively researched. Successful outcome of catheter in an individual depends upon meticulous adherence to guidelines as those recently provided by a 'catheter and exit-site advisory committee' and published in the *Peritoneal Dialysis Bulletin* [27].

c) *Prevention of transmural infections*

The peritoneal cavity can be invaded from the bowel either through a normal bowel wall, as in patients with severe diarrhea, or through an abnormal wall as in patients with an ischemic bowel or diverticulosis and diverticulitis [2]. Transmural, fecal, peritonitis should be suspected wheneved one finds two or more different organisms in a cloudy effluent. The presente of anaerobic organisms is pathognomonic of this type of peritonitis. Finally, it is possible that some of the episodes of peritonitis from which one isolates a single gram-negative organism may also be due to a transmural infection. Most episodes of fecal peritonitis are due to diverticulitis. The frequency of peritonitis due to diverticulitis can be reduced by excluding from CAPD those with extensive diverticulosis, but unfortunately this defect is frequent in patients older than 50, who make up the majority of those selected for CAPD. To date, presence of diverticulosis has not been considered a contraindication for CAPD. However, it is worth identifying these patients in advance so that they can be trained to avoid constipation. Partial colectomy might be considered in certain cases who insist on staying on CAPD after repeated episodes of diverticulitis. In certain patients, colonoscopy has been followed by invasion of the peritoneal cavity with organisms from the bowel; therefore it is advisable to 'cover' these patients with antibiotics from the day before and two days after the procedure. This does not seem to be necessary for patients undergoing sigmoidoscopy [2].

d) *Prevention of hematogenous infections*

This group includes Tuberculous peritonitis and probably Streptococcus viridans peritonitis. According to Oreopoulos et al. [3] patients should have a skin test for tuberculosis at the initiation of CAPD, and those who have a positive reaction should receive prophylaxis with isoniazide. Also CAPD patients undergoing dental procedures and perhaps those with tonsillitis should be treated with prophylactic antibiotics.

e) *Prevention of ascending peritonitis*

Patients, who have vaginal leak of the dialysis fluid, are prone to peritonitis and should have their Fallopian tubes ligated.

Peritoneal defences

Keane [28] and Lamperi and Carozzi [29] have shed new light on the role of host defence mechanisms of the peritoneal cavity. Indeed, they showed that 1) a significantly greater incidence of S. epidermidis peritonitis occurred in CAPD patients with 'low' IgG opsonic activity than in those with 'high' opsonic activity in their peritoneal dialysis effluent; 2) treatment with intraperitoneal immunoglobulin restored defective opsonic activity of peritoneal fluid and decreased the peritonitis rate in patients with previous high peritonitis incidence. These studies demonstrate the role of defective opsonization in CAPD peritonitis and the possibility of preventing infection by passove immunization with intraperitoneal immunoglobulin therapy. These studies indicate that alterations in the host defence of the peritoneal cavity may play an important role in the pathogenesis of peritonitis. These data also suggest that we might be able to prevent peritonitis by measures that enhance local defence mechanisms.

In conclusion, in the last years it has been demonstrated that the incidence of peritonitis can be dramatically reduced by the adoption of safer connecting devices. Over the next few years we should continue the development of connector technology (connectology) but we should focus research on the development of new catheter design and plastic material, the study of virulence of causative organisms and the colonization of the catheter [30], the identification of high-risk patients, the study of peritoneal defences during CAPD and the role of these defences in controlling infection.

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