Biochemical factors associated with early peritoneal catheter complications – a 5 years prospective study

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ABSTRACT

Introduction. Early complications of peritoneal dialysis (PD) catheter restrict the applicability of the method. Highlighting and removing the predisposing factors contribute to a better survival of this renal replacement therapy.

Aims. To establish correlations between serum albumin, urea and creatinine values before surgery and the risk of early complications after catheter insertion.

Methods. We conducted a prospective study between March 2009 and March 2014 including all patients that underwent laparoscopic insertion of Tenckhoff catheter in our hospital. Several biochemical characteristics of interest were assessed before surgery (serum albumin, BUN, creatinine) and we correlated their values in the groups of patients presenting or not early complications of PD catheter.

Results. In the total of 77 patients (mean age 60.08 +/- 11.64 years), 54.54% men, we noted 23 early complications (29.76%), of which 13 infectious complications (56.52%) and 10 mechanical complications – catheter malposition (n = 4), fluid leakage (n = 3), abdominal wall hematoma (n = 3). Low levels of serum albumin have shown positive association both with infectious and mechanical complications (p = 0.02112, respectively p = 0.01277). High values of urea and creatinine are strongly correlated to mechanical complications (p = 0.18295 and 0.18770), but not to the early infectious complications (p = 0.5754, p = 0.86001).

Conclusions. Forcing the early use of Tenckhoff catheter due to high and dangerous levels of serum urea and creatinine proved to result in increased episodes of mechanical complications; hypo-albuminemia in pre-dialysis patients correlates positively both with mechanical and infectious catheter complications in the first month after insertion.

Keywords: peritoneal catheter, early complications, biochemical predictors
INTRODUCTION

There are currently several surgical insertion techniques of peritoneal dialysis (PD) catheters. Some centers usually use for implantation a less invasive method, the so-called percutaneous approach under radiological control. The most common methods of a catheter insertion remain the laparoscopic technique and the approach through the classical surgery.

The laparoscopic technique is associated with higher operative duration, higher costs and it requires a general anesthesia. This is the method to prefer when you want to save a catheter that no longer works properly in patients with previous abdominal surgery. It is also the preferred method when the presence of peritoneal adhesions is suspected that requires an extended evisceration in order to optimize the catheter function.

It is advisable that the surgeon who makes such operations to be familiar with both techniques. The decision to use one of them must be made individually for each patient, also taking into account the resources of the institution (1,2).

The initiation of dialysis exchanges must be delayed 10-14 days after catheter insertion; in the meantime the bowel of the patient, the general and localized phenomena painful abdomen and the body temperature are to be monitored daily. The wound dressing should be performed once a week. If the dressing is moistened and if local painful phenomena occur then the dressing should be changed daily. During this period the patient will be given a daily series of 3-4 lavages with 200 mL dialysis serum and 1,000 Units heparin. This technique, recommended by the European Best Practice Guidelines, should minimize the complications risk (3,4).

Post-operative complications can occur early – less than 30 days after the surgical intervention – or late, after more than 30 days from the catheter insertion.

**Early complications:**

- **Intestinal perforation** – rarely occurs in about 1% of cases when opening the abdomen and handling (5,6).
- **Hemoperitoneum** is rarely generated by defective hemostasis in the pro-peritoneal area. It may be self-limiting and does not require further intervention but tracking. If bleeding still persists, local pressure can stop the bleeding (7).
- **The outflow failure** may be a consequence of fibrin clots existing in the catheter, of a trans-plant failure or in the subcutaneous tunnel or of a sleeve with omentum. This can be solved by using a guide wire or the laparoscopic approach (8). The nature of a catheter obstruction may be suggested by the interval of time it occurs after the surgery. In case of a twist, a catheter obstruction can appear immediately after its placement. Malposition occurs within a few days after the installation of a catheter.
- **The malposition or migration of the catheter** – 5-20% of cases (9-16) may be accompanied by pain and impaired drainage. The diagnosis is made by clinical examination, anamnesis and simple abdominal radiography. The use of a guide wire can successfully reposition the catheter; the recurrence can occur, leaving only 33% of patients who will not require repositioning. For the rest, the surgical intervention may be performed in the classical or laparoscopic manner (17). Few displacements occur due to constipation. In this case the treatment consists in enemas, glycerin suppositories, and lactuloses.
- **Dialysate leakage** can be caused by a defect in closing the parietal gap, a weak abdominal wall or an early mobilization of the patient during dialysis, accompanied by an increased inter-abdominal pressure. The incidence 1 to 40%, having higher rates of occurrence in the percutaneous placement of a catheter as compared to open surgical method. Putting the catheter to rest for a few weeks and passing to temporary hemodialysis can solve this complication. If these methods fail, the patient undergoes surgery to reposition the deep cuff or even catheter replacement (18-20).
- **Catheter cuff extrusion** appears in 3.5-17% of cases (18-22). It is favored by infection at the implant site and consists in the exposure of the superficial sleeve to the skin surface by erosion. The treatment involves remodeling or partial reduction of the sleeve. Vicious wound healing, inflammatory persistent signs or local infection require the removal of the catheter.
- **Infectious complications** treated in time are easy to solve, but if neglected, they can easily turn into an early peritonitis. By using Mupirocin and Vancomycin early peritonitis rate may significantly decrease (23). If there are no signs of peritonitis but of a non-responding gateway or an inter-parietal infection, the catheter can be removed and another will be placed in the contralateral abdominal
region during the same operative session (24-26). If there are signs of peritonitis, the new catheter will not be placed in another operative session (27).

Many studies underline the importance of hypo-albuminemia complex infectious during the treatment of renal remediation by PD (28, 29). However, the risk of early complications of PD is not correlated with the values of albumin and other constant bioumoral parameters in patients undergoing PD catheter insertion.

AIMS OF THE STUDY

During 5 years, in a comprehensive study analyzing all surgical complications recorded in a group of 118 PD patients, we focused on the subjects with a peritoneal catheter implantation performed in the Department of Surgery, “Sf. Ioan” Emergency Clinical Hospital. We evaluated the clinical and biological features for catheter insertion and the postoperative evolution of the individuals both in the early stage, during the first post-implantation month and the late stage, after more than one month the peritoneal catheter insertion.

METHODS

Between March 2009 and March 2014, the study analyzes patients with recent Tenckhoff catheter implantation for initiating PD. According to the patients’ medical records, the study underlines the preoperative values of serum albumin, urea and creatinine. Additionally, one of the two ways for placing the catheter Tenckhoff used in the Department of Surgery was the open method, performed under local anesthesia using lidocaine 1% (30 mL). After insertion, the catheter placement shall always be tested byinstillation of 100 mL saline into the peritoneal cavity. Catheter permeability, the tightness suture and the way the effluent looks should be checked (the effluent must not contain blood or feces).

Following the postoperative evolution, we divided the initial segment of patients into groups according to the presence and type of early postoperative complications – within one month after implantation of the catheter. We centralized the interesting values of the biological parameters in these groups of patients and we analyzed their mean values in correlation with the risk of early complications of a peritoneal catheter.

Statistically, we expressed the values of the biological constants as mean +/- SD; we used Chi-square test for qualitative variables comparison and student T-test for comparisons between quantitative mean variables values in the established groups of patients.

RESULTS

During the research years a total number of 77 peritoneal catheters were inserted in 70 patients; 7 patients required a catheter re-implantation during the study, so we considered them twice, as another case for the second catheter implant.

Demographic characteristics and important bioumoral features and important complications in the group of patients with catheter implant were centralized in Table 1.

TABLE 1. Demographic and bioumoral preoperative characteristics in the selected patients

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. total number</td>
<td>77</td>
</tr>
<tr>
<td>2. males (%)</td>
<td>42 (54.54%)</td>
</tr>
<tr>
<td>3. median age +/- SD</td>
<td>60.08 +/- 11.64</td>
</tr>
<tr>
<td>4. primary disease</td>
<td></td>
</tr>
<tr>
<td>diabetes nephropathy</td>
<td>11</td>
</tr>
<tr>
<td>hypertension</td>
<td>15</td>
</tr>
<tr>
<td>glomerulopathy</td>
<td>14</td>
</tr>
<tr>
<td>tubular nephropathy</td>
<td>16</td>
</tr>
<tr>
<td>ischemic nephropathy</td>
<td>17</td>
</tr>
<tr>
<td>others</td>
<td>4</td>
</tr>
<tr>
<td>5. mean creatinine (mg/dL)</td>
<td>3.54 +/- 0.37</td>
</tr>
<tr>
<td>6. mean urea (mg/dL)</td>
<td>183 +/- 31.70</td>
</tr>
<tr>
<td>7. mean albumin (mg/dL)</td>
<td>8.37 +/- 3.92</td>
</tr>
</tbody>
</table>

All noticed complications in the first month after Tenckhoff catheter implantation were assessed, analyzed and correlated with clinical and biological characteristics. The mean interval from the insertion to the onset of the complication was 8.4 +/- 1.2 days.

A total of 23 detailed complications that occurred during the first month after the implantation of the PD catheter (29.87%) were graded, as follows:

- 13 cases of patients who developed early infectious complications – 7 operative wound infections and 6 infections of the subcutaneous tunnel;
- 10 cases of patients who developed new mechanical complications of the implanted catheter;
- 3 patients had fluid leaking through implantation site – by analyzing the bioumoral constants of patients who presented this type of complication, we found serum albumin levels below 3.5 g/dL (mean levels of 3.1 +/- 0.05 g/dL) and high levels of nitrogen waste
products. These values imposed the early initiation of peritoneal flushing in order to speed up the start of dialysis exchanges (uremia 241 +/- 23.57 mg/dL – mean values, creatinine 12.13 +/- 0.95 mg/dL – mean levels);

• in 3 cases hematoma occurred on the abdominal wall at the site of implantation – these subjects presented hypoalbuminemia (3.0 +/- 0.1 g/dL), and the following bioumoral features: serum urea 151.33 +/- 18.58 mg/dL, serum creatinine 7.36 +/- 0.5 mg/dL. Two of the patients underwent emergency hemodialysis (HD) initiated on a temporary catheter with periorificial HD made without anticoagulant;

• 4 cases in which we diagnosed catheter malposition – insufficient exhaust after initiation of dialysis lavage and exchanges, one solved by accelerating bowel motility, the other 3 required repositioning of the catheter using a guiding wire.

In this group, mean levels of serum urea was 195.75 +/- 19.7 mg/dL, of serum creatinine was 9.1 +/- 1.83 mg/dL, and albumin was 3.5 +/- 0.08 g/dL.

The mean values of preoperative bioumoral parameters for the whole group, the group with mechanical complications and the group with infectious complications are listed in Table 2.

Statistical correlations revealed that mean albumin values are significantly lower in the infectious complications group (p = 0.02112) and in the mechanical complications group (p = 0.01277) than those found in the global group of patients.

The mean values of urea were found significantly higher in the group of patients with mechanical complications (p = 0.18295), but no correlations were made between the group with infectious complications and the global group (p = 0.5754).

As for the mean values of creatinine, we determined a significantly higher value in the mechanical complications group versus the total group (p = 0.18770), but no significance in the relationship between the infectious complications group and the whole group (p = 0.86001).

**DISCUSSIONS**

During the study years a total number of 77 peritoneal catheters was placed in 70 patients; 7 patients required a catheter re-implantation.

The insertion of a second peritoneal catheter in 7 patients was imposed by:

• a series of prolonged peritonitis with microbial biofilm formation in the catheter;

• the persistent leakage of fluid at the site of implant, with or without tissue maceration associated with pulling out of the periorificial external Dacron sleeve.

Wound and tunnel infections are difficult to diagnose because in the first 14 days no PD exchange is recommended and the implant site has to remain at rest, with as few medical maneuvers as possible at this level.

Patients are marked by the received surgery and they are less cooperative. Therefore, it is difficult to distinguish between major complaints given by uremic milieu and wound infection, often with subclinical onset (uremic patients do not present fever, diabetics are affected by painful sensitivity; their tissues are hyper-hydrated and in poor conditions, their healing being difficult).

Taking into account these circumstances, although patients were hospitalized, the unfavorable development of wound infection and/or of the subcutaneous tunnel with the development of peritonitis in 7 cases, resulted in the removal of the catheter in 3 patients. An important recorded fact was the presence of diabetes comorbidities in seven of the 13 patients who had infectious complications after catheter implantation. The values of analyzed constants in correlation with the early complications issued after catheter insertion can give us clues to their importance in adopting an active medical attitude.

Patients who developed early complications showed low levels of serum albumin. The indicator showed that it had favored both infectious complications and mechanical complications of PD catheter implantation.

The values of nitrogen waste products were relatively high in the group of infectious compli-
cations, the differences in the total group of subjects with catheter implants not being, however, significant, because most of the infections occurred in diabetic patients, in which dialysis started early, without waiting for large values of uremia. In patients who had mechanical complications, urea and creatinine values were significantly higher than the overall group of subjects with implants. These individuals have forced early initiation of dialysis, because of their high levels of uremia and the presence of severe symptoms caused by the end-stage renal disease and its complications.

The incomplete healing of the implant site especially favored the liquid leakage attached to the catheter and the catheter malposition. As a feature of mechanical complications subgroup through peri-catheter hematoma at the site of implantation, the patients had extreme uremia, because most of them had already started renal supplant by HD on temporary catheter.

*European Best Practice Guidelines* recommend that we should allow the healing of the abdominal wall around the Tenckhoff catheter for a period of 10-14 days after the surgical insertion (4). In the group of patients with early mechanical complications the mean interval between the surgery and the start of the exchanges was $8 +/- 1.89$ days; the mean interval between insertion and exchanges in the group of patients without early mechanical complication was $12 +/- 2.19$ days. As a recent study concluded, each day of delay for exchanges initiation can lower the risks for early mechanical complications (30). Therefore, the insertion of the catheter should be done early enough, before the high values of urea and creatinine force us to start urgently the exchanges.

**CONCLUSIONS**

Hypoalbuminemia is a risk factor for both early post-implant infections of peritoneal catheter and for early post-implant mechanical complications.

High levels of urea and creatinine have not proven contribution as risk factors of infectious complications, but can significantly influence post-implant mechanical complications of the peritoneal catheter.

Forcing the early use of the Tenckhoff catheter due to high and dangerous levels of serum urea and creatinine proved to result in an increased number of mechanical complications; hypoalbuminemia in pre-dialysis patients correlates positively both with mechanical and infectious catheter complications in the first month after insertion.

**REFERENCES**


