# Peritonitis in Children Receiving Continuous Ambulatory Peritoneal Dialysis in Northeast Thailand

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***Objective:*** *To clarify the peritonitis rate and to characterize the differences between the peritonitis and non-peritonitis group in ESRD children using continuous ambulatory peritoneal dialysis (CAPD) in Khon Kaen, Thailand.*
***Material and Method:*** *The authors reviewed the medical records of ESRD children under 15 years old at the time of PD catheter placement, who received CAPD in Srinagarind Hospital, Faculty of Medicine, Khon Kaen University between 1994 and 2007.*
***Results:*** *Eighteen male and fifteen female patients were identified. Their mean age at the time of PD catheter placement was 11.48 $\pm$ 3.12 years (range, 3.52-15.67). Twenty patients (11 male and 9 female) were complicated with 47 episodes of peritonitis during 400.44 patient-months. The peritonitis rate was one episode every 8.52 patient-months. The three most frequent clinical presentations were cloudy effluent (78.72%), abdominal pain (76.60%) and fever (63.83%). Negative effluent culture was 42.55%. Staphylococcus aureus and Enterococcus species were the two most frequent causative organisms. The dialysis duration and serum creatinine level were significantly different between the peritonitis and non-peritonitis groups.*
***Conclusion:*** *Peritonitis frequently occurred in ESRD children treated by CAPD in Northeast Thailand, particularly from gram-positive organisms. The dialysis duration and serum creatinine level at the time of catheter placement were associated with PD peritonitis.*

***Keywords:*** *Peritonitis, Peritoneal dialysis, Children, End-stage renal disease*

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Peritoneal dialysis (PD) is the most common dialysis modality used in children with end-stage renal disease (ESRD), particularly in the developing countries. Children with PD have less fluid and diet restriction, better growth and school performance over against those with hemodialysis. Furthermore, scarcity of a pediatric hemodialysis program and lack of governmental support are important factors in developing countries, including Thailand.

Peritonitis is the most common complication of PD and leads to compromise peritoneal function. Therefore, the objective of the present study was to identify the rate of peritonitis and compare between the peritonitis and non-peritonitis group in ESRD children using continuous ambulatory peritoneal dialysis (CAPD) in Khon Kaen, Thailand.

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## Material and Method

Medical records of ESRD children under 15 years old at the time of PD catheter placement, who received CAPD in Srinagarind Hospital, Faculty of Medicine, Khon Kaen University between 1994 and 2007, were thoroughly reviewed by the permission from the hospital director. Demographic data, cause of ESRD, clinical presentation, causative organisms and rate of peritonitis were analyzed.

Peritonitis was defined by the presence of two or more of the following criteria, a) symptoms of peritoneal inflammation, b) cloudy effluent with total white blood cell count more than 100 cells/mm$^3$, with at least 50% polymorphonuclear cells, c) presence of organisms on peritoneal effluent gram staining or culture[1].

Straight double-cuffed silicone Tenckhoff catheters were used in all patients. All catheters were performed by the same open surgical technique under general anesthesia. CAPD was begun within the first week of catheter placement in all patients. Prophylactic

intravenous antibiotic at the time of catheter placement and daily topical mupirocin application around the exit site were not routinely practiced.

All parameters were expressed as mean ± standard deviation (SD). Mean differences and 95% confidence interval of parameters between the patients with peritonitis and those without peritonitis were analyzed by t-test. P-value less than 0.05 was defined as statistical significance.

## Results

Eighteen male and fifteen female patients were identified. Their mean age at the time of PD catheter placement was 11.48 ± 3.12 years (range, 3.52-15.67). Their demographic data including gender, age, weight, height, body mass index, laboratory parameters, and dialysis duration are demonstrated in Table 1. When the authors compared parameters between the peritonitis and non-peritonitis groups, the duration of CAPD and serum creatinine level were significantly different (Table 2).

The three most common causes of ESRD were renal hypoplasia (21.21%), rapidly progressive glomerulonephritis (18.18%) and lupus nephritis (15.15%) respectively (Table 3).

Twenty patients (11 male and 9 female) were complicated with 47 episodes of peritonitis during 400.44 patient-months. The peritonitis rate was one episode every 8.52 patient-months. The three most frequent clinical presentations were cloudy effluent (78.72%), abdominal pain (76.60%) and fever (63.83%) respectively (Table 4).

Negative effluent culture was 42.55% in the present study. Of those positive cultures, one and two causative organisms were reported in 22 (81.48%) and five (18.52%) effluent cultures respectively. *Staphylococcus aureus* (22.22%) accounted for the greatest number of gram positive organisms, whereas,

**Table 1.** Demographic data and biochemical profiles of patients at the time of PD catheter placement

| Characteristics | Peritonitis group | Non-peritonitis group |
|---|---|---|
| Number of patients | 20 | 13 |
| Gender: male | 11 | 7 |
| Age (years) | 11.17 ± 3.53 (3.52-15.67) | 11.96 ± 2.41 (6.45-14.92) |
| Weight (kg) | 37.52 ± 18.79 (13.5-78) | 33.87 ± 14.35 (20-57) |
| Height (m) | 1.33 ± 0.21 (0.88-1.55) | 1.32 ± 0.17 (1.11-1.48) |
| Body mass index (kg/m$^2$) | 19.73 ± 6.37 (11.11-36.10) | 18.39 ± 4.05 (13.89-25.45) |
| Hemoglobin (g/dL) | 8.47 ± 2.18 (5.70-12.90) | 8.52 ± 1.10 (7.30-11.10) |
| Blood urea nitrogen (mg/dL) | 123.13 ± 61.23 (39.60-213.60) | 117.02 ± 82.98 (14.70-325.50) |
| Serum creatinine (mg/dL) | 14.79 ± 7.68 (4.80-32.60) | 9.61 ± 5.19 (1.60-21.10) |
| Serum albumin (g/dL) | 3.20 ± 0.70 (2.10-4.40) | 2.98 ± 0.76 (1.50-4.30) |
| Dialysis duration (patient-months) | 16.33 ± 17.21(3.88-76.54) | 5.69 ± 6.79 (0.16-22.72) |

**Table 2.** Comparison between patients with peritonitis and peritonitis free patients

| Characteristics | Mean differences | 95% confidence interval | p-value |
|---|---|---|---|
| Age (years) | -0.783 | -3.069, 1.503 | 0.490 |
| Weight (kg) | 3.656 | -11.053, 18.364 | 0.613 |
| Height (m) | 0.008 | -0.188, 0.204 | 0.934 |
| Body mass index (kg/m$^2$) | 1.349 | -4.522, 7.219 | 0.637 |
| Hemoglobin (g/dL) | -0.056 | -1.388, 1.275 | 0.931 |
| Blood urea nitrogen (mg/dL) | 6.111 | -50.041, 62.264 | 0.825 |
| Serum creatinine (mg/dL) | 5.186 | 0.006, 10.365 | 0.049* |
| Serum albumin (g/dL) | 0.215 | -0.349, 0.78 | 0.440 |
| Dialysis duration (patient-months) | 10.637 | 0.378, 20.896 | 0.043* |

* Statistical significance different

**Table 3.** Etiology of ESRD (n = 33)

| Etiology | Number of patients (%) |
|---|---|
| Renal hypoplasia | 7 (21.21) |
| Rapidly progressive glomerulonephritis | 6 (18.18) |
| Lupus nephritis | 5 (15.15) |
| Glomerulosclerosis | 2 (6.06) |
| Ig M nephropathy | 1 (3.03) |
| Hemolytic uremic syndrome | 1 (3.03) |
| Thrombotic thrombocytopenic purpura | 1 (3.03) |
| Urolithiasis | 1 (3.03) |
| Trauma | 1 (3.03) |
| Dengue shock syndrome | 1 (3.03) |
| Unknown | 7 (21.21) |

ESRD = end-stage renal disease

**Table 4.** Clinical manifestation of peritonitis (n = 47 episodes)

| Clinical manifestations | Number of peritonitis episodes (%) |
|---|---|
| Cloudy effluent | 37 (78.72) |
| Abdominal pain | 36 (76.60) |
| Fever | 30 ( 63.83) |
| Catheter malfunction | 10 (21.28) |
| Diarrhea | 6 (12.77) |
| Nausea/vomiting | 3 (6.38) |

**Table 5.** Causative organisms of peritonitis (n = 27)

| Organisms | Number of peritonitis episodes (%) |
|---|---|
| Gram-positive organisms | 18 (66.67) |
| *Staphylococcus aureus* | 6 (22.22) |
| Methicillin-sensitive | 5 (18.52) |
| Methicillin-resistant | 1 (3.70) |
| *Enterococcus* species | 5 (18.52) |
| Coagulase-negative *Staphylococcus* | 4 (14.81) |
| *Streptococcus viridans* | 1 (3.70) |
| Non-hemolytic *Streptococcus* | 1 (3.70) |
| *Bacillus* species | 1 (3.70) |
| Gram-negative organisms | 14 (51.85) |
| *Acinetobacter baumannii* | 4 (14.81) |
| *Klebsiella pneumoniae* | 3 (11.11) |
| *Pseudemonas stutzeri* | 3 (11.11) |
| *Pseudomonas aeruginosa* | 2 (7.41) |
| *Aeromonas* species | 1 (3.70) |
| *Acinetobacter calcoa* | 1 (3.70) |

*Acinetobacter baumannii* (14.81%) was the most frequent gram negative organism cultured from peritoneal effluent in the present study (Table 5).

## Discussion

PD is the most common dialysis modality performed in ESRD children due to its less sophisticated technique. CAPD is most frequently performed in ESRD children in Thailand because of scarcity of a pediatric hemodialysis program and lack of governmental support for other dialysis modalities. Peritonitis is the most frequent PD complication, which contributes to peritoneal dysfunction. Therefore, peritonitis rate reduction in order to maintain peritoneal function is important in Thai children with ESRD.

The peritonitis rate of published reports varied from one episode every 3.5 patient-months to one episode every 20.69 patient-months[2-8]. Patients receiving automated PD, which was associated with a lower rate of peritonitis than the manual method, were included in some of those reports. Due to limited resources, automated PD was rarely used in the presented ESRD patients. The peritonitis rate in ESRD children who receiving CAPD was one episode every 8.52 patient-months in the present study. Cloudy effluent, abdominal pain and fever were the three most common clinical manifestations of PD peritonitis.

In the present study, gram-positive organisms especially *Staphylococcus aureus* were the predominate cause of peritonitis, which was similar to some published reports[8-10]. Therefore, excellent hand hygiene and exit site care should be encouraged in all patients and their caregivers. Intravenous cefazolin prophylaxis given at the time of catheter placement, which is evident to decrease infection rate, should be encountered in to the authors' protocol[11]. Furthermore, in patients with *Staphylococcus aureus* peritonitis, nasal carriage detection should be performed in these patients and their caregivers. Intranasal mupirocin should be administered in all nasal carriage and topical mupirocin should be applied to those patients' skin around the exit site. Unlike those published reports, *Enterococcus* species, which was one of the enteric organisms, was frequently observed in the present study. From the International Society for Peritoneal Dialysis (ISPD) recommendations[11], there is an association between severe constipation and peritonitis caused by enteric organisms due to transmigration of those organisms across the bowel wall. Characteristics of bowel habit in the presented patients were not recorded. However, all PD patients

should be free of constipation to decrease bowel colonization. Negative effluent culture rate in the present study (42.55%) was higher than the ISPD recommendation (20%)[11]. Improvement of the authors' culture technique by using blood-culture bottles for effluent culture, according to the recommendation, may decrease this rate.

According to the study of risk factors in PD children, Boehm M et al showed the exit-site infection and residual urine volume were strong independent predictors of peritonitis in PD children in 2005[4]. Both exit site score and residual urine volume were not recorded in the presented patients. However, the present study showed statistical difference of the serum creatinine level at the time of catheter placement and dialysis duration between patients with peritonitis and peritonitis free patients. Earlier PD administration and renal transplantation in ESRD children may decrease the peritonitis rate.

In conclusion, peritonitis in children receiving CAPD in Thailand is an important problem. Further studies to identify risk factors of peritonitis and PD guideline development should be encouraged in Thailand in order to decrease the incidence of peritonitis in ESRD children receiving CAPD

**Potential conflicts of interest**

None.

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# *เยื่อบุช่องท้องอักเสบในผู้ป่วยเด็กที่ได้รับการล้างไตทางช่องท้องอย่างต่อเนื่องในภาคตะวันออกเฉียงเหนือของประเทศไทย*

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***ภูมิหลัง**: การล้างไตทางช่องท้องอย่างต่อเนื่องเป็นการบำบัดทดแทนไตซึ่งเป็นที่นิยมใช้ในผู้ป่วยเด็กไตวายเรื้อรัง ภาวะแทรกซ้อนที่พบบ่อยที่สุดคือ เยื่อบุช่องท้องอักเสบ ซึ่งอาจทำให้ประสิทธิภาพของการล้างไตทางช่องท้องลดลง ดังนั้นการศึกษาเพื่อหาวิธีลดภาวะนี้จึงมีความสำคัญโดยเฉพาะในประเทศไทยซึ่งมีความจำกัดทางด้านทรัพยากร*

***วัตถุประสงค์**: เพื่อศึกษาอัตราการติดเชื้อ ลักษณะทางคลินิก เชื้อที่เป็นสาเหตุของภาวะเยื่อบุช่องท้องอักเสบ และความแตกต่างของผู้ป่วยระหว่างกลุ่มที่พบและไม่พบภาวะเยื่อบุช่องท้องอักเสบในผู้ป่วยเด็กที่ได้รับการล้างไตทางช่องท้องอย่างต่อเนื่องในโรงพยาบาลศรีนครินทร์ คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น*

***วัสดุและวิธีการ**: รวบรวมข้อมูลย้อนหลังจากเวชระเบียนของผู้ป่วยเด็กไตวายเรื้อรังที่ได้รับการล้างไตทางช่องท้องอย่างต่อเนื่องในโรงพยาบาลศรีนครินทร์ตั้งแต่ พ.ศ. 2537 ถึง พ.ศ. 2550*

***ผลการศึกษา**: ผู้ป่วยมีจำนวน 33 คน (ชาย 18 คน และหญิง 15 คน) อายุเฉลี่ย 11.48 $\pm$ 3.12 ปี พบภาวะเยื่อบุช่องท้องอักเสบ ในผู้ป่วย 20 คน (ชาย 11 คน และหญิง 9 คน) จำนวน 47 ครั้งในระยะเวลา 400.44 เดือน (1 ครั้ง: 8.52 เดือน) ลักษณะทางคลินิกที่พบบ่อยที่สุดคือน้ำยาไตเทียมขุ่น (ร้อยละ 78.82) ปวดท้อง (ร้อยละ 76.60) และไข้ (ร้อยละ 63.83) ผลการเพาะเชื้อจากน้ำยาไตเทียมให้ผลเป็นลบ 20 ครั้ง (ร้อยละ 42.55) เชื้อที่พบส่วนใหญ่เป็นเชื้อแบคทีเรียกรัมบวก โดยเชื้อที่พบบ่อยที่สุดคือ Staphylococcus aureus (ร้อยละ 22.22) และ Enterococcus species (ร้อยละ 18.52) ระยะเวลาที่ได้รับการล้างไตทางช่องท้องอย่างต่อเนื่องและระดับคริอะตินินในเลือดระหว่างผู้ป่วยที่พบและไม่พบภาวะเยื่อบุช่องท้องอักเสบมีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ (p-value = 0.043 และ 0.049 ตามลำดับ)*

***สรุป**: ภาวะเยื่อบุช่องท้องอักเสบเป็นปัญหาสำคัญในผู้ป่วยเด็กที่ได้รับการล้างไตทางช่องท้องอย่างต่อเนื่องในโรงพยาบาลศรีนครินทร์ โดยเชื้อที่พบส่วนใหญ่เป็นเชื้อแบคทีเรียกรัมบวก นอกจากนี้พบว่าระยะเวลาที่ได้รับการล้างไตทางช่องท้องอย่างต่อเนื่อง และระดับคริอะตินินในเลือดมีความสัมพันธ์กับภาวะเยื่อบุช่องท้องอักเสบในผู้ป่วยเหล่านี้*