Guideline for chronic dialysis in children in South Africa

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Introductory remarks

For children with end stage renal failure there are 4 treatment options:

- Pre-emptive kidney transplantation is the ideal treatment for suitable patients and in most cases implies live related kidney transplantation
- Peritoneal dialysis
- Haemodialysis
- Conservative treatment without dialysis

Chronic dialysis should be delivered in the context of a comprehensive and integrated service for renal therapies, including:

- Continuous ambulatory peritoneal dialysis (CAPD)
- Automated peritoneal dialysis (APD)
- Haemodialysis (including temporary backup HD facilities)
- Transplantation
- Conservative care

The choice of treatment modality should be decided upon by considering the following factors:

- Contraindications to a specific form of dialysis
- Caregiver/parent and patient preference (where applicable)
- Quality of life factors
- Treating practitioners advice

Peritoneal dialysis (PD) guideline for children

PD has become the equal of haemodialysis in many centres Home PD is the preferred chronic dialysis modality for most children owing to its almost universal applicability and superior compatibility with lifestyle over other modalities.

For technical reasons PD is without doubt the modality of choice in infants and young children.

Long-term outcome of children on dialysis is inferior compared to older children.[1]

Mortality rate in infants is 13.6 deaths/1000 patients years which is higher than that of older children.[2]

No studies of haemodialysis (HD) and PD outcomes in children suggest that one procedure is superior to the other.

Dedicated PD nursing staff should be part of the multidisciplinary team.

Selection for PD

It is important to evaluate the family's socio-economic and psychological background to determine the ability of the family to cope with the burden of care associated with the provision of chronic home treatment on a daily basis. In addition the level of education of the caregiver/parent is equally important.

Evaluation of the parent/caregiver

Parents/caregivers and older patients should be informed about treatment options.

The parent or caregiver's educational background and learning capacity should be evaluated in order to assess their ability to process the information necessary to do home PD successfully.

It may be necessary to individualise the training plan for the parent or caregiver.

In poor socio-economic circumstances, or in situations where the parents are illiterate or unwilling to co-operate with treatment, renal replacement therapy may not be in the best interest of the child.

Absolute indications for PD (in preference to HD) in children with end-stage renal failure:

- Very small child (<10 kg)
- Lack of vascular access
- Contraindication to anticoagulation

Performance of PD requires a patent abdominal cavity and a functioning peritoneal membrane across which solute and fluid transport can occur.

Contraindications to chronic PD

- Omphalocoele
- Gastrochisis
- Bladder extrophy
- Diaphragmatic hernia
- Obliterated peritoneal cavity
- Peritoneal membrane failure

Presence of a colostomy, gastrostomy, pyelostomy or ureterostomy does not preclude the use of chronic PD.

Insertion of the PD catheter

- Local expertise at individual centres should govern the choice of method of PD catheter insertion. For chronic dialysis a permanent peritoneal dialysis catheter should preferably be implanted surgically in theatre by a surgeon with experience in the placement of PD catheters
- As an alternative to standard surgical insertion, laparoscopic PD catheter insertion may be done with the advantage of a less-invasive procedure and a smaller peritoneal perforation
- Surgical support should be available for catheter insertion, replacement or removal as necessary
- The catheter should be inserted 2-3 weeks before starting peritoneal dialysis
- The location of the exit site should be determined in advance of the surgical procedure
- Preoperative bowel preparation and showering or bathing with an antiseptic soap may help to reduce the risk of postoperative infections.

Catheter type

- Tenckhoff type catheter are preferred in children
- Single and double cuff, straight and coiled Tenckhoff catheters are available and there is no agreement on which particular catheter functions better or is associated with fewer complications (blockage, migration and frequency of peritonitis/exit site complications) in children across all age groups.[3]
- There is no benefit of coil catheters over straight catheters with respect to the prevention of catheter-related infections
- Coil catheters may have the advantage of improved drainage and less obstruction of drainage of fluid
- In infants, coil catheters with single cuffs are preferred
- In older children swan-neck catheters with downward-directed exit sites are preferred.

Surgical technique

- Antibiotic prophylaxis directly before peritoneal catheter placement decreases the risk of early peritonitis. Recommendation: Cefazolin 25 mg/kg IV. Antibiotic choice depends on centre-specific susceptibility patterns vs. risks of emergence of bacterial resistance
- A paramedian incision is preferred to avoid herniation or dialysate leakage
- A partial omentectomy reduces the risk of catheter blockage
- When using a catheter with two cuffs, the distal (outer) cuff should be situated approximately 2 cm from the exit site to decrease the risk of cuff extrusion
- Sutures should not be placed at the exit site because of the risk of bacterial colonization and increased risk of exit site/tunnel infection
- The exit site should be round and small for a snug fit of the catheter
- In infants the exit site should be directed upwards, outside the diaper area and away from site of stomas (gastrostomy, ureterostomy)
- In toilet trained children a downward pointing exit site is recommended to decrease the risk of peritonitis. It should also be placed away from the belt line and stomas (gastrostomy, ureterostomy)
- The catheter drainage should be checked in theatre
- It should be flushed with 10 ml/kg dialysate until the dialysate is clear then capped off
- Thereafter the catheter should be flushed weekly until use
- The catheter should be securely anchored close to the exit site to minimize movement. Movement of the catheter in the tunnel prevents healing, and results in leaks, exit site infection and granulomas.

Early exit site care

- Catheter dressings should not be removed during the first postoperative week
- Thereafter, the exit site should be cleaned once a week for the first 3 weeks. Dressing changes should be done by experienced personnel
- The exit site should be cleaned aqueous chlorhexidine 0.05%, followed by water. Strong agents such as hydrogen peroxide and povidine iodine should be avoided because they are cytotoxic and can be damaging to granulation tissue
- Apply a topical antibiotic cream (Bactroban/gentamicin) at the time of the weekly sterile dressing
- Avoid showering or bathing during the healing phase
- Perioperative catheter care and catheter complications (leaks, hernias, obstruction) should be managed according to the International Society of Peritoneal Dialysis (ISPD) guidelines at www.PDIconnect.com.

Prevention and treatment of exit site infections

- The exit site should be kept clean, dry, scab-free, crust-free, painless, and noninflamed
- Immobilization of the catheter and protection from trauma is essential

- The exit site should be cleaned every other day using aseptic technique
- Aqueous chlorhexidine 0.05% should be used until the site is clean and the chlorhexidine is then removed with water
- The exit site should be swabbed and cultured once a month or when there are signs of infection
- Positive Staph cultures but no clinical signs of infection should be treated with topical mupirocin ointment for 4 weeks
- If the tunnel looks infected, treat with topical mupirocin ointment, oral flucloxacillin and oral nystatin. Treatment is adapted when culture and sensitivity data are available. If no positive culture, continue with above treatment for a minimum of 4 weeks
- If no improvement by 4 weeks consider replacement of the catheter.

Touch contamination

Advise patient to:

- Replace minicap
- Twist clamp on transfer set to closed position
- Report to hospital

When patient reports to hospital:

- Drain peritoneal fluid and send for culture
- Change transfer set
- Add vancomycin 10 mg or Kefzol 25 mg to a 1 litre twin bag of dialysate
- Instill the usual fill volume of the patient and leave in the peritoneal cavity for at least 3 hours, then drain.

Guideline for the management of peritonitis

For the complete guideline see Peritoneal Dialysis International 2010;30:393-423.

Prevention Strategies

- PD units should undertake regular audit of their peritonitis and exit-site infection rates, including causative organism, treatment and outcomes. They should enter into active dialogue with their microbiology department and infection control team to develop optimal local treatment and prevention protocols
- For children on manual PD the flush-before-fill dialysis delivery systems should be used
- Caregivers or patients should undergo regular review of their technique, at least once every 6 months, or more frequently if indicated, such as after an episode of PD-related infection or after a significant interruption of the caregiver performing the PD. They should receive intensified training if their technique is below standard
- Administer prophylactic antibiotics
  - after accidental intraluminal or touch contamination: intraperitoneal vancomycin 25 mg/L
  - before invasive dental procedures: amoxicillin 50 mg/kg PO, maximum 2 g
  - before procedures involving the gastrointestinal or genitourinary tract and associated with a high risk of bacteraemia: cefoxitin or cefotaxime 25 mg/kg, max 2 g.

Important general points

- Symptoms and outcome are usually worse with Staphylococcus aureus and gram-negative infections and fungi
- Prolonged use of antibiotics may result in fungal peritonitis. Use oral nystatin at the time of antibiotic administration to reduce the risk of fungal peritonitis
- Treatment should be aimed at preservation of the peritoneal membrane rather than the catheter.

Clinical Presentation

- Cloudy dialysate fluid ± (menstruating girls may develop cloudy or blood-stained PD fluid)
- Abdominal pain ±
- Fever ±
- History of line break / contamination ±
- Septic shock ±
- Increased vomiting ± (especially noted in babies)
- Non-specific signs and symptoms (especially noted in babies).

Assessment

- Send a single bag of PD fluid effluent for cell count and differential, Gram stain and MC&S. Also ask for an eosinophil count if the white blood cell count is >100 x 10^6/litre
- NB: Unless child's clinical presentation requires urgent action, ensure the effluent has been dwelling for a minimum of 2-4 hours before collecting the sample, to improve culture yield
- Blood investigations: FBC and differential, CRP
- Blood cultures if clinically indicated
- Assess PD exit site and send swab for MC&S. If infected, order abdominal ultrasound to exclude tunnel infection.

Diagnosis

Features strongly suggestive of peritonitis include peritoneal fluid analysis (uncentrifuged specimen and dwell time of >2 hours) revealing:

- WBC >100 x 10^6/litre or
- WBC >50-100 x 10^6/litre and clinical features suggestive of peritonitis
- In both the above cases treatment should be initiated
- Negative Gram stain does not exclude peritonitis.

In doubtful cases when there are:

- 50 -100 WBC x 10^6/litre and the patient is asymptomatic, repeat specimen culture in 4-6 hours
- WBC in peritonitis are usually >50% neutrophils. If the differential count is predominantly lymphocytes fungal peritonitis should be considered
- Positive PD culture usually develops in 24 hours.

Treatment

- Methicillin resistant organisms (MRSA) will require systemic treatment (e.g. vancomycin) and will need to comply with local infection control policies
- Initial treatment regimens for peritonitis should include cover for bacterial gram-positive and gram-negative organisms including Pseudomonas species until the result of culture and antibiotic sensitivities are obtained
- Intraperitoneal administration of antibiotics is superior to IV dosing for treating peritonitis; intermittent and continuous dosing of antibiotics are equally efficacious
- Once culture results and sensitivities are known, antibiotic therapy should be adjusted as appropriate
- For patients with substantial residual renal function (e.g., residual glomerular filtration rate 5 mL/minute/1.73 m^2), the dose of antibiotics must be adjusted accordingly
- Treatment guidelines are from the peritoneal dialysis-related infections recommendations at www.PDIconnect.com.

Treatment in the first 48 hours

If there are only local signs or minor systemic illness use both intraperitoneal vancomycin and amikacin until Gram stain or culture of PD fluid is available:

- Vancomycin 25 mg/L IP
- Amikacin 25 mg/L IP
- Heparin 200 u/L IP
- Nystatin oral suspension 100,000 iu bd for the duration of antibiotic treatment.

If severe systemic illness, initially use both IV vancomycin and amikacin until Gram stain and culture is available. Initial doses of parenteral antibiotics:

- Vancomycin 10 mg/kg IV stat
- Amikacin 15 mg/kg IV stat
- Modify treatment according to results of culture and sensitivity
- In most cases, discharge home is possible after 3-4 days of treatment
- Continue treatment at home with bags spiked with antibiotics and heparin, prepared by experienced nursing staff every 48 hours
- Treatment should be continued for 14 days for culture positive and culture negative peritonitis, and 21 days for Staph aureus
- If the PD fluid WBC is persistently >100 x 10^6/litre reassess the exit site and repeat fluid and exit site MC & S.

Eosinophilic peritonitis

- Should be considered in an asymptomatic patient with cloudy dialysate and when >10% of WBC in PD fluid consists of eosinophils
- It is usually benign and resolves spontaneously over 2 to 6 weeks
- Most occur after catheter insertion or during the treatment phase of peritonitis
- May be associated with peripheral blood eosinophilia
- Treat with oral anti-histamines
- Rarely, it may occur in association with fungal and parasitic infections.

Recurrent Peritonitis

Consider risk factors

- Revisit the exchange technique and consider burn out
- Tenckhoff catheter, exit site or tunnel infection - swab the exit site and obtain an ultrasound scan of the tunnel
- May need a further course of oral antibiotics (up to 6 weeks) according to sensitivities
- An infected superficial cuff can be exteriorised and shaved. If the inner cuff is involved it will need catheter replacement
- Staph. aureus infection: Take a nasal swab for Staph carriage for both carers and patient. If positive use intranasal mupirocin (Bactroban) bd for one week.

Fungal peritonitis

Children at risk

- Frequent broad-spectrum antibiotic usage
- Gastrostomy (but no significant relationship).

Treatment

- Start treatment with fluconazole 12 mg/kg IV once daily for 48 hrs decreasing to 6 mg/kg/ day (max dose 200 mg daily) for a total of at least 2 weeks. Then continue with oral fluconazole for further 4 weeks
- Most Candida albicans are sensitive to fluconazole. If not responding, change to liposomal amphotericin B 1mg/kg as a daily IV dose (monitor cultures for sensitivities)
- Catheter removal as soon as possible
- Start HD until PD can be reinitiated. Preferably rest the peritoneum for 3 months if possible.

Indications for removal of the catheter

- Severe intra-abdominal sepsis and septic shock
- Exit site or tunnel infection due to the same organism as that causing the peritonitis
- A recurrence with the same organism within 4 weeks of stopping therapy (i.e. relapsing peritonitis)
- Persistently raised WCC after 3 to 4 days if the infection is severe, or 7 days if the infection is mild
- The child remains symptomatic after 3 to 4 days.

After the catheter has been removed

- Antibiotics should be continued for a minimum 5 to 7 days
- A new catheter can be inserted at a minimum of one week after all clinical evidence of peritonitis has subsided, providing Staphylococcus aureus carriage has been eliminated and any infection in the catheter tunnel has resolved
- Ideally, the peritoneum should be rested for 4 weeks (3 months for fungal peritonitis)
- If there has been a tunnel infection with abdominal wall sepsis, catheter replacement needs to be delayed until this has healed.

Technical issues

Assessment of membrane function

Knowledge of the transport capacity of the patient's peritoneal membrane is required to be able to write an optimal dialysis prescription. For this purpose a peritoneal equilibration test should be done with an exchange volume scaled to the body surface area and peritoneal membrane surface area of the child.[4,5]

PD solutions

- Should meet the requirements of the European good manufacturing practice and the European Pharmacopoeia Monograph "Solutions for Peritoneal Dialysis". Manufacturing facilities are required to meet the relevant standards (ISO 9001/2 and EN 46001/2)
- Glucose is the standard osmotic agent in most dialysis solutions e.g. Dianeal 1.5 % and 2.5 %
- Higher glucose concentrations should be avoided as it results in more damage to the peritoneal membrane and eventually membrane failure and failure of the technique
- Glucose degradation products in dialysis solutions damage the peritoneal membrane in the long term
- High glucose concentrations are also associated with increased absorption of glucose which results in the development of obesity, hyperinsulinism and dyslipidaemia
- The rate of absorption of glucose from the peritoneum varies and affects the length of time for which the gradient remains effective
- To improve ultrafiltration, dialysis fluid with higher glucose concentrations or shorter dwell times are used
- Standard dialysis solutions contain lactate which contributes to peritoneal fibrosis
- Newer solutions contain bicarbonate in a separate bag which can be mixed into the main solution just before instilling into the peritoneum. It is associated with less pain during filling and less injury to the peritoneal membrane
- The sodium concentration in dialysis fluid is usually 132 - 134 mmol/L. Children may need sodium supplementation particular those with ongoing renal tubular salt losses or diarrhoea
- Dialysis fluids with two different calcium concentrations are available i.e. 1.75 mmol/L and 1.25 mmol/L
- The latter is mostly used in children who receive large doses of calcium-containing phosphate binders or in those with increased levels of blood ionised calcium.

Determination of exchange volume

- The fill volume in children should be scaled to body surface area
- In children >2 years the target volume should be 1000-1200 ml/m^2 body surface area
- In patients receiving automated PD the exchange volume can be gradually increased to the upper limit of 1200-1400 ml/m^2
- In children <2 years an initial dwell volume of 600-800 ml/m^2 should be used
- Maximal volume is determined by intraperitoneal pressure.

Assessment of PD adequacy

- Dialysis prescription should be individualised for each patient
- Treatment goals are aimed at improving the overall clinical status of the patient
- Consider ultrafiltration, water and sodium balance, and blood purification of components including urea and phosphate
- Current recommendations are a combined peritoneal and kidney Kt/V_{urea} of ≥ 1.8
- When calculating V, sex-specific nomograms should be used
- Clinical indications of inadequate dialysis include congestive heart failure, hyperphosphataemia, excessive calcium-phosphate product, overt uraemia (pericarditis or pleuritis) and clinical and biochemical signs of malnutrition or wasting.

Comorbidities associated with chronic kidney disease (CKD)

Mineral bone disorder

May manifest with hyperparathyroidism and associated with radiological signs of active bone disease or with adynamic bone disease with growth failure.

Main factors associated with hyperparathyroidism include: high serum phosphate level, low serum calcium level and metabolic acidosis.

For the more information on the comorbidities and the management of comorbidities see.[6-8]

Training of the carer

- Two family members or caregivers should be trained to ensure continuous treatment and to decrease the burden of PD care
- Teenagers should be encouraged to take a more active role in their own dialysis
- Staff of the PD clinic should be available to give support to caregivers in the event of "emergencies" like touch contamination, catheter malfunctions, etc.
- PD training should be performed by an experienced PD nurse with paediatric training
- A standardized teaching plan with learning objectives should be used
- The educational material must be written at an elementary level to ensure that it can be understood by most caregivers
- Retraining should be provided to all caregivers at regular intervals
- PD technique should be evaluated after development of peritonitis.

Handwashing

- Handwashing is the most important step to prevent contamination and infection
- Caregivers must be taught to wash their hands thoroughly before any care procedures
- Hands must be dried completely with a clean towel
- Plain soap and water is used for initial washing, then, after thorough drying, an alcohol-based liquid or gel should be applied to the hands
- Caregivers should be made aware of how clean hands are contaminated accidentally by touching dirty surfaces (like touching the tap, etc.).

References

[1] Verrina E, et al. A multicenter experience on patient and technique survival in children on chronic dialysis. Pediatr Nephrol 2004; 19:82-90

[2] Leonard MB, et al. A prospective cohort study of incident maintenance dialysis in children: an NAPRTC study. Kidney Int 2003; 63:744-755

[3] Stylianou KG, et al. Selecting the optimal peritoneal dialysis catheter. Kidney Int 2014; 85:741–743

[4] Warady BA, et al. Peritoneal membrane transport function in children receiving long-term dialysis. J Am Soc Nephrol 1996; 7:2385-91

[5] Van Biesen W, et al. Evaluation of peritoneal membrane characteristics: clinical advice for prescription management by the ERBP working group. Nephrol Dial Transplant 2010; 25:2052-62

[6] KDIGO 2012 Clinical practice guideline for the evaluation and management of chronic kidney disease. Chapter 3: Management of progression and complications of CKD. Kidney Int Suppl 2013; 3:19-62

[7] KDIGO Clinical practice guideline for anemia in chronic kidney disease. Kidney Int Suppl 2012; 2:279-335

[8] KDOQI Clinical practice guideline for nutrition in children with CKD: 2008 update. Kidney Int 2009; 53 (3, Suppl 2):S11-S104.