CUSUM application in Nephrology: Tenckhoff Catheter insertion and renal biopsy

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CRC Serdang
1 October 2009
Why Tenckhoff?
PD or HD as first choice for RRT

- Preservation of RRF
- Haemodynamic stability
- Virus transmission
- Incidence of bacterial infections
- Anaemia and EPO needed
- QoL with home based therapy
- Outcome of renal transplantation
- Patient survival
Percent distribution of prevalent dialysis pts by modality, 2005  USRDS

PD  HomeHD  HD
Global dialysis modality used

Dialysis Patients

- HD
- PD

1300
158
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
FIG 2: Mode and Location of Dialysing Patients at 31st Dec, 1997-2006

Method and Location of Dialysing Patients at 31st Dec, 1997-2006

Proportion of patients

- Centre HD
- Home and office HD
- CAPD

Year
1997 1999 2001 2003 2005

FIG 2: Mode and Location of Dialysis Patients at 31st December in Malaysia 1997-2006 Source: Malaysian National Renal Registry Report 2006
Why is PD utilization low?

- Poor outcome
- Bias
- Bad press?
Peritoneal Dialysis utilization

- Underutilized
  - Bias by Nephrologists
  - Not offered to patients
  - Clinical team may have lack of experience, suboptimal results
  - Por reimbursement system
- Like most therapy, poor application (usage)=poor outcomes
  - Patient selection bias
  - Dose of dialysis required not prescribed
  - Lack of knowledge (clinical staff)
  - Patient education facility inadequately staffed
- Technologies may be good but may be poorly applied=poor outcomes
  - Patient selection
  - Dialysis prescription
  - Patient education and understanding
  - Patient support services inadequate
Malaysia

- Long waiting time for insertion for PD catheter by surgical colleague
- Lack of in centre nephrologist
- Shortage of trained PD staff
- PD is inferior
- Perception that peritonitis is extremely common
- Archilles’ heel- Tenckhoff catheter survival
AUDIT

• Duration from January to end of August 2003
• Divided to first and second 4 months
• Combined data
Months of January to end of April 2003

- Total procedures: 26
- Primary failure (unable to be used at first trial: < 10 days): 14 (54%)
- Complications within 10 days, but functioning: 4 (15%)
  - Leaking: 2 (50%)
  - Tunnel infection: 1 (25%)
  - PD peritonitis day 5: 1 (25%)
- No complications: 8 (31%)
JANUARY TO APRIL 2003

Primary Failure: 15%
Complications but functioning: 31%
No complications: 54%
Audit from May to end of August 2003

- Total procedures: 28
- Primary failure (unable to be used at first trial: < 10 days): 8 (29%)
- Complications within 10 days, but functioning: 4 (14%)
  - Leaking: 4
- No complications: 16 (57%)
MAY to AUGUST 2003

- Primary Failure: 57%
- Complications but functioning: 14%
- No complications: 29%
Primary Failure
Complications but functioning
No complications

Jan-April 2003

May-August 2003
Total for the duration of 8 months, Jan to August 2003
Total for the duration of 8 months (2003)

- Total procedures: 54
- Primary failure (unable to be used at first trial: < 10 days): 22(41%)
- Complications within 10 days, but functioning: 8(15%)
- No complications: 24(44%)
Total Cumulative

- **44%** Primary Failure
- **41%** Complications but functioning
- **15%** No complications
TENCKHOFF IN THIS INSTITUTION…..

• Primary Failure
  – 1 in 2.5 patients

• No complications
  – 1 in 2.25 patients

• Functioning but with complications
  – 1 in 4
History

Clinical Application of Peritoneal Dialysis:

- 1923 Georg Ganter  
  PD was first used in humans at the U of Wurzburg
- 1934 Rosenak  
  Treatment of ATN in human
- 1938 Rhoads  
  Treatment of ESRD with IPD

Clinical Application of Peritoneal Catheter:

- Initial use  
  Metal tubing to access peritoneum
- 1952 Arthur Grollman  
  Flexible catheter (temporary)
- 1959 Paul Doolan  
  Polyethylene catheter (long-term)
- 1968 Henry Tenckhoff  
  Silicon catheter with 1 or 2 cuffs
Early design and concept

- The first application of Peritoneal Dialysis occurred as early as 1923. Georg Ganter of Germany instilled between 1-3 litres of a sterile physiologic solution with dextrose through a needle in a female patient who suffered from renal failure after childbirth and let it dwell between 30 mins and 3 hours.
- The woman initially recovered and blood chemistries improved.
- He however sent the patient home and she died.
- The principles of peritoneal dialysis
  - Importance of adequate access
  - Sterile solutions
  - Fluid removal by dextrose concentrations
  - Dwell time and fluid volume affect clearance

Are all credited to Georg Ganter
Arthur Grollman

- Arthur Grollman in 1952 described the first application of intermittent peritoneal dialysis that we use today, 1 L infusion of sterile physiologic fluid instilled and drained by gravity.
- Also designed the first catheter with side-holes.
Russel Palmer and the first Cuffed PD Catheter

- Designed the first single cuffed catheter along with Quinton.
- Exit site sealed to prevent bacterial migration.
Henry Tenckhoff- The father of Peritoneal Dialysis

- Helped to simplify the concept of peritoneal dialysis.
- Introduced home peritoneal dialysis using a RO system with a PD fluid concentrate instilled using a simplified solenoid cycler.
- Designed the 2 cuff Peritoneal Dialysis catheter (both coiled and straight) with dacron felt cuffs to help prevent bacterial migration and introduced a trocar for easy placement of the catheter.
Methods of Tenckhoff Catheter Insertion

- **Tenckhoff Catheter**
  - Surgical Techniques
    - Open Method (Blind)
    - Laproscopic Placement
  - Physician Techniques
    - Blind Trocar Placement (Seldinger Technique)
    - **Peritoneoscope Method**
    - Fluroscopy (Seldinger Technique)
<table>
<thead>
<tr>
<th></th>
<th>Peritoneoscope</th>
<th>Laparoscope</th>
<th>Open Surgical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (mm)</td>
<td>2.2</td>
<td>3-10</td>
<td>-</td>
</tr>
<tr>
<td>Operator</td>
<td>Physician/S</td>
<td>Surgeon</td>
<td>S/P</td>
</tr>
<tr>
<td>OT Room</td>
<td>Yes</td>
<td>Definite</td>
<td>Yes</td>
</tr>
<tr>
<td>Procedure Room</td>
<td>Yes</td>
<td>No</td>
<td>Possible</td>
</tr>
<tr>
<td>Anaesthesia</td>
<td>LA</td>
<td>GA</td>
<td>LA/GA</td>
</tr>
<tr>
<td>Poor GA Risk</td>
<td>Yes</td>
<td>No</td>
<td>Possible</td>
</tr>
<tr>
<td>Anaesthetist</td>
<td>No</td>
<td>Yes</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Incision/puncture</td>
<td>1 (1-3cm)</td>
<td>2-3 (1-3cm)</td>
<td>2 (5cm)</td>
</tr>
<tr>
<td>Op Time (min)</td>
<td>20-30</td>
<td>45</td>
<td>30-45</td>
</tr>
<tr>
<td>Insufflation</td>
<td>Air</td>
<td>CO2</td>
<td>-</td>
</tr>
<tr>
<td>Tissue manipulation</td>
<td>minimal</td>
<td>more</td>
<td>most</td>
</tr>
<tr>
<td>Direct visualization</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Immediate use</td>
<td>Yes</td>
<td>Maybe</td>
<td>No</td>
</tr>
<tr>
<td>Leak</td>
<td>minimal</td>
<td>minimal</td>
<td>more</td>
</tr>
<tr>
<td>Pain</td>
<td>↓↓</td>
<td>↓</td>
<td>most</td>
</tr>
<tr>
<td>Complexity</td>
<td>Simple</td>
<td>Complex</td>
<td>Mix</td>
</tr>
<tr>
<td>LOS</td>
<td>&lt;24 hours</td>
<td>&gt;24 hours</td>
<td>2-3 days</td>
</tr>
<tr>
<td>Break-in Time</td>
<td>&lt;=1 week</td>
<td>&gt;=2 weeks</td>
<td>&gt;=2 weeks</td>
</tr>
<tr>
<td>Previous surgery</td>
<td>Yes/No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Obese</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Catheter Salvage</td>
<td>Possible</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Pros and Cons
Pros

• Ability to directly visualise IP structures is advantages to catheter placement
• Operator can avoid bowel loops, adhesions, and omentum
• Determine the most suitable site for catheter placement
• Neither the rectus sheath/muscle nor the parietal peritoneum is incised, and the initial puncture is only 3mm in diameter
• The layers of abdominal wall remain intact and tightly opposed to the catheter and cuff after placement
Complications

• Preference of one technique over another should take into account incidence of cx:
  – Pericatheter leakage
  – Exit site infection
  – Tunnel infection
  – Catheter survival
  – Costs, ease and timely insertion
  – Mortality risk (GA)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Peritoneoscope</th>
<th>Surgery</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peritonitis (&lt;2 weeks)</td>
<td>2/72 (2.6%)</td>
<td>9/72 (12.5%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Exit site leak</td>
<td>1/76 (1.3%)</td>
<td>8/72 (11.1%)</td>
<td>0.002</td>
</tr>
<tr>
<td>Bowel perforation</td>
<td>1/76 (1.3%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bladder perforation</td>
<td>0</td>
<td>1/72 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Survival (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 months</td>
<td>77.5</td>
<td>62.5</td>
<td>0.02</td>
</tr>
<tr>
<td>24 months</td>
<td>63</td>
<td>41.5</td>
<td>0.01</td>
</tr>
<tr>
<td>36 months</td>
<td>51.3</td>
<td>36</td>
<td>0.04</td>
</tr>
<tr>
<td>Overall catheter failure rate</td>
<td>32.8%</td>
<td>55.2%</td>
<td>0.003</td>
</tr>
</tbody>
</table>

- Decreased tissue dissection with peritoneoscope
- Extensive dissection (incision/splitting the rectus sheath/muscle as well as incising the parietal peritoneum) in the surgical technique lead to loose attachment of the catheter to the abdominal wall, hence increasing pericatheter leaks, subsequent tunnel infection and peritonitis, and catheter loss
Catheter Advancement

Peritoneoscope
- Direct inspection of the peritoneal cavity and identification of suitable site for intra-peritoneal portion of the catheter
- Much smaller scope 2.2mm
- 1 small peritoneal puncture
- Device to advance the cuff into the muscle
- Air insufflation
- Local anaesthesia
- Procedure room

Open
- Catheter advancement into peritoneal cavity by feel

Laparoscope
- 3-10 mm scope
- 2-3 punctures
- CO2 insufflation
- GA (anesthetist)
- Proper OT room (more OT staff)
- Delays and restriction inherent in this system and increase costs
<table>
<thead>
<tr>
<th></th>
<th>nephrologist</th>
<th>surgeon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time* (days)</td>
<td>6.4 ± 0.9</td>
<td>34.3 ± 1.6</td>
</tr>
</tbody>
</table>

*, time between initial contact with operator and PD catheter insertion

Asif et al. AJKD 42:229-233, 2003
• B’coz of minimal tissue dissection:
  – Post op course is brief
  – Catheter can be used immediately for overnight IPD
  – Shorter break-in time
Previous abdominal surgery

• Peritoneoscope identifies adhesions, assesses their extend, and determines suitable site for catheter placement
• PD catheter insertion can be successfully performed in this population with high (>95%) success rate

GA vs LA

Mortality risk from GA varies (ASA physical status categories)

<table>
<thead>
<tr>
<th>Class</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>minimal risk</td>
</tr>
<tr>
<td>II</td>
<td>3 per 1000</td>
</tr>
<tr>
<td>III</td>
<td>1.8%</td>
</tr>
<tr>
<td>IV</td>
<td>7.8%</td>
</tr>
</tbody>
</table>

(mild to moderate systemic disturbances: HPT, DM, anemia)

- ESRD usually have multiple complex and advanced medical problems
- Avoiding GA and its inherent risk is a major advantage
Summary

• Minimally invasive
• Use LA
• Relatively easy to perform
• In ambulatory setting
• Less costly
• Avoid risks associated with GA
Does Peritoneal Dialysis Catheter Insertion by Interventional Nephrologists Enhance Peritoneal Dialysis Penetration?

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Department of Nephrology, Serdang Hospital, Jalan Puchong, Kajang, Malaysia

ABSTRACT

Traditionally peritoneal dialysis (PD) catheter was implanted by surgeons using mini-laparotomy or open technique in Malaysia. We introduced peritoneoscopic Tenckhoff catheter insertion technique since the beginning of our PD program. Data were collected from the start of our PD program in February 2006 until April 2008. All Tenckhoff catheters were inserted by nephrologists using the peritoneoscope technique. We also compare the penetration rate of PD versus hemodialysis (HD) in our center, as well as comparing to national PD penetration rate. There were 83 patients who underwent 91 peritoneoscope Tenckhoff catheter insertion procedures from March 2006 until April 2008. The patients were mostly female (66%) with the mean age of 51.99 ± 1.78 years and the majority (67%) of them were diabetics. All together there were 749.7 patient-months at risk and the overall peritonitis rate was 1 in 93.7 patient-months. The 1-year catheter survival was 86.5%. Primary catheter failure (defined as failure of the catheter within 1 month of insertion) occurred in 16 procedures (17.6%). The main cause of catheter malfunction was catheter tip migration and omentum wrap. The penetration ratio of PD when compared with HD in our center is 44.8%, which is about 4.5 times the national average. With our integrated care approach where nephrologist was heavily involved from the outset of renal replacement therapy discussion, PD access implantation to the assistance of spoke person to whom new patient can identify with, we were able to achieve PD penetration rate which far exceeds that of the national average.
Establishing Learning Curve for Tenckhoff Catheter Insertion Using CUSUM Analysis: How Many Procedures and in Which Situation?

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¹Department of Nephrology, Serdang Hospital
²CRC, HKL
Introduction

• Peritoneal dialysis (PD) catheter insertion success rate is known to vary among different operators, and may be influenced by many factors such as patients and various situations.
• The traditional approach to Tenckhoff catheter insertion in PD patients by surgeon has been by mini-laparotomy or open technique.
• With recent advances in endoscopic instrumentation and video capabilities, peritoneoscope Tenckhoff catheter insertion has become a viable approach to interventional nephrologists initiated PD access programme.
• Previously it was demonstrated that nephrologist initiated peritoneoscopic PD access program has a positive impact on PD penetration in our centre
• This technique has been shown to be associated with better primary success rate, superior catheter survival, lesser post op pain, shorter hospital stay, and shorter catheter break-in time when compared to conventional surgical technique
• the role of peritoneoscope Tenckhoff catheter implantation by interventional nephrologists is still perceived to be relatively new, investigational by some, and many nephrologists and surgeons alike remain skeptical of the value of this recent option
• The crucial questions frequently raised were how many procedures one need to perform before one is considered competent and who can be credentialed to perform or supervise trainee performing this procedure
Cumulative summation (CUSUM) is a type of monitoring tool that recently gained acceptance in the medical field.

- Answer the question as to how many procedures that is required to be done before a nephrologist can be credentialed to perform PD catheter insertion independently.
- Able to assess the performance and competency of new trainee, it also allows us to pick-up unacceptable performance earlier.
Introduction:
• QA of medical practice requires assessment of doctors’ performance
• Informally via a system such as peer review or more formally via one such as credentialing

Objective:
• Assessing doctors’ competence by application of CUSUM technique in monitoring doctors’ performance
Methods

• We have prospectively analysed the survival of all consecutive Tenckhoff catheters implanted in our centre.
• Data were collected prospectively from the start of our PD programme on 21st February 2006 until 6th April 2008.
• All catheters were implanted by nephrologist using peritoneoscopic technique (Y-Tec® system from Medigroup with a 2.2mm peritoneoscope and disposable VP210 STD set) (See Photo 1 and Photo 2).
• All catheters implanted were coiled, double-cuffed Tenckhoff catheters.
• The standard chronic catheter care with povidone iodine dressing was employed.
• Patients are admitted the evening before their operation and given Hibitane solution for their baths.
• Abdomens are shaved as necessary.
• Patients are reassessed for scars, hernias and hydroceles on the day prior to the operation and informed consent is taken.
• On the day of the operation they are given iv Cefuroxime 1.5g STAT on call to the operating theater. All procedures are done in an Operating Theater setting under strict aseptic techniques.
• Most patients opt for the operation to be carried out under local anaesthesia with moderate sedation (monitored anaesthetic care). Sedation is administered by the Nephrologist performing the procedure with the help of the nurses.
• We generally use a combination of Fentanyl and Midazolam to moderately sedate the patient and produce some degree of post procedural anaesthesia. (Figure 2)
• Local anaesthesia is also administered with lignocaine being the agent of choice. Patients opting for the procedure to be done under general anaesthesia will have their anaesthesia administered by the Anesthesiologist in charge of the theater.
Description of Technique Used: Procedure

1. Breaching the abdomen with Quill Assembly
2. Distending the abdomen with air using insufflator
3. Checking the position with Peritoneoscope
4. Advancing catheter & Implantation of the cuff
5. Catheter position in abdominal cavity
6. Subcutaneous Tunneling
7. Proper position of deep and superficial cuff
8. Final position
Results

Survival of Tenckhoff catheters were analyzed using the Kaplan-Meier Method to determine survival of catheters inserted for CAPD. A total of 129 catheters were inserted in 120 CAPD patients in Hospital Serdang from the period February 2006 up to April 2008. The 1 year catheter survival rate was 89.19% (See Graph 1).
<table>
<thead>
<tr>
<th>Cause of ESRD</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Mellitus</td>
<td>67.5%</td>
</tr>
<tr>
<td>Chronic GN</td>
<td>6.0%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>6.0%</td>
</tr>
<tr>
<td>NSAIDS</td>
<td>2.4%</td>
</tr>
<tr>
<td>Reflux Nephropathy</td>
<td>1.2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>16.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>51.99 ±1.78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>33.7%</td>
</tr>
</tbody>
</table>
Figure 1: Kaplan Meier plot showing survival of Tenckhoff Catheters inserted via Peritoneoscope Method for CAPD patients at Hospital Serdang. 1 year Tenckhoff Catheter Survival for patients in our centre is 86.45%.

12 Month Kaplan Meier survival of Tenckhoff catheters at Hospital Serdang via Peritoneoscope Method = 86.45%
We applied CUSUM charting to assess doctor’s performance of peritoneoscopic Tenckhoff catheter insertion. CUSUM chart is a graphical representation of the trend in the outcome of a series of consecutive procedures. At acceptable levels of performance, the CUSUM curve is flat, while at unacceptable levels of performance, the curve slopes upward and eventually crosses a decision interval, h. When this occurs, the CUSUM chart indicates unsatisfactory performance. When this happens, the doctor being monitored is required to determine and correct the cause of unacceptable performance. The CUSUM monitoring scheme is then restarted. Restart should theoretically be at 0, but one often restart at h as the new x-axis, so the raising CUSUM chart can be obtained to represent the learning curve that is typically seen for trainee
Acceptable Level of Performance

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Catheter Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable level of performance</td>
<td>0.25</td>
</tr>
<tr>
<td>Unacceptable level of performance</td>
<td>0.40</td>
</tr>
<tr>
<td>Reference value k</td>
<td>0.322</td>
</tr>
<tr>
<td>Average run length and corresponding h</td>
<td>IC-ARL=48.2</td>
</tr>
<tr>
<td></td>
<td>OC-ARL=15.1</td>
</tr>
<tr>
<td></td>
<td>h-2.00</td>
</tr>
</tbody>
</table>
Table 2: Design for CUSUM Charting for Tenckhoff Catheter Insertions

<table>
<thead>
<tr>
<th>#</th>
<th>Specifications</th>
<th>Parameter</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Outcome measure</td>
<td>Catheter Failure</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Acceptable level of performance $\pi_1$</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Unacceptable level of performance $\pi_2$</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Reference value $k$</td>
<td>0.322</td>
<td>Calculated by “anygeth.exe” based on specified $\pi_1$ and $\pi_2$.</td>
</tr>
<tr>
<td>5.</td>
<td>Average run length and corresponding $h$</td>
<td>•IC-ARL=48.2</td>
<td>Calculated by “anygeth.exe”, see justification.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>•OC-ARL=15.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>•$h=2.00$</td>
<td></td>
</tr>
</tbody>
</table>
• *h*, h is the decision interval
• When the sequence of CUSUM exceeds h, the CUSUM monitoring scheme is said to signal, indicating that an unacceptable level of performance has occurred
• When this happens, the doctor being monitored is required to determine and correct the cause of the poor performance
• The CUSUM monitoring scheme is then restarted. Restart should theoretically be at 0, but one often restart at h as the new x-axis, so the raising CUSUM chart can be obtained to represent the learning curve that is typically seen for trainee
### Justification

Results from “anygeth” for $k = 0.322$

<table>
<thead>
<tr>
<th>$h$</th>
<th>IC ARL</th>
<th>OC ARL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>10.9</td>
<td>5.7</td>
</tr>
<tr>
<td>1.00</td>
<td>13.1</td>
<td>6.4</td>
</tr>
<tr>
<td>1.50</td>
<td>32.9</td>
<td>11.9</td>
</tr>
<tr>
<td>2.00</td>
<td>48.2</td>
<td><strong>15.1</strong></td>
</tr>
<tr>
<td>2.10</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Graph shows the upward CUSUM chart of a consultant and a trainee nephrologist for a series of 42 and 58 procedures, respectively. The consultant’s upward CUSUM curve is flat, indicating his performance has met the specified standard. In contrast, the trainee’s upward CUSUM curve was rising initially. The CUSUM crosses the decision interval (h) for the first time at the 8th procedure, indicating failure to meet the specified standard. Nevertheless, he is making progress from then on, his upward CUSUM curve appears to level off after the 23rd procedures, indicating his performance has met the specified standard for the procedure.
TABLE 3: Placement of catheters directed towards the left iliac fossae in patients undergoing peritoneoscope Tenckhoff catheter insertion is associated with lower rates of primary catheter failure. Realising our initial results we switched to placing most catheters directed to the left iliac fossae of our patients with far better results.

<table>
<thead>
<tr>
<th>Direction of Catheter</th>
<th>Primary Catheter Failure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Right Iliac Fossae</td>
<td>8(50.00%)</td>
</tr>
<tr>
<td></td>
<td>8(50.00%)</td>
</tr>
<tr>
<td>Left Iliac Fossae</td>
<td>8(10.67%)</td>
</tr>
<tr>
<td></td>
<td>67(89.33%)</td>
</tr>
</tbody>
</table>

Chi-Squared Test p<0.01
Figure 3: Kaplan Meier plot showing survival of Tenckhoff catheters inserted via Peritoneoscope Method for CAPD patients at Hospital Serdang based on placement direction of catheter. 1 year Tenckhoff catheter survival for patients in our centre for catheters directed to the Left Iliac Fossa is 94.6%. For catheters directed to the Right Iliac Fossa, our catheter survival is 48.6%.
Discussion

• It is a basic human nature that a person engaged in a repetitive task will improve his performance over time.
• CUSUM analysis is a statistical and graphical tool that can be used to track the success and failure of a technical skill and examines trends over time.
• It can be used to demonstrate proficiency in a newly learned technical skill or as a measure of quality assurance once a technical skill has been mastered such as determining whether or not a trainee has achieved competency in a particular skill.
• The CUSUM analysis in our study showed an acceptable learning curve by trainee was achieved after 23 procedures, with less than 25% primary failure rate

• We also demonstrated the importance of self monitoring and quality control as we were able to pick-up unsatisfactory performance (higher failure rate for right iliac fossa approach versus left iliac fossa approach) much earlier with continuous CUSUM monitoring

• With the experience gained from this learning curve and subsequent adoption of left iliac fossa approach we were able to achieve PD catheter survival rate of 94.6%
• Learning curve had been studied extensively in numerous surgical fields
• 25 operations were needed to achieve an acceptable speed in performing appendicectomies, open cholecystectomies and inguinal hernia repairs
• Proficiency at intraoperative cholangiography was evaluated during laparoscopic cholescystectomies
• Surgical residents during their first month of anesthesia rotation were put in CUSUM analysis on intubation
• Technical proficiency of a single endoscopist in performing ERCP was studied and a success rate of 90% was achieved for selective cannulation after 100 procedures and 120 interventions
• In Malaysia, it has been used as a monitoring tool to measure the performance and competency of doctors performing endoscopic retrograde pancretography, breast and renal biopsy, thyroidectomy and instrumental delivery successfully
Conclusion

- we advocate that quality control of Tenckhoff catheter insertion is performed using CUSUM charting as described to monitor for:
- primary catheter dysfunction (i.e. failure of catheter function within 1 month of insertion)
- primary leak (i.e. within 1 month of catheter insertion)
- primary peritonitis (i.e. within 2 weeks of catheter insertion)
- The proposed acceptance failure rate for primary dysfunction in our centre is currently 10% (25% previously), primary catheter leak 10% and primary peritonitis rate <5%
- We propose that future Tenckhoff catheter insertion programmes in Malaysia will adopt the same QA programme and standards set
What Acceptable Level of Performance?
Results of Audit: for the duration of 8 months (2003)

• Total procedures: 54
• Primary failure (unable to be used at first trial: < 10 days): 22(41%)
• Complications within 10 days, but functioning: 8(15%)
• No complications: 24(44%)
Total Cumulative

- 44% Primary Failure
- 41% Complications but functioning
- 15% No complications
TENCKHOFF IN THIS INSTITUTION…..

- **Primary Failure**
  - 1 in 2.5 patients

- **No complications**
  - 1 in 2.25 patients

- **Functioning but with complications**
  - 1 in 4
Acceptable Levels of Performance

• One month failure rate:
  – Acceptable 25% (15%)
  – Unacceptable 40% (30%)

• Leaking rate (immediate or catheter break)
  – Acceptable 10% (5%)
  – Unacceptable 20% (10%)

• Infection (peritonitis, exit site, tunnel tract)
  – Acceptable 5%
  – Unacceptable 10%
Establishing Learning Curve for Tenckhoff Catheter Insertion by Interventional Nephrologist Using CUSUM Analysis: How Many Procedures and in Which Situation?

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ABSTRACT

Peritoneal dialysis (PD) catheter insertion success rate is known to vary among different operators, and peritoneoscope PD catheter insertion demands mastery of a steep learning curve. Defining a learning curve using a continuous monitoring tool such as a Cumulative Summation (CUSUM) chart is useful for planning training programs. We aimed to analyze the learning curve of a trainee nephrologist in performing peritoneoscope PD catheter implantation with CUSUM chart. This was a descriptive single-center study using collected data from all PD patients who underwent peritoneoscope PD catheter insertion in our hospital. CUSUM model was used to evaluate the learning curve for peritoneoscope PD catheter insertion. Unacceptable primary failure rate (i.e., catheter malfunction within 1 month of insertion) was defined at >40% and acceptable performance was defined at <25%. CUSUM chart showed the learning curve of a trainee in acquiring new skill. As the trainee became more skillful with training, the CUSUM curve flattened. Technical proficiency of the trainee nephrologist in performing peritoneoscope Tenckhoff catheter insertion (<25% primary catheter malfunction) was attained after 23 procedures. We also noted earlier in our program that Tenckhoff catheters directed to the right iliac fossae had poorer survival as compared to catheters directed to the left iliac fossae. Survival of catheters directed to the left iliac fossae was 94.6% while the survival for catheters directed to the right iliac fossae was 48.6% (p < 0.01). We advocate that quality control of Tenckhoff catheter insertion is performed using CUSUM charting as described to monitor primary catheter dysfunction (i.e., failure of catheter function within 1 month of insertion), primary leak (i.e., within 1 month of catheter insertion), and primary peritonitis (i.e., within 2 weeks of catheter insertion).
Thank You