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LAPAROSCOPIC TENCKHOFF CATHETER INSERTION USING AN IMPROVISED PRE-PERITONEAL TUNNELING TECHNIQUE UNDER CONSCIOUS SEDATION – 1 YEAR OUTCOME

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ABSTRACT

Background: Peritoneal dialysis (PD) catheter dysfunction is one of the reasons for PD dropout. Tenckhoff Catheter (TC) functional longevity will improve PD outcomes. This series aims to study the safety and feasibility of laparoscopic TC insertion using an improvised pre-peritoneal tunnelling technique under conscious sedation.

Methods: Retrospective observational study of patients underwent laparoscopic TC insertions using the proposed improvised preperitoneal tunneling technique under conscious sedation.

Results: The mean age of the patients was 51.10 (SD=13.43) years old. Patients' mean body mass index was 25.44 (SD=4.27) kg/m^2. The procedure was performed on 115 patients, 78 (67.8%) had previous abdominal surgery. 15 (13.0%) required catheters reinsertion using this technique due to non-functioning existing TC inserted via a different method. 3 (2.6%) of the patients developed primary catheter dysfunction. At one year post procedure the catheter survival rate was 97.3%, with a patient survival rate of 87.0%. At the time of writing, median catheter survival was 16.5 months.

Conclusion: Laparoscopic TC insertion using this pre-peritoneal tunneling technique under conscious sedation is able to yield satisfactory catheter functionality, particularly for patients with a history of abdominal surgery, all while avoiding the risks associated with general anesthesia.

Keywords: Peritoneal dialysis, Tenckhoff catheter, ESRD

INTRODUCTION

Chronic kidney disease (CKD) prevalence throughout Malaysia is 15.48%[1]. Despite having the second highest population, of 3.9million[2]. Sabah had the lowest dialysis prevalence compared to other states at 115 per million population (pmp) in 2018[3]. The state of Negeri Sembilan had the highest dialysis prevalence at 389pmp in the same year[3] for a population of 1.2million[1]. Multiple factors have contributed to this situation, including a scarcity of physical facilities for in-center hemodialysis (HD) and the challenging economic status of Sabah, which is recognized as the poorest state in Malaysia.

To improve the dialysis accessibility and provide optimum dialysis for end stage kidney disease (ESKD) population in Sabah, we opted to maximize peritoneal dialysis (PD) utilization as an immediate solution. PD is non-inferior as a kidney replacement therapy (KRT) to HD and has additional benefits at least during the initial years of dialysis[4,5,6]. Sabah adopted a "PD preferred" policy, whereby PD is prescribed as the initial dialysis modality for all ESKD patients who do not have an absolute contraindication for PD[6,7,8]. The success of this policy is determined by timely Tenckhoff catheter (TC) insertions with acceptable complications and success rate. Nephrologist-initiated PD catheter programs are noted to improve PD utilization[9].

There are many TC insertion modalities, namely, peritoneoscopic[9,10], Seldinger without imaging[11], Seldinger with imaging[12], laparoscopic and mini-laparotomy. Each technique has its pros and cons in terms of the resources required, learning curve, as well as procedure and catheter related complications[13]. The best outcome, in terms of primary failure rates reported, is following the advanced laparoscopic technique[14]. ESKD population generally have other co-morbidities which render them high risk for general anesthesia (GA). Although laparoscopic surgery is conventionally performed under GA, TC insertions using this modality under conscious sedation have been reported in literature[15,16].

The nephrology department in collaboration with the departments of general surgery and urology identified a strategy to perform laparoscopic TC insertions using an improvised pre-peritoneal tunneling technique under conscious sedation. We propose this technique as a modality of TC insertion that can be safely performed following adequate training to increase its availability across the country.

AIM

To evaluate the safety and feasibility of the proposed technique, we aim to analyze the primary failure rate and complication rate associated with this approach.

METHODOLOGY

This is a retrospective observational study of who underwent successful laparoscopic TC insertions using the improvised pre-peritoneal tunneling technique under conscious sedation at our center. This procedure was performed by two general surgeons and two interventional nephrologists between September 2020 to August 2022. The series started off in September 2020 but halted subsequently due to the COVID-19 pandemic and was resumed in March 2021. The patients were followed up till they completed one year. This minimally invasive technique allows inspection of the peritoneal cavity and catheter placement under direct vision thus translating to a shorter hospital stay and lower rates of inadvertent injuries[17]. Concerns regarding TC migration and omental wrap were addressed by the pre-peritoneal tunnelling component of this technique that provided fixation of the catheter in the pelvis.

Statistical analysis

All numerical data are summarised in mean and standard deviation or median and interquartile range depending on the data normality distribution. Categorical data are presented in frequencies and percentage. The one year patient survival rate is computed by the number of surviving patients at one year after the TC insertion divided total number of enrolled patients at the beginning of the study. All analyses were done by Microsoft excel version 16.78.

Patient selection:

All ESKD patients that agreed for CAPD as the modality of KRT we included in this study.

Patient preparation:

Patients, are pre-operatively screened for Methicillin-Resistant Staphylococcus Aureus (MRSA). Bowel preparation is done with laxatives and the bladder is emptied prior to the procedure. A prophylactic antibiotic is administered 1-2 hours before the procedure[18]. Vital signs monitoring and oxygen supplementation are provided.

Sedation and Analgesia:

The procedure is performed under intravenous (IV) sedation and analgesia as well as local anaesthesia (LA) for field block. IV Midazolam and IV Fentanyl are given in boluses by a trained resident to achieve a score of 3 to 4 on the Rikers Sedation-Agitation Scale. Patient's consciousness level, pain score, cardiac monitoring, and vital signs are monitored at regular intervals.

OPERATIVE TECHNIQUE:

1. TC entry point is identified and marked using the location of TC internal cuff as a guide when the base of the TC curl is placed at the level of the symphysis pubis.

2. Patient is placed in the supine position with both arms laid out and cleaned and draped in the usual manner.

3. A forward-oblique 30-degree, 5mm laparoscopic telescope and a 5-mm working port is used. The camera port is inserted either at infra / supra-umbilical regions or at the Palmer's point. Insertion site is tailored optimally for each patient based on their past surgical scars and body habitus. Initial access to the peritoneal cavity is gained using the open (Hasson) method[19,20] and a 5mm camera port is inserted before creation of pneumoperitoneum using carbon dioxide. Low pressure and flow settings at 6-8mmHg and 4L/minute respectively are used.

4. Diagnostic laparoscopy is performed taking note of adhesions, course of bilateral inferior epigastric vessels, inguinal hernial orifices and important anatomical landmarks, namely, median umbilical ligament, bilateral medial umbilical ligaments and the bladder (fig 1a). If the diagnostic laparoscopy findings deem the patient suitable for TC insertion, a field block is given at the pre-determined entry point before infiltration of the pre-peritoneal space with LA under direct visualization.

5. Pneumoperitoneum is desufflated temporarily and the entry site is cut-down until the rectus sheath. A stab incision is made on the rectus sheath to allow a 13Fr dilator to be inserted.

6. Pneumoperitoneum is re-insufflated and the dilator is advanced through the rectus muscle in a rotatory movement until the tip is seen tenting the peritoneum. The dilator is directed caudally and medially towards the ipsilateral medial umbilical ligament along the pre-peritoneal space. LA is infiltrated into the space via the dilator before it is advanced in a similar rotatory manner to create a pre-peritoneal tunnel. Infiltration of the pre-peritoneal space with LA provides the patient with better pain relief besides facilitating the safe passage of the dilator by hydro-dissection (fig1b) which prevents injury to the peritoneum and inferior epigastric vessels as well as creating a tamponade effect to prevent bleeding from capillaries (fig1c).

7. The peritoneum is perforated just lateral to the medial umbilical ligament at the level of the

bladder dome and an 18G guidewire is inserted via the dilator (fig1d) before the dilator is removed and reinserted over the guidewire along with a peel-away-sheath.

8. Once the sheath is within the peritoneal cavity, the dilator and guidewire are removed and a double-cuffed, coiled TC on a stylet is advanced through the sheath to be placed at the pelvis under direct vision (fig1e).

9. The sheath is peeled away (fig1f) and the stylet is removed. Pneumoperitoneum is desufflated and the internal cuff is embedded below the anterior rectus sheath. Flow is tested with 50 – 100cc of sterile water and the catheter is tunneled subcutaneously in the usual manner. Flow is tested again before the incisions are closed.

RESULTS

A total of 135 procedures attempted. 20 patients were excluded as 11 cases were abandoned due to severe adhesion,8 were successfully inserted without pre-peritoneal tunnelling due to inability to achieve adequate pneumoperitoneum and 1 was lost to follow-up. Patient demography and characteristics are as shown in Table 1. 115 patients underwent successful TC insertion with pre-peritoneal tunnelling without any major complications (Table 2). None of the patients developed vasovagal attack during the procedure as we conclude might be due to the low pressure and flow setting we used[1]. 78 (67.8%) of the patients had previous abdominal surgery, with 37 (47.4%) of them having adhesions at the previous scar site. 7 patients developed minor complications, 1 subcutaneous hematoma, 2 exit site bleeding and 4 leaking during training all of whom were treated conservatively. The 4 patients who developed leaking was rested for 2 weeks and CAPD training was restarted. The rest of the patients started PD on day 10 onwards as per our standard local protocol. 4 patients developed surgical site infection at the entry and exit site respectively within the first month. The peritonitis rate was 0.037 episodes per year. 3 (2.6%) patients developed primary catheter dysfunction. All the three catheter dysfunction occurred during training period. The number of catheters removed < 3months due to refractory peritonitis or exit infection were 0 and >3months due to refractory peritonitis or exit site infection were 3 (2.6%). Patient survival rate was 87.0% (n =100), the catheter survival rate for mechanical dysfunction alone was 97.3% (n=112) and mechanical dysfunction with infection related was 94.6% (n=109) at 1 year. No mortality was related to the procedure. Median catheter survival was 16.5 months at the time of writing.

Table 1. Demographics and patient characteristics

Total number of procedures	135
Insertion with PPT	115
Abandoned	11 (severe adhesion)
Insertion without PPT	9 (unsafe to proceed with tunneling)
Lost to follow-up	1
Gender	
Male	43.5% (n =50)
Female	56.5% (n =65)
Age, mean	51.1 (range 20-74)
Primary disease	
Diabetes mellitus	62.6%
Hypertension	20.8%
GN	13.2%
Others	3.4%*
Underlying disease	
Heart disease	12.3%
Dyslipidemia	39.5%
BMI (kg/m^2), mean	25.45kg/m2
≤ 24.9	36.5% (n=42)
25.0-29.9	52.2% (n=60)
≥30.0	11.3% (n=13)
Previous Abdominal surgery	
Pfannenstiel Caesarean section	n=29
Lap cholecystectomy / Appendicectomy/ BTL	n=6
Previous TC Insertion	n=28
Appendectomy/Cholecystectomy	n=8
Laparotomy	n=4
Previous Renal transplant	n=1
Previous Inguinal hernia	n=1
Nephrectomy	n=1
TC removal and reinsertion	15 (Catheter dysfunction – 11 omental wraps, 3 entangled in the bowel, 1 extraperitoneal) **

*Others – Renal stones, ADPKD

**Previous method (10 Seldinger without imaging, 2 Seldinger with imaging and 3 Peritoneoscope)

PPT – pre-peritoneal tunnelling; FSGS – focal segmental glomerulosclerosis; GN –glomerulonephritis; BMI – body mass index

Table 2 : Outcome

Adhesion at previous insertion site	47.7% (n= 37)
Complications	
Subcutaneous hematoma	n=1
Exit site bleeding	n=9
Leaking during training	n=4
Surgical site infection <1 month	n=4
Exit site infection < 1month	n=4
Primary catheter dysfunction	n=3
Catheter removed d/t ESI/Peri <3months	n=0
Catheter removed d/t ESI/Peri >3months	n=3
Completed Training	97.3% (n=112)
Peritonitis <1 month	1.7% (n=2)
1 year	
Patient survival	87.0%
Catheter survival	97.3% *
Catheter survival	94.6% **

* Patient who has passed away with functioning catheter and catheter removed due to refractory exit site or peritonitis has been censored

**Patients who have passed away with functioning catheter have been censored

d/t – due to; ESI- exit site infection; Peri- peritonitis

DISCUSSION

To establish a successful PD program, multiple factors play an essential role. Policy change[6,7] may result in good outcome but it has to go hand-in-hand with a strong TC insertion service[9], trained PD staff and funding to support the PD program. In terms of TC insertion, it's paramount to have a short waiting time and to be able to provide TC insertion for complex cases.

The nephrologists started contributing to TC insertion in November 2017. The modalities utilized based on patient characteristics (BMI, with or without previous abdominal surgery, type of abdominal surgery). The PD unit has been established since 1998, the number of PD patients in December 2019 was 178. Since implementing the PD-preferred policy in Jan 2020, our current PD patients are at 588 as of August 2023. It has tripled over the last two and a half years.

When a laparoscope is used only to ascertain the catheter tip position, the outcome is no different from any other catheter insertion method[22,23,24]. On the other hand, advanced laparoscopic methods that include either omentopexy, pre-peritoneal tunneling or suture fixation is associated with a significantly superior outcome compared with open insertion and basic laparoscopy[25]. A successful TC insertion is dependent on the longevity of the catheter survival by reducing the mechanical dysfunction and catheter lost due to infection [13]. Laparoscopic TC insertion under sedation with pre-peritoneal tunneling has been reported using nitrous oxide (NO) gas to create pneumoperitoneum[16].

The advantages of this method include the non-requirement for the cases to be done under GA, especially since many of the ESKD patients are high risk for GA. In addition, this technique of TC insertion requires only a single port and access to the peritoneal cavity is achieved using the Hasson method, which has a lower risk of complications[19,20]. In complex cases, diagnostic laparoscopy which is the initial step in this procedure can be used to assess the peritoneal cavity for the suitability of TC insertion. This is a particularly useful assessment for patients with history of insult to the peritoneal cavity, for example, abdominal surgery and PD peritonitis. TC survival can be ameliorated with pre-peritoneal tunneling by eliminating the possibility of catheter migration.

Reported primary failure rate for Seldinger TC insertion without imaging is 12.05 - 18.3%[26-30]. This method is suitable for most non-complex cases as the waiting time for this technique is shorter and the resources required are less compared to the other techniques. However, for patients who developed primary failure following Seldinger TC insertion technique, laparoscopic TC insertion with pre-peritoneal tunneling under sedation can be used as a modality for reinsertion of a new TC whilst being able to determine the cause for the previous failure.

The possibility of performing laparoscopic TC insertion under conscious sedation eliminates the risks associated with GA for ESKD patients, therefore allowing more such patients to benefit from its superior outcome which will also encourage these patients to choose PD as their choice of KRT. The ability to inspect the peritoneal cavity and insert the TC under direct vision increases its safety profile and prevents inadvertent vascular and visceral injuries. The utilization of laparoscopy in this technique for visualization alone with no need for instrumentation or handling of abdominal organs reduces the learning curve and further strengthens our proposition that this technique can be safely performed by surgical residents and interventional nephrologists following adequate training. This will increase the availability of this modality of TC insertion across the country in preparation for a PD-first policy in the near future and in line with the World Health Organization's vision of global access to healthcare.

CONCLUSION

Laparoscopic TC insertion under sedation with pre-peritoneal tunneling is a safe method. The low catheter dysfunction rate associated with this method allows patients to maintain CAPD effectively. In intricate cases, diagnostic laparoscopy can be utilized to evaluate the peritoneal cavity's suitability. This approach will further enhance the PD penetration in Malaysia.

ETHICAL APPROVAL

Ethical approval has been obtained for the present study from National Medical Researcher Register NMRR ID -22-00434-FPP(IIR) and approved for publication by the Director General of Health Malaysia. This study was completed in accordance with the Helsinki Declaration as revives in 2013.

INFORMED CONSENT TO PUBLISH

Written informed consent was obtained from the patients for anonymised information to be published in this article.

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