

Prevention of kinking in percutaneous tubes

ABSTRACT

Introduction Percutaneous tubes (PTs) allow permanent or temporary drainage or relieve obstruction caused by blockages or abnormal narrowing of openings or ducts. There is risk of PT kinking due to rotation and bending of the soft tube at the distal end during movement. Despite anchoring and dressing, indentation of the tubing occurrence results in impeded flow of fluid that may lead to infection risk. Aside to discomfort and pain, patients will likely require medical intervention and longer hospital admission. An average of 9–10 cases per month of PT damage were reported in our department.

Aims To explore solutions to minimise the incidence of PT damage and reduce the occurrence of PT kinking.

Methods A quality improvement (QI) team conducted root cause analysis to identify causes for the prevention and management of PT kinking. A modified fishbone framework identified root causes and possible interventions. The number of kinking in PTs was monitored.

Results Lack of training in staff to manage PT, the absence of standardised way of dressing, and the soft material-based tube were three major causes identified. Intensive education with a training video for the nurses and a standardised method of dressing application reference guide over the PT were initiated. A non skin-irritant conformable gadget was applied to protect the PT. The incidence of PT kinking dropped within the first month of implementation of the solution.

Conclusion Patients with long-term PTs/catheters can benefit from the use of an inexpensive efficacious protector to prevent damage to their PTs.

Keywords tube care, catheter care, tube protector, percutaneous

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INTRODUCTION

Percutaneous tube (PT) insertion is a minimally invasive well-established procedure in which a catheter is inserted through a skin puncture into an organ such as the kidney or liver for

diagnostic and therapeutic purposes¹ to allow permanent or temporary drainage of urine, bile or abscess. PT insertion also relieves obstruction caused by blockage or abnormal narrowing of the ureter or bile duct and is used to drain abscesses². This procedure reportedly reduces morbidity and mortality compared to open surgical drainage procedures, especially in critical ill or high surgical risk patients³. Although procedural complications are uncommon, the management of PT drainage-related complications can have adverse consequences that lead to increased length of stay and associated raised healthcare costs³.

Lorenz and Thomas⁴ have discussed procedure-related complications and strategies to prevent or reduce these occurrences. Aside from procedural-related complications, blockage and slippage of PTs are commonly reported PT complications^{5,6}. Further, while the soft material of the PT facilitates patient comfort, there is the risk of kinking. Rotation and bending of the PT at the distal end are most common observations on drainage PTs. Sdrales and Benumof⁷ defined kinking of a PT as the touching of diametrically opposite sides

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of the plastic catheter alone at a point of sharp curvature, observed visually. This twisting and bending of the PT may cause temporary kinking and/or permanent indentation of the tubing, resulting in the flow of fluid in the PT being impeded. PT kinking can lead to increased risk of infection and septicemia that may require high dependency or intensive care admission. With total catheter failure, patients will require reinsertion of a new PT and treatment of potential or actual infection. Aside from experiencing additional discomfort and pain, those patients who require further medical intervention will endure a longer hospital admission.

The patency of nephrostomy PTs should be always maintained to ensure adequate flow and drainage of urine. Although care of nephrostomy PTs often focuses on proper anchoring and dressing, the PT may still twist and bend during patient movement and positioning. Complications such as kinking and prevention of PT fractures are rarely discussed or reported as being observed. Turo et al.⁸ reported the incidence of nephrostomy PT-related complications such as fracturing, kinking and blockage was 6.1% in 66 patients in their study. Figure 1 shows the types of kinking which are most likely to occur at the distal end of the catheter. Kinking results in twisting and bending of the PT, which will eventually fracture, tear and leak and become a portal for infection.

The care of the PT is a fundamental aspect of surgical nursing. Martin and Baker⁹ emphasised, in addition to suturing the PT in position on the skin, the importance of dressings over the exit site of nephrostomy PTs in consideration of patient comfort and prevention of infection. As the exit site for drainage can be inserted at a challenged anatomical site, body movements or positions may cause discomfort and dislodgement. Commercialised drain-specific dressings or simple gauze-tape methods can support the PT to prevent unintentional tugging and secures it over the patient's skin^{9,10}.

The SKATER™ drainage catheters are designed for easy insertion and patient comfort, while ensuring effective drainage flow. Within our hospital, these PTs inserted by an interventional radiologist (IR) for drainage procedures are small in diameter and flexible. Post-insertion, the ward nursing staff would keep and monitor the IR-placed dressing. Dressings over the exit sites were changed every 3 days or as per required when soaked or stained.

Although the manufacturing company claims a kink-resistance quality to the SKATER™ drainage tube, the nature of the PT's soft material may be another contributing factor to potential twisting. An observation of PT kinking/twisting incidence over the distal end of the PT and the hub connection resulting in PT fracture, was noted in our department (Figure 2). An average of 9–10 cases per month in nephrostomy PTs, biliary and abscess drains were reported over a 3-month period. However, the authors found limited literature discussing strategies regarding the prevention of kinking in PTs.

A quality improvement (QI) project was embarked upon, aiming to explore solutions to minimise the incidence of PT damage and to reduce the occurrence of PT kinking in our patient population in general surgical wards of our hospital within a 6-month period.

METHODS

The nursing team was formed to brainstorm possible causes and solutions. The team brainstormed the problem using a fishbone concept to identify the root causes of PT kinking. The fishbone concept or Ishikawa diagram¹¹ is an effective authenticated framework to brainstorm potential causes of problems, narrow the root causes, mind-mapping the quality issues to focus on problem solving. As this was a QI study with no invasive patient interventions, separate ethical clearance from our hospital ethics committee was not required.

In the root cause analysis (Figure 3), the members identified three major causes of PT kinking: the lack of training and knowledge in managing PTs among staff; the absence of a standardised way of applying a protective/anchoring dressing and; the likelihood that the soft material used in PT manufacture will kink with body movement.

The pilot project was implemented in five general surgical wards over a period of 6 months. Each of the three causative problems were addressed using brainstorming strategies.

Staff lack of training in managing PTs

Proposed intervention: A training video on PT dressing steps was disseminated to the ward nurses. Following comprehensive in-service and dissemination of the training video, the nurses were surveyed on their knowledge of

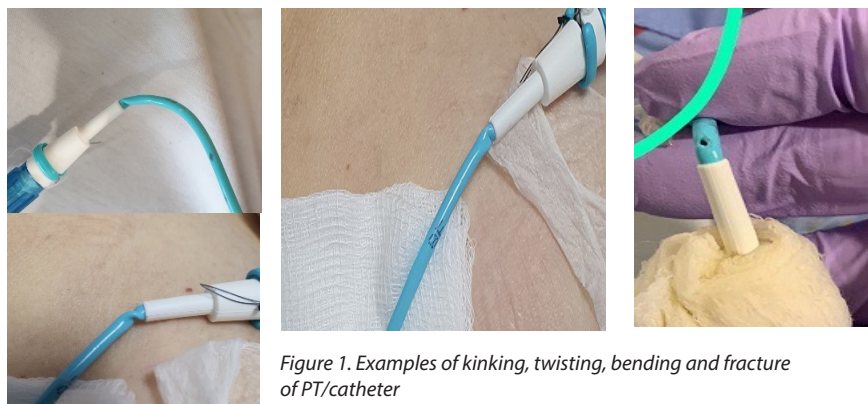


Figure 1. Examples of kinking, twisting, bending and fracture of PT/catheter

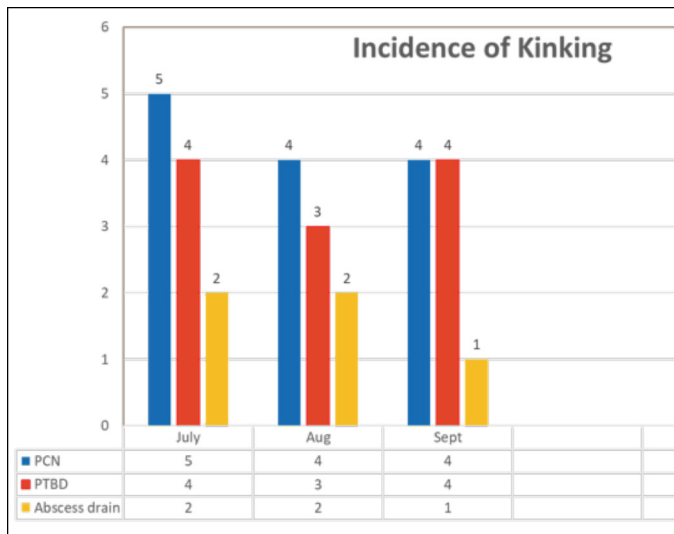


Figure 2. Incidence of kinking in PTs/catheters

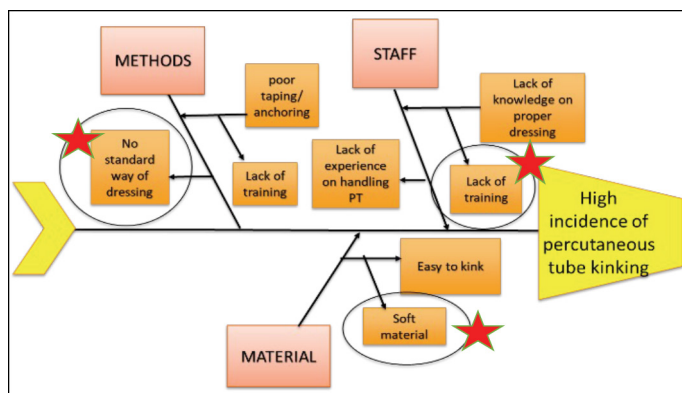


Figure 3. Root cause analysis

managing PTs (Figure 4). Responses from survey were analysed: 83.3% (n=60) answered they were still not confident in managing PTs, particularly dressing and anchoring.

The QI team also developed a quick reference guide (Figure 5) as a resource for the nurses to resolve this. However, kinking of PTs was still observed.

Lack of standardised way of dressing application over the PT

Proposed intervention: different methods of dressing and anchoring were explored (Figure 6). A non-adherent island over the exit site and film dressing over the tubing (a) was

- How confident are you to manage patient with percutaneous tube?
 - Confident
 - Not confident
- In what area do you think you need to improve on in managing percutaneous tube? You may chose more than 1 answer.
 - Dressing
 - Proper anchoring
 - Providing Caregiver Training (CGT)
- In the current practice, what are the issues you faced that needs improvement to provide effective nursing care when managing patient with percutaneous tubes. You may choose more than 1 answer
 - Anchoring of tube
 - Lack of knowledge in providing CGT
 - No standardisation of dressing
- Why do you think the issues above need to be addressed?
 - The current anchoring technique is not effective
 - Lack of teaching materials for CGT
 - No guide available for appropriate dressing application
- Do you think with proper resources, all issues will be resolved? Yes or No and why

Figure 4. Nurses' survey

applied. The second method was a large non-adherent island dressing (b) that covered both the exit site and the tubing; this was considered to stabilise the tubing. The third method was to use the commercial Grip-Lok securement device (c), which is commonly to secure urine catheters. This was applied in addition to the conventional dressing over the exit site in order to stabilise the area prone to kinking.

Although the non-adherent island and film dressing were readily available, kinking of the PT persisted at the distal end of the tubing. Likewise, despite the use of the Grip-Lok securement device, twisting of the tubing was still observed. The additional cost of the Grip-Lok securement device at S\$3.00 was another disadvantage to consider.

Likelihood of soft material kinking with body movement

Proposed intervention: the team proposed a PT stabiliser, an idea inspired from cable protectors that could protect the soft material tubing from kinking and twisting. The PT-protector (PTP) (Figure 7) was made with non skin-irritant thermoplastic polyurethane material; it was flexible yet durable. The

Figure 5. Nurses' resource guide

conformable PTP could be removed for cleaning and reapplied. The cost of the protector is minimal at 16 cents. The infection control department was consulted to discuss options of disinfection vs sterilisation. Aligned with the Spaulding classification¹², alcohol 70% can be used to disinfect the PTP before application and during each dressing change, or as deemed necessary.

Utilising the three interventions of staff training, improved standardised dressing application and PTP in conjunction with one another further education and training was conducted demonstrating the improved dressing method of management and the PTP application. The quick reference guide was revised and uploaded to the hospital education website for nurses to easily access. The effectiveness of PTP with a standardised dressing (Figure 8) in preventing kinking of PT was monitored.

RESULTS

The interventions were implemented on 100 patients with PTs or drains in five surgical wards. The incidence of PT kinking in nephrostomy PTs, biliary and abscess drains significantly dropped within the first month of implementation (Figure 9). One incident of PT bending was reported on the 3rd month post-implementation which was attributed to an improper anchoring technique. Subsequently, nil numbers of kinking/bending/twisting were observed in the next 3-month period of monitoring. The PTP device was effective in stabilising PT to prevent kinking. This initiative of PTP, together with proper anchoring and regular staff compliance audits, resulted in zero incidence of PT kinking from the month of implementation to date. At the 3-month follow-up, no primary PT infection was reported nor was any secondary infection as a result of the use of the PTP.

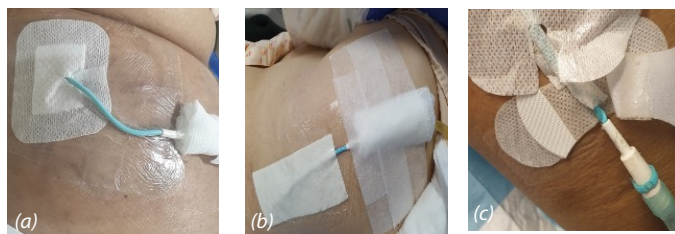


Figure 6. Dressing for anchoring
 a) Non-adherent island and film dressing
 b) Non-adherent island dressing
 c) Grip-Lok securement device



Figure 7. Tube protector



Figure 8. PTP application with standardised gauze dressing

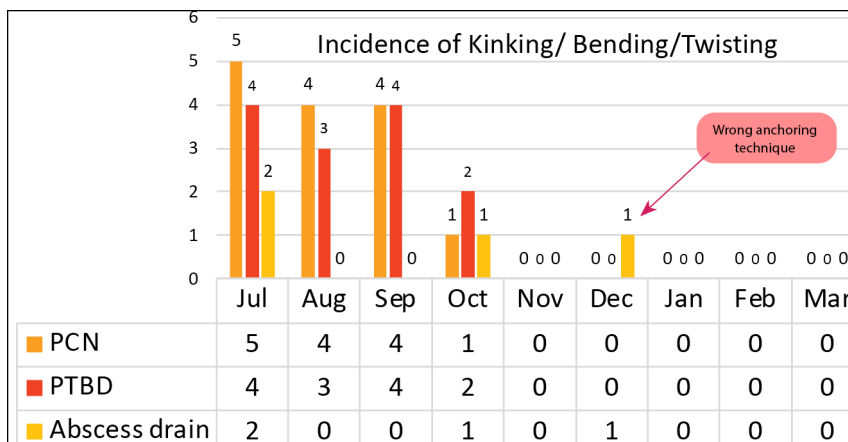


Figure 9. Effectiveness of PTP

DISCUSSION AND IMPLICATIONS FOR PRACTICE

Although most of the literature^{2-6,8} combined major and minor complications from PT placement or procedures related such as injury to adjacent structures, severe bleeding or severe infection, we found limited publications discussing the incidence or complications arising from PT kinking as result of care of PTs. However, PT kinking can impede drainage or result in fractures or tears, leading to leakage of contents¹³. As these PTs are placed for a period of duration and managed in the home care environment, correct care of the PT is imperative. Furthermore, while a soft material-based tubing is ideal for patient comfort, the pliability may have a disadvantageous potential for kinking with patient movement or positioning.

Our team believe that this is a great milestone for maintaining the target of zero-harm for patients with PT. It is recommended that staff should perform regular checks for kinking over the PT site once every shift. Nurses need to be knowledgeable on what to look out for and monitor when handling patients with PTs. Nurses play a vital role in ensuring that all patients with a PT in our facility have had a PTP device and the standardised dressing applied to prevent the incidence of PT kinking. We also recommended judicious change of the PTP weekly and cleansing of the device with alcohol 70% routinely as per the Spaulding classification process.

A reference guide for nurses was also useful to elaborate the steps of applying the PTP, with the aim of reinforcing the practice. This simple guide with illustrations was used to educate and train nurses for better understanding and compliance. A copy of the reference guide was available to the nurses on the institution's intranet. Compliance with the use of the PTP device and the standardised dressing application was also reviewed through adhoc audits and reinforcement training.

It is proposed that the incidence of PTP-related PT exit site infection can be monitored as a follow-up study to evaluate the safety and efficacy of PTP. The following potential outcomes for patients that could be measured are decreased length of stay, the need for antibiotics use, re-insertion of PTs, and avoidance of readmissions of patients discharged with PTs.

The success of this project was shared with the surgeons at the hospital's department meeting platform. The PTP concept was subsequently considered for other types of soft material-based drainage PTs or catheters. Project outcomes were also shared at the local healthcare QI conference platform with other hospitals. The project team are also considering developing an educational video on the care of drainage catheters.

CONCLUSION

Subsequent follow-up monitoring of data post-implementation of the PTP device and standardisation of dressings to secure the PT reported no incidence of PT kinking or damage. This QI project benefited patients with long-term drainage PTs/catheters; the use of this inexpensive and efficacious method prevents damage to PTs or catheters that potentially leads

to complications and increased duration of hospitalisation. Further, it can be assumed that there were facility and cost efficiencies from fewer infections, dressing procedures and replacements of PTs from kinking.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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