Dislodgement of percutaneous nephrostomy and biliary catheters: The importance of catheter anchoring technique

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Aims and objectives

Catheter dislodgement is one of the most if not the most common complication of percutaneously inserted catheters. Quoted dislodgement rates in the literature are no good reference for comparison as the time to dislodgement and proportion of catheters removed or revised before dislodgement could occur were not accounted for. This study aims to look for risk factors associated with dislodgement of percutaneous nephrostomy (PCN) and biliary (percutaneous transhepatic biliary drainage (PTBD) and cholecystostomy) catheters by survival analysis.

Methods and materials

This is a single center retrospective study. All percutaneous nephrostomy (PCN), percutaneous transhepatic biliary drainage (PTBD) and cholecystostomy catheters inserted in Radiology Department of Queen Mary Hospital in year 2012 were reviewed retrospectively. Only successful catheter placements were included.

Survival analysis was used. Information regarding duration till catheter removal (censored) or dislodgement (event), size and type of catheter, the participating radiologists, whether insertion was via old tract or new puncture and basic patient demographics was collected.

Catheter dislodgement was determined when there was obvious complete dislodgement clinically or when there was unequivocal radiological evidence that the catheter end was no longer within the intended anatomical compartment.

Catheter anchoring techniques of all the individual radiologists who anchored more than 15 catheters were also studied.

Log-Rank test was used to determine which factors had significant effect on catheter dislodgement.

Results

PCN versus PTBD versus Cholecystostomy (Fig.1)
There was a total of 466 successful percutaneous catheter insertions (PCN: 289, PTBD: 162, Cholecystostomy: 15), involving 186 patients. Estimated median time-to-dislodgement were 67 days (95% CI: 55.2 - 78.8), 73 days (95% CI: 47.2 - 98.8) and 31 days (95% CI: 1.2-60.8) for PCN, PTBD and cholecystostomy respectively. There was no statistically significant difference in rate of dislodgement between the different procedures.

Male versus Female (Fig.2)

234/466 (50.2%) catheters insertions were performed on female patients while 232/466 (49.8%) were on male patients. No significant difference in rate of dislodgement is observed between the genders.

Patient age (Fig.3)

Patients were grouped into different age groups of 10-year intervals. The majority of patients was >50 years of age while sample size of those <40 years old is small. There were no patients in the 10-19 year old group. It appears that patients younger than 50 years old may have a lower rate of catheter dislodgement.

Right versus left side (Fig.4)

All 15 cholecystostomies were performed via right sided transhepatic route. There were 170 and 119 right and left sided PCNs respectively. 9 of the 170 right sided PCNs were performed on a graft kidney at the right iliac fossa and were not included for analysis in this part. There was no left sided graft kidney PCN. For PTBD, 98 and 64 were performed on the right and left lobe of the liver respectively. No significant difference in rate of dislodgement is observed between different sides for both PCN and PTBD (Fig.3).

Catheter size and type (Fig.5)

Various sizes and types of catheters were used. Only those which were used in more than 10 occasions were included for analysis. These include the 7.0 Fr and 8.0 Fr Nephropur catheters which have non-locking pigtail ends, the 10.0 Fr Malecot catheter which has wings at its end and the 8.5 Fr Ring catheter which has a non-locking pigtail end. The Nephropur catheters were used for both PCN and external PTBD. The Malecot catheter was used only for PCN while the Ring catheter was used only for internal-external PTBD. For PCN, no significant difference in dislodgement rate is observed between 7.0 Fr and 8.0 Fr Nephropur and 10.0 Fr Malecot catheters. For PTBD, the internal-external 8.5 Fr Ring catheter showed significantly lower rate of dislodgement than the 7.0 Fr and 8.0 Fr Nephropur catheters (p<.01). This was thought to be more likely due to the longer length of catheter within the body for internal-external PTBD than external PTBD rather than due to the difference in catheter size or shape.
New puncture versus revision via old tract (Fig.6)

Some catheters were inserted by a new percutaneous puncture while some were inserted as a revision of the old catheter via guidewire exchange. 201 and 88 PCN catheters were new and revised respectively. 107 and 55 PTBD catheters were new and revised respectively. There were no cholecystostomy revisions. For both PCN and PTBD, revised catheters had significantly lower rate of dislodgement (p=.044 for PCN and p =.001 for PTBD). One possible explanation for this may be that patients who took better care of their catheters were more likely to have kept their catheters in-situ so that a revision could be performed while those who did otherwise and had dislodged catheters had to have new punctures instead. Significantly less dislodgement of revised versus new PTBD catheters was still observed after accounting for the internal-external 8.5 Fr Ring catheters.

Radiologist performing or directing catheter insertion (Fig.7)

All procedures except 10 were performed by two radiologists, a senior who performed or supervised the catheter insertion and a junior who performed the catheter anchoring. There were 17 different senior radiologists. Of these, 10 had more than 15 cases and were included for analysis. There was no significant difference in dislodgement rate of catheters between the senior radiologists.

Radiologist performing the catheter anchoring (Fig. 8)

20 different junior radiologists were involved. Of these, 12 anchored more than 15 catheters and were included for analysis. A wide range of catheter dislodgement rates with significant differences in between is observed in these different junior radiologists, likely reflecting the difference between their catheter anchoring techniques.

Catheter anchoring technique

All of the 12 junior radiologists used variations of the Roman Garter technique in anchoring the catheters. 2-O silk suture was used to hook the skin at two sites in all cases. But how the suture was tied to the catheter was highly variable between radiologists. Such variabilities included but were not limited to the number of throws per knot, number of knots per anchor, practice of squaring when tying knots, hand tying versus instrumental tying, tightness of knots and number of loops of thread around the catheter tubing between knots. Detailed analysis and comparison of these would make a whole different project on its own and would not be presented here. We would however like to present one significant finding. Visible indentations on the catheter tubing was observed only when there was only one loop of thread around the tubing between knots (Fig.9). Based on this, the different techniques were grouped into those with only one loop of thread around the tubing the those with more than one. Significantly lower rate of dislodgement was observed for those with only one (p<0.001) (Fig.10).
**Fig. 1:** Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for the different procedures (PCN, PTBD and cholecystostomy). (Duration lasted is in days.)
Gender

**Fig. 2:** Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for the different genders. (Duration lasted is in days.)
Fig. 3: Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for the different age groups. (Duration lasted is in days.)
Fig. 4: Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for different sides for PCN and PTBD. (Duration lasted is in days.)
Fig. 5: Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for the different catheter sizes and types for PCN and PTBD. (Duration lasted is in days.)
Fig. 6: Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for new punctures and revisions. (Duration lasted is in days.)
Catheter insertion was supervised or carried out by 17 different senior radiologists. Of these, 10 had more than 15 cases and were included for analysis.

Fig. 7: Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for the different senior radiologists who supervised or performed the catheter insertions. (Duration lasted is in days.)
Catheter anchoring was performed by 20 different junior radiologists. Of these, 12 radiologists anchored more than 15 catheters and were included for analysis.

**Fig. 8:** Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for the different junior radiologists who performed the catheter anchoring. (Duration lasted is in days.)

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Fig. 9: Upper image: Single loop of thread around tubing between knots. Lower image: multiple loops of thread around tubing between knots. The traditional Roman Garter technique has multiple loops of thread around the tubing. The crossing of threads resembles the crossing bands in the Roman sandals/stockings, thus the name.
One vs multiple loops of suture between knots

Fig. 10: Kaplan-Meier plot of catheter survival (remaining in-situ), case summary table and pairwise comparison table for single-loop and multiple-loop techniques. (Duration lasted is in days.)
Conclusion

The markedly different rates of catheter dislodgement between different radiologists performing the catheter anchoring suggests great importance of good catheter anchoring technique. The traditional Roman Garter technique which involves having multiple loops of thread around the catheter tubing between knots is prone to dislodgement. Having only one loop of thread around the tubing between knots was associated with a much lower rate of catheter dislodgement.

Personal information

References