

Single Centre Radiographer Advanced Practitioner led Nephrostomy Exchange Programme: 3 Year Experience

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Abstract

PURPOSE: To evaluate the technical success, radiation dose, complications and costs from the introduction of a radiographer-led nephrostomy exchange service.

METHODS: Post-graduate qualified interventional radiographers with several years' experience in performing other interventional procedures began performing nephrostomy exchanges. Training was provided by an interventional radiologist. Each radiographer performed ten procedures under direct supervision followed by independent practice with remote supervision. Each radiographer was then responsible for the radiological report, discharge, re-referral for further exchange and, where indicated, sending urine samples for culture and sensitivity. Data extraction included the time interval between exchanges, radiation dose/screening time and complications.

RESULTS: Thirty-eight long-term nephrostomy patients had their histories interrogated back to the time of the initial insertion. The mean (range) age at nephrostomy insertion was 67 (35-93) years and 65% were male. Indications for nephrostomy were prostatic or gynaecological malignancy, ureteric injury, bulky lymphoma and post-transplant ureteric stricture. A total of 170 nephrostomy exchanges were performed with no statistically differences in the radiation dose, fluoroscopy time nor complication rates between consultants and radiographers. There was, however, a statistical reduction in the time interval between nephrostomy exchanges for the radiographer group ($P=0.022$).

CONCLUSION: Interventional radiographers can provide a safe, technically successful nephrostomy exchange program with radiation doses equivalent to radiologists. This is a cost-effective solution to the capacity issues faced in many departments, whilst providing career progression, job satisfaction and possibly improved care.

IMPLICATIONS FOR PRACTICE: Radiographer-led interventional services should be considered by other institutions as a means of providing effective nephrostomy exchanges.

Abbreviations

AP – Advanced Practitioner

IR – Interventional Radiology

PCN – Percutaneous nephrostomy

RADU – Radiology Day Unit

Introduction

Percutaneous nephrostomy (PCN) was first described in by Goodwin and colleagues in 1955¹. PCN provides external drainage of urine from a kidney which is unable to drain normally into the bladder². Indications for PCN include stone disease, external compression (i.e. malignancies), surgery, iatrogenic injury amongst others³⁻⁶. Traditionally, nephrostomies are inserted percutaneously under ultrasound/fluoroscopic guidance in the interventional radiology (IR) suite². Long-term nephrostomies have an associated morbidity and mortality, as well as an associated cost³; over time crystal deposits can form on or within the tubes leading to mechanical or bacteriological complications⁴⁻⁸ warranting exchange.

Nephrostomies, within our institution, have historically been exchanged by radiologists and have required an overnight hospital stay^{2,3}. An Advanced Practitioner (AP) radiographer-led, day-case, nephrostomy exchange programme was introduced in our institution in (2017 as a means of reducing costs and improving patient experience.

Literature Review

A review of the existing literature related to nephrostomy exchange in long-term PCN patients was performed using the [NHS NICE Healthcare Databases Advanced Search](#) system; databases searched were CINAHL, PubMed and Science Direct, as well as a keyword search of [Google Scholar](#). Searches were limited to peer-reviewed journals published in English in the last 15 years.

Literature suggests that regular nephrostomy exchanges reduces complications, admissions and therefore costs, although many statements are based on expert opinion, anecdotal opinions or local preferences rather than empirically derived evidence³. Consensus around the optimum exchange frequency suggest around 60-120 days. Exchange is dependant on compliance as the preferred standard, but there is a poor evidential basis^{2-4,6-10}. Results of this literature search has demonstrated a paucity of empirical evidence with the literature related to the management of long-term nephrostomy tubes², a finding supported by the single available systematic review¹⁰.

Radiographer Advanced Practice (AP) has received favourable reports within the literature, AP is described as promoting safe and effective treatments and is similar to other, more established, areas of advanced practice¹¹⁻¹³. Although, it should be noted that there is little evidence specific to IR^{11,14,15}. Within the literature there are reports of two other centres introducing a similar services but they have yet to report any results^{2,9}.

Study aims

The aim of this project was to evaluate the technical success, radiation dose, complications and costs from the introduction of a radiographer-led nephrostomy exchange service.

Methods

In terms of background, historically patients within our institution were admitted under the Urology or Renal Transplant team either on the day, or evening prior to exchange. Patients were then typically discharged the same day or the day after exchange. Consultant radiologists began performing nephrostomy exchanges as a day-case procedure in 2016. AP radiographers took over management (database management, re-referral, microbiology, communication with GP/referrer) of the long-term PCN population in 2017.

The protocol for “Radiographer-led Nephrostomy and Gastrostomy Exchange” was approved by the institution’s clinical governance committee in April 2017. A standard exchange method was first used to confirm the position of the indwelling catheter via an iodinated contrast injection. This was followed by over-the-wire exchange and confirmation of the position of the new catheter with a second contrast injection.

Experienced AP interventional radiographers, with several years’ experience performing other interventional procedures¹⁴ and post-graduate qualifications¹⁶ subsequently began undertaking these procedures. Training was provided ‘in-house’ by a consultant interventional radiologist. Each radiographer performed ten procedures under direct supervision before ‘sign off’ which allowed for independent practice with remote supervision (radiologist on-site and available to help if needed.) The performing radiographer was then responsible for the radiological report, discharge, re-referral for further exchange and, where indicated, sending urine samples for culture and sensitivity.

The overall study population was all patients having enrolled in the outpatient nephrostomy exchange program. These patients (n=38) had their histories interrogated back to the time of the initial nephrostomy insertion. The mean (range) age at nephrostomy insertion was 67 (35-93) years and 65% were male. Indications for nephrostomy insertions were in line with the literature (prostatic or gynaecological malignancy, ureteric injury, bulky lymphoma, post-transplant ureteric stricture). All patients were long-term nephrostomy patients who required nephrostomy exchange. Comparisons would include evaluating the move from an in-patient radiologist led service to a day-case (out-patient) radiographer led service.

Data were extracted for each nephrostomy exchange (n=170) including the time interval between exchanges, radiation dose/screening time and complications. If complications arose then further qualitative data was sought from the medical notes or electronic records. These data accounted for 28,083 catheter days (19,977 pre intervention/6,203 post-intervention) spanning a period of 11 years. The primary outcome was successful nephrostomy catheter exchange (with free flow of urine) with secondary outcome measures of radiation dose, screening time and complications. Complications would include post-exchange pain and haemorrhage requiring intervention or a delay in discharge, loss of access or any unplanned re-admission.

Data Analysis

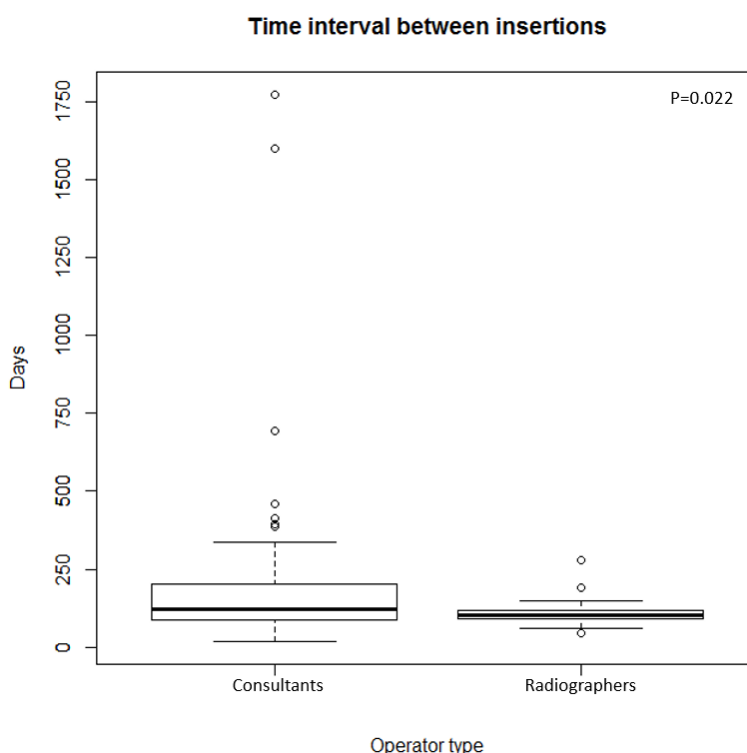
Descriptive statistics were predominantly used to describe trends between radiologist and radiographer-led exchanges. Where the data were normally distributed data were summarised as mean values plus their standard deviations. If the data were approximately not normally distributed, then median values together

with inter-quartile ranges were reported. Inferential statistics were used to compare radiologists to radiographers and when evaluating the utility of the radiology day-case service (Mann-Whitney U test and Chi-squared/Fisher Exact test).

Results

The overall median (IQR; range) time to nephrostomy exchange, regardless of operator, was 112 (89-176; 17 to 1774) days. Following the introduction of the radiographer-led service, with database management by the Radiology Department, the median (IQR, range) fell by 15% from 120 (86-203; 17 to 1774) days (radiologists) to 102 (91-119; 46 to 279) days (radiographers) and was statistically significant ($P < 0.022$; **Figure 1**). Prior to the radiographer-led service, 79 (76%) of patients waited over 90 days and 63 (61%) waited over 120 days. This compares favour with the radiographer-led group where 44 (70%) and 9 (14%) waited over 90 days and 120 days, respectively.

Figure 1. A Boxplot illustrating the differences in the time interval between nephrostomy exchanges for the Consultant and AP Radiographer groups.



Technical success was achieved in all patients (100%), for both types of operators; (125/125 consultants) and (42/42 radiographers). Both groups successfully achieved an exchange across a range of catheter situations (**Table 1**).

Table 1. Differences in the nephrostomy exchange types between operators.			
	Consultants	Radiographers	P value
Unilateral	85 (51%)	33 (20%)	0.345
Bilateral	26 (16%)	7 (4%)	
Post-transplant	14 (8%)	2 (1%)	
TOTAL	125 (75%)	42 (25%)	167
n (%). P values were calculated using the Chi-squared test.			

Fluoroscopy time (median [IQR; range]) was non-statistically ($P=0.097$) shorter for AP radiographers (1.15 [0.5-3.2; 0 to 16) seconds when compared to consultants (1.57 [1.0-4.1; 0 to 305) seconds (**Figure 2**). Fluoroscopy dose (median [IQR; range] was similar ($P= 0.236$) for AP radiographers (115.6 [35.6-206.9; 6 to 779) mGy*cm² when compared to consultants (117.6 [48.1-301.7; 8 to 2225) mGy*cm² (**Figure 3**). In terms of complications (detailed in the discussion), there were a total of four post-exchange complications (2.4%), two (1.6%) in the consultant group and two (4.8%) in the AP radiographer group ($P=0.263$). In terms of the introduction of the Radiology Day Case Unit (RADU), following introduction of this service the mean (IQR, range) interval between exchanges fell by 34% from 149 (92-209; 17 to 1774) days to 98 (81-112; 46 to 712) days ($P<0.001$).

Figure 2. An illustration comparing total fluoroscopy time between consultants and AP Radiographer groups.

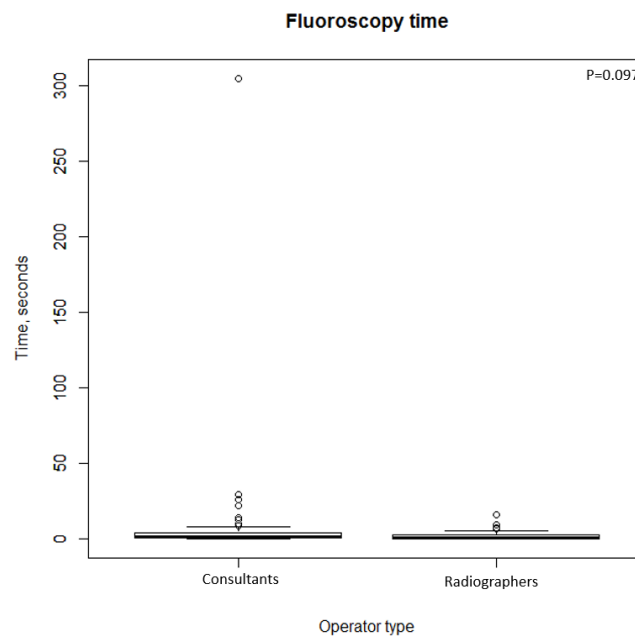
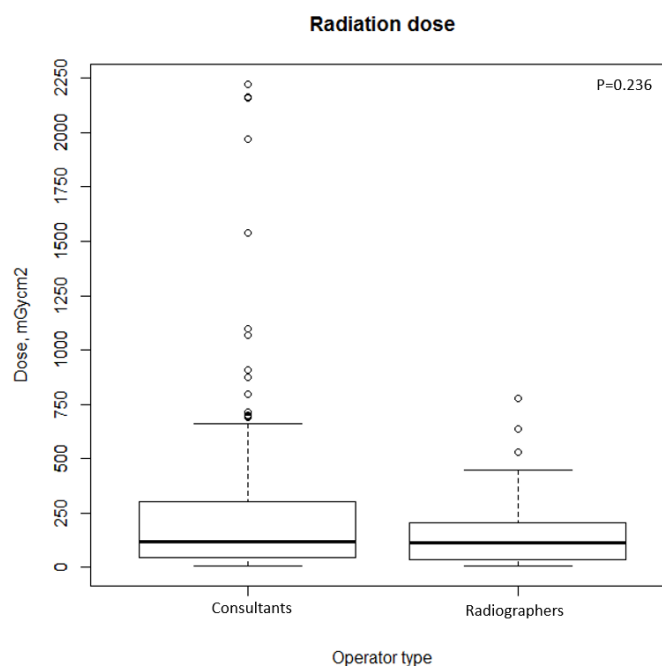


Figure 3. An illustration comparing fluoroscopy dose between consultant and AP Radiographer groups.



Discussion

The introduction of a day-case radiographer-led nephrostomy exchange programme had a 100% technical success rate, meaning no patient who has attended for an exchange and has left the department without a functioning nephrostomy *in situ*. This does not mean there have been no procedural complications. In one patient, after the hub was cut from a blocked PCN, the remaining portion of the drain migrated into the kidney. This was retrieved percutaneously through the existing nephrostomy track – with the help of a consultant radiologist and did not require hospital admission. In a second patient, previously lost to follow, the patient presented with a 13-month-old PCN which was fully encased in calculi. A second PCN was placed down the side of the existing PCN and the patient went home the same day (awaiting lithotripsy and removal of original tube). The important point from both cases is that the radiographer recognised the potential difficulty of both these procedures from the outset and sought involvement of a senior colleague. The two other ‘procedural’ complications were a drain being pulled out whilst hoisting the patient in RADU (new one reinserted immediately and patient discharged within the hour) and a blockage soon after insertion (resolved by upsizing from 6 Fr to 8 Fr drainage tube).

Our data suggests that radiology taking over the coordination and administration of this program has seen an increase in compliance with routine PCN exchanges; compliance is as important a factor as the exchange interval in improving the management of long-term PCN³. Even three years into the program patients are still being referred into the service that had previously been lost to follow-up following their initial PCN insertion. Some of these patients had been nephrostomised for over a year with no exchanges and present with tubes in a very poor condition. Under the new radiology management program referrals for exchange are generated at the time of initial PCN insertion and these outliers should be eliminated in the future.

The radiation doses from the AP radiographers were slightly lower than the consultant radiologists (**Figure 3**, not statistically significant). This may be because the radiologists still perform the more complex exchanges or that the radiographers were more mindful of their practice, this is consistent with the literature^{14,17,18} although the literature specifically on radiography AP in IR is scarce.

As has been reported in other areas of AP¹³, radiographers are able to provide high levels of patient satisfaction; although no formal qualitative data were collected in this study. Anecdotally, patients on this program reported high levels of satisfaction. They particularly like that they are seeing the same two or three APs each time, and the relationships they have built with staff members over time.

The number of patients in the program has fluctuated as individual patient’s situations change, but the current population (n=25) is not atypical. For twenty five patients requiring four exchanges per year - with an average of 1.5 bed-nights/procedure - the saving is >150 bed-nights per annum (≈£60,000)¹⁹. There are also uncaptured savings from unplanned admissions and reduced PCN related complications³; urine samples sent at the time of PCN exchange⁸ detected several urinary infections, prior to the patients becoming symptomatic, which would have likely resulted in improved outcomes.

A well-established theme in the literature was that of a shortage of radiologists²⁰ and those radiologists in post being overloaded with work and as such AP Radiographers can provide a safe, cost-effective alternative in specific circumstances^{15,16}. AP radiographers performing these procedures will free up one non-vascular interventional consultant session per week, as well as the resources previously

expended booking/clerking for the admissions. It is widely regarded that AP and role development in the allied health professions increases job satisfaction and can also improve staff retention¹⁵.

Limitations

Whilst this is the first study of its kind to quantify outcomes of a radiographer-led nephrostomy service there are a number of limitations. Results from this study are from a single centre and have not been adjusted for the complexity of the procedure, indication for PCN nor type of exchange (unilateral, bilateral or transplant-related). This initial or early data should encourage others to consider adopting a similar radiographer-led service and auditing their own practice.

Conclusion

AP interventional radiographers can provide a safe, technically successful nephrostomy exchange program with radiation doses equivalent or better than consultant radiologists. This is a cost-effective solution to the capacity issues faced in many IR departments, whilst providing career progression, job satisfaction (and possibly therefore retention) for radiographers.

Conflicts of Interest

None.

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