Application of a fluoroscopy protocol in percutaneous nephrolithotomy to decrease radiation exposure: A feasible option

Blair B, Huang G, Arnold D, Li R, Schlaifer A, Anderson K, et al. Reduced fluoroscopy protocol for percutaneous nephrostolithotomy: Feasibility, outcomes and effects on fluoroscopy time. J Urol 2013;190:2112-6.

SUMMARY

Blair et al.[1] performed a retrospective chart review of 80 patients treated with percutaneous nephrolithotomy (PCNL) by a single surgeon between 2007 and 2011 at a single academic institution. They compared data of 40 patients each treated before and after the implementation of a reduced fluoroscopy protocol. Patients underwent PCNL for large volume renal or staghorn calculi. Stone burden was assessed preoperatively by computed tomography (CT) or plain X-ray of the kidneys, ureters, and bladder. Patient demographics, body mass index (BMI), stone surface area in mm², operative time, fluoroscopy time, complication rate, estimated blood loss, transfusion rate, hospital stay, and success rate were reviewed. Percutaneous access was obtained by intervention radiologist (IR) before PCNL.

As a part of the reduced fluoroscopy protocol, preoperative imaging was displayed on high definition monitors in front of the operating surgeon throughout the case. A laser guided C-arm allowed the surgeon to center the unit over the surgical site without using fluoroscopic images for orientation. Fluoroscopy activation was timed at end expiration, the longest, and most reproducible period of the respiratory cycle, to minimize image distortion, and the need to re-image. Static images obtained during the operation were saved on the secondary screen. At the start of the procedure, a single spot film using continuous fluoroscopy at normal mAs and kVp settings was taken and saved along with a nephrostogram using half-strength contrast medium. Fluoroscopy settings were then changed using fixed, lowered mAs and kVp combined with a single pulse per second fluoroscopy to reduce the amount of radiation. In each case, a designated fluoroscopy technician educated in urological anatomy and proficient in applying the reduced fluoroscopy protocol was used. Fluoroscopy activation was done only by the primary operating surgeon using a foot pedal. A working wire and a safety wire were routinely placed using tactile and measurement cues. Preoperatively, the distance from skin to proximal ureter was measured on CT to indicate how far the dual lumen catheter needed to pass to access the ureter. Single pulse fluoroscopy was performed if there was excessive resistance or doubt of wire location. If the second wire had the same length as the first after passage, no fluoroscopy was needed to confirm the location. Tract dilatation with the balloon was guided under minimal pulsed fluoroscopy. Direct visualization was used to monitor stone fragmentation instead of fluoroscopic imaging. When no residual stones remained, a short pulse of continuous full dose fluoroscopy was administered at the conclusion of the procedure to ensure complete clearance of all stone fragments. Lastly, low dose, single pulse per second fluoroscopy was done for nephrostomy and reentry catheter placement.

Preoperative characteristics, fluoroscopy and operative time, complications and treatment success were examined using univariate and multivariate analysis. There were no significant differences in BMI, stone size, success rate, operative time, or complications between the groups. Implementing a decreased fluoroscopy protocol resulted in an 80.9% reduction in fluoroscopy time ($P < 0.001$) while maintaining success rates, operative times, and complications similar to those of the conventional technique. No complication in either group was attributable to fluoroscopic technique.[1]

COMMENTS

PCNL is one of the most common urologic surgeries. The effects of ionizing radiation and its potential to cause late cancers are well-known and with the increase in the number of PCNLs, there is a pressing need to minimize...
radiation exposure to patients as well as to the surgeon and other operation theater personnel. The practice of minimizing radiation exposure during PCNL is governed by the principal “as low as reasonably achievable (ALARA)” and it continues to evolve. This was an attempt by the authors and a reminder to the practicing urologist about how small and careful modifications can actually reduce the amount of radiation exposure, improving the safety.

In this retrospective study, the implementation of simple steps such as a laser guide, pulsed fluoroscopy, fixed lowered mAs and kVp, visual and tactile cues and a dedicated single technician were found to decrease the fluoroscopy time significantly. However, certain issues remain unaddressed. First, percutaneous access was achieved by radiologists using a combination of ultrasound and fluoroscopy, which was not included in the calculation of the fluoroscopy exposure time. This is important keeping in view that most urologists acquire renal access themselves in the operating rooms using fluoroscopy. This step carries significant radiation exposure which was not included in this study. Second, while placing the second guide wire, fluoroscopic confirmation was not obtained if the second wire had the same length as the first after placement. This may not be true in all cases since the second guide may or may not take the same path and thus requires a fluoroscopy exposure. Technical issues during surgery vary with many factors such as pelvicalyceal system (PCS) anatomy, site, and size of calculus. Although the authors analyzed size of calculus as a factor, the site and PCS anatomy was not discussed, which forms an important confounder in the interpretation of results. The authors did not discuss the need for additional intraoperative tracts to clear the calculi. If additional percutaneous tracts were needed it is not clear whether IR was available in the operative room for puncture or it was done by operating surgeon. The author also did not discuss the need of relook PCNL if any and the fluoroscopy exposure related to a second procedure. Perioperative complications such as urosepsis, drug-induced thrombocytopenia may not have relevance in comparing fluoroscopy times and treatment outcomes. Nevertheless, the simple steps that they demonstrate to decrease radiation exposure are worth implementing in the day-to-day practice by the urologist regularly performing PCNLs.\[2,3\]

REFERENCES

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