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Combined use of the blunt needle and carbon dioxide for percutaneous nephrostomy

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SUMMARY. **We describe a modified method for percutaneous nephrostomy which combines using carbon dioxide to 'opacify', and an 18-gauge blunt needle to enter, targeted posterior calyces. This technique was successfully used during a clinical trial in 50 selected patients. Technical success was 100% with a very low complication rate. This method, as well as its possible advantages and disadvantages, will be discussed.**

INTRODUCTION

Percutaneous nephrostomy (PCN) is currently a widely performed interventional uroradiological procedure. Usually either fluoroscopy with iodinated contrast in the collecting system, or real-time ultrasound, is used to localize the collecting system, and a sharp needle is used to gain access to the collecting system for PCN. Previous animal experiments suggest that the blunt needle may be less traumatic than a sharp needle, because the blunt needle tends to displace blood vessels rather than lacerating them. In other studies, carbon dioxide has been shown to be both a safe and efficacious intravascular and non-vascular contrast agent. In a selected group of patients, we evaluated the feasibility of combining the two techniques as a possible alternative method for PCN, using carbon dioxide as a collecting system contrast agent and the blunt needle as the percutaneous access device.

PATIENTS AND METHODS

A clinical trial was performed over a 2-year period during which PCN was performed in 50 patients who required either percutaneous drainage of an obstructed collecting system, or percutaneous access for further endourological procedures. The medical records and imaging studies of these patients were reviewed retrospectively. 32 (64%) were male and 18 (36%) were female. The patients' ages ranged from 11 years to 86 years, with a mean of 46 years. 12 patients (24%) received bilateral PCN. One patient (2%) had his PCN placed into a renal transplant. Indications included nephrolithiasis requiring percutaneous lithotripsy in 19 (38%), and obstruction due to metastatic neoplasm in 14 (28%), ureteral calculi in 10 (20%), benign ureteral strictures in six (12%), and a traumatic retroperitoneal hematoma in one (2%). Preprocedural ultrasound examinations demonstrated hydronephrosis in 31 (62%). Access to the collecting system via a posterior calyx was agreed upon by the attending urologist and interventional radiologist prior to the procedure. Patients specifically needing access via an anterior calyx were excluded from this study.

After receiving prophylactic intravenous antibiotics, the patients were placed in the prone position and the flank was examined with real-time ultrasound (Diasonics, Milpitas, CA) utilizing a 3.5 MHz transducer in a sterile sleeve. The renal pelvis was localized in both the transverse and longitudinal planes. The renal pelvis was chosen for this part of the procedure because it was the largest sonographic 'target'. A $4\frac{11}{16}$ inch (11.9 cm) long 25 gauge spinal needle (Becton-Dickenson, Franklin Lakes NJ) was inserted through the skin at the point directly over the renal pelvis as indicated by ultrasound, and advanced toward the renal pelvis until the hub was at the skin. During advancement, periodic fluoroscopic monitoring was used to keep the highly flexible needle from deviating from the intended path to the renal pelvis. The stylus was removed, and the needle was slowly withdrawn while aspiration was applied. When urine was obtained, 10–20 cm^3 of carbon dioxide was injected into

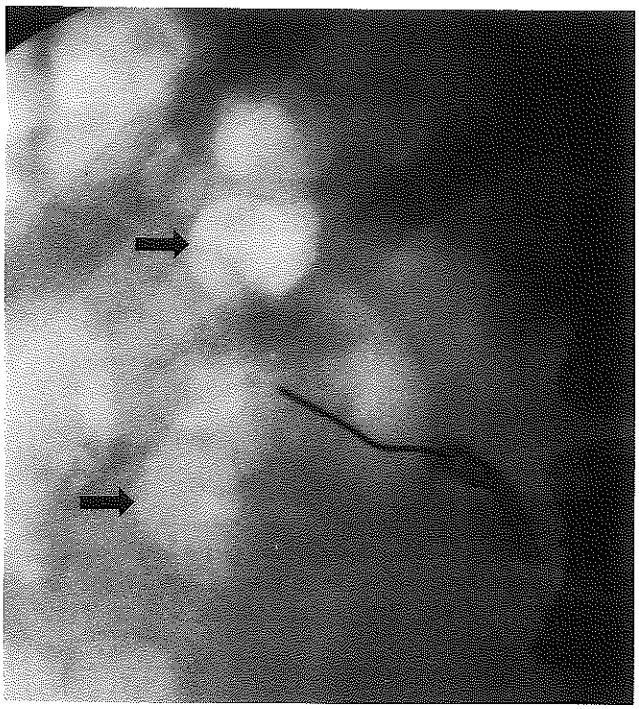

Fig. 1—Collecting system 'opacified' with carbon dioxide (arrows) through 25 gauge needle.

the collecting system under fluoroscopic monitoring until the posterior calyces, which appeared as rounded bubbles of gas, were filled (Fig. 1). No iodinated contrast was used. A multi-directional fluoroscopic unit (C-arm) was used to help differentiate gas in the collecting system from superimposed bowel gas.

After 'opacification' of the collecting system with carbon dioxide, a posterior calyx was entered with a 15 cm 18 gauge blunt needle (Cook, Bloomington, IN). This needle has a blunt stylus within an 18 gauge cannula which accepts a 0.035 inch (0.089 cm) standard guide wire. After the stylus is removed, the cannula has a flat profile with no cutting edge. The blunt needle was aligned with the target posterior calyx in such a manner that both were seen en face during fluoroscopy. After the needle was advanced into the parenchyma we would frequently see the gas within the target calyx move or change configuration as the needle was pushed directly against the calyx. When the calyx was entered a characteristic 'give' was felt.

Once in the collecting system, the blunt stylus was removed and a 0.035 inch (0.089 cm) guide wire was placed through the cannula into the system (Fig. 2). At times urine did not flow back through the cannula after the stylus was removed, presumably due to the fact that the calyx entered was filled with gas rather than urine. In this situation, the course of the guide wire and lack of resistance to its advancement would confirm correct placement. The cannula was then removed and a nephrostomy catheter was advanced over the guide wire and formed in the renal pelvis.

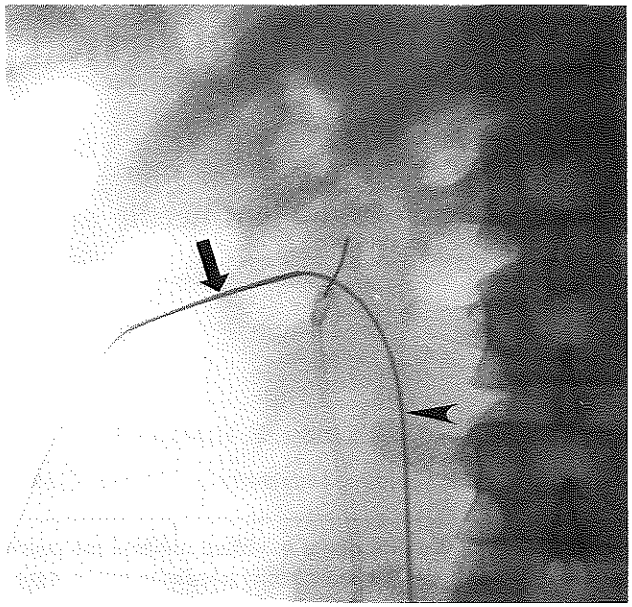

Fig. 2—Blunt needle (arrow) inserted into posterior calyx with guide wire placed down ureter (arrowhead).

RESULTS

We were successful in performing PCN in all 50 patients for a technical success rate of 100%. In one case pulsatile bleeding from the skin entrance site occurred, but ceased within minutes of PCN placement. A computed tomography (CT) scan performed immediately after the procedure showed no hematoma. The patient's urine cleared within 4 h with no change in his hematocrit. No further evidence of bleeding complications as seen in the other patients based on clinical follow-up, serial hematocrit levels, and imaging studies that were performed for other reasons.

In a few cases the 25 gauge needle tip became dislodged from the renal pelvis before the carbon dioxide syringe could be connected and the gas injected resulting in inadvertent injection into the perirenal or peripelvic space. Fortunately, this did not impede the procedure since the gas would diffuse or become absorbed within minutes allowing repeat attempts.

DISCUSSION

We undertook this clinical trial to evaluate the technical feasibility of this alternative PCN technique. The technique was based upon previous animal and human experience with the blunt needle, and separately the use

of carbon dioxide as an intravascular and non-vascular contrast agent. Although conventional methods of performing PCN are well accepted, successful, and have a low morbidity and mortality, we undertook this study because this method has potential theoretical and practical advantages.

When compared to sharp needles of the same size, the blunt needle caused less bleeding at the kidney puncture site in surgically exposed canine kidneys.[1] Similarly, fluoroscopic comparison of the two types of needles in which the renal arterial system had been opacified with barium showed that the blunt needle pushed aside arteries while sharp needles frequently lacerated them.[1] These studies suggested that the blunt needle may be a less traumatic access device. Although our study was retrospective in nature and did not directly compare the blunt needle to sharp needles, in only one case in 50 did we encounter possible arterial bleeding from the blunt needle puncture. This suggests that the blunt needle is at least as safe as sharp needles, and may be safer based on previous animal studies, though controlled human studies will need to be performed to clearly establish this.

The blunt tip did not impede our ability to enter the collecting system as we initially thought it might. We were able to penetrate the renal parenchyma in all cases, and the sturdiness of its 18 gauge size allowed the blunt needle to be placed without bending or deviating from the desired course. Once in the collecting system, the cannula prevented any buckling of the guide wire if resistance was encountered by the wire, for example in trying to negotiate past calculus. In addition, the cannula may be slightly torqued safely to aid guide wire manipulation since the cannula tip has no cutting edge unlike sharp puncture needles.

Room air has been described as a contrast agent in PCN.[2] However, we believe carbon dioxide has the potential advantage that it is innocuous if it is inadvertently injected into the renal vasculature. Because the 25 gauge needle is extremely difficult to visualize sonographically, the renal pelvis was initially entered, rather than a calyx, for carbon dioxide injection. No adverse effect on the kidney occurs if carbon dioxide is injected into the renal artery.[3] Intravascular carbon dioxide dissolves in the blood, and is expired in one pass through the lungs.[4] Using the technique, we were able to perform PCN in these selected cases using only gas as a contrast agent rather than its use as an adjunct to iodinated contrast.

There are, however, some technical disadvantages to this method. The 25 gauge needle may deviate from the intended course due to its flexibility. We chose to use a very small needle because we believed it would reduce potential injury to centrally located renal vessels. Also, since gas has a very low viscosity, it is very easy to inject gas through such a small gauge needle. Depending on the operator's preference, a larger needle (e.g. 22 gauge) could probably be used safely, and may avoid the problem of deviation of the opacifying needle. If a C-arm is not available it may be difficult to differentiate gas in the collecting system from superimposed bowel gas. Rolling the patient from one oblique position to another is an alternative, though less convenient. This study only included selected patients who required posterior calyceal access. With the patient prone, gas may not fill anterior calyces due to their dependent position. Therefore, this technique is not recommended in those instances in which a specific anterior calyx must be entered.

In conclusion, this study demonstrated that this alternative technique is technically feasible and safe. Although it is not meant to replace existing conventional PCN methods, it potentially may be a useful alternative in selected patients such as those who have had reactions to iodinated contrast, or those who have a coagulopathy or are on anticoagulant medication. Further work will need to be done to define the exact role this technique will play in the performance of percutaneous nephrostomy. A prospective, randomized study comparing this method to conventional methods seems to be justified.

References

1. Akins EW, Hawkins IF, Mladinich C, Tupler R, Siragusa RJ, Pry R. The blunt needle: a new percutaneous access device. AJR 1989; 152: 181–182.
2. Ellis JH, McKay DC, Sonda LP. Infusion of air into the collecting system to avoid needle blockage during percutaneous nephrostomy after extracorporeal shock-wave lithotripsy. AJR 1992: 158–808.
3. Hawkins IF, Mladinich CRJ, Storm B et al. Short-term effects of selective renal arterial carbon dioxide administration on the dog kidney. JVIR 1994; 5: 149–154.
4. Hawkins IF. Carbon dioxide digital subtraction arteriography. AJR 1982; 139: 19–24.

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