Letter

Int Neurourol J 2014;18:45-47
http://dx.doi.org/10.5213/inj.2014.18.1.45
pISSN 2093-4777 · eISSN 2093-6931

International Neurourology Journal
INJ

Neurologic Complications of Percutaneus Nephrolithotomy

Hakan Öztürk

Department of Urology, Sifa University School of Medicine, Izmir, Turkey

To the editor:

Percutaneous nephrolithotomy (PCNL) was first reported by Fernstrom et al. [1] in 1976. After being defined as a novel extraction technique, the method has gained popularity by urologists. The technique has evolved over time and is still being advanced today. The main goal of researchers is to reduce undesirable outcomes of the technique and facilitate interventions for complex conditions including horseshoe kidneys and ectopic kidneys. With the introduction of laparoscopy-assisted PCNL techniques in recent years, the success rate of PCNL has increased. However, it should be noted that complication rates may have increased with these recent developments. PCNL-related complications are categorized according to the Clavien classification system. This system is treatment-oriented, which allows identification of procedure-related complications and management of the condition. The primary goal of the system modification is to standardize treatment approaches for urological diseases.

PCNL-related complications vary widely from basic medical treatment and follow-up, to fatal events. The major and minor complication rate of PCNL is as high as 83% [2]. According to the Clavien grading system, grade I defines all events requiring a simple medical treatment. Bleeding requiring blood transfusion is one of the most frequently seen grade II PCNL complications (5.8%). The rate of mortality, which is defined as a grade V complication, is 0.1%. PCNL-related neurological complications are very rarely seen, with an incidence of below 0.1% (Table 1). However, such complications are of utmost importance, as they are extremely severe and early diagnosis can be difficult.

Table 1. Neurological complications of percutaneous nephrolithotomy

Temporary impairment of consciousness	Coma
Watch	Paraplegia
Sensory disturbances	Hemiplegia
Aphasia	Quadriplegia

Air embolisms were first defined as PCNL-related complications in 1984 by Miller et al. [3]. To date, the utilization of the pyelographic media, chemolytic agents, irritant solutions, and coagulating agents have been thoroughly scrutinized in the literature [3]. The first case of sudden death due to venous air embolism after PCNL was reported in 1985 [4]. Since then, air embolisms have been recognized as a complication of PCNL. In 2007, PCNL-induced paradoxical air embolism was defined. In this case, neurological complications resulted from an air embolism entering the paradoxical arterial system through a patent foramen ovale, which was essential for fetal circulation [5]. Paradoxical air embolisms may be caused by barotrauma/decompression sickness, penetrating trauma injuries, as well as during intracardiac shunting or cardiac surgery. It occurs when gas entering into the vein or the left heart and, thereby, systemic circulation, may lead to an arterial embolism [6,7]. Air embolisms are a very rare complication of PCNL. The most common causes of air embolism include direct airing of the venous system and utilization of air retrograde pyelogram during the procedure. Complication-related morbidity and mortality are associated with the air drift velocity, drifting volume pressure, patient po-

Corresponding author: Hakan Öztürk
Department of Urology, Sifa University School of Medicine,
Fevzipasa Boulevard No: 172/2, 35240, Basmane-Konak, Izmir, Turkey
Tel: +902324460880 / Fax: +902324460770
E-mail: drhakanozturk@yahoo.com.tr
Submitted: January 21, 2014 / Accepted after revision: February 19, 2014

sition during the procedure, and cardiac status [5]. The foramen ovale is necessary during intrauterine life, and is typically closed within the first two years of life. However, clinicians should be aware of a patent foramen ovale, an undiagnosed atrial septal defect, or a ventricular septal defect in children, particularly during PCNL.

Paradoxical air embolism is a major neurological complication of PCNL. Air embolisms that enter arterial circulation through a patent foramen ovale may lead to confusion, loss of sensation, and seizures. Cryptogenic stroke, which is a more serious neurological complication, should be also taken into consideration [8]. In addition, the use of medical gases such as nitrogen, nitrogen oxide, carbon dioxide, and helium have been known to cause air embolisms. Among them, water-soluble carbon dioxide has the lowest complication rate. Endoscopic surgery has been recognized as a safe treatment modality when performed in combination with pneumovesicum, a novel technique for endoscopic cross-trigonal ureteral reimplantation [9].

Standard PCNL is performed under general anesthesia in the lithotomy position for the insertion of a 6-French ureteral catheter, after placing roll cushions under the ipsilateral leg, iliac bone, and shoulder. Initial exploratory puncture is performed with an 18-gauge needle in the prone position. Then, an iodine-contrast medium is injected intravenously to view an antegrade pyelogram and the collecting system. It can be achieved under fluoroscopic guidance using semi-rigid Amplatz dilators and rigid nephroscopy with a pneumatic lithotriptor at a low pressure through irrigation with isotonic solution.

On the other hand, there is a significant difference in treatment modalities among patients with PCNL-related neurological complications and those without any complications. The most significant difference is the utilization of air instead of contrast medium to view the collecting system. The volume of the system is 10–12 mL, though 20–50 mL of air has been reportedly used in pyelography. However, there is a similarity with respect to the procedure used among the patients: all are operated in prone position under general anesthesia using an air pyelogram. Furthermore, neurological complications of PCNL are not solely associated with a patent foramen ovale, as predisposing factors that could induce such complications may be present. These include left ventricular dysfunction, a hypokinetic left ventricular wall, heart valve diseases, prolonged preoperative hypertension, a sudden drop in blood pressure in hypertensive patients, atherosclerosis, and the tendency to thrombosis [8].

In addition, the use of supportive cushions under the abdomen in the prone position and fixation cushions in the flexion position during PCNL, may result in inadequate spinal cord perfusion and, thus, ischemia. Preoperative hypotension is also a cause of increased malperfusion and ischemia. Transient spinal artery ischemia and thrombus are also associated with lengthening of the flexor and lying face-down in the prone position [10,11].

In conclusion, serious neurological complications due to PCNL such as paraplegia, hemiplegia, or quadriplegia should be kept in mind. These complications may be both a financial and emotional burden for patients and their relatives. We recommend that urologists who prefer using air to produce pyelograms during PCNL should be made aware of the possible risk of air embolism. We conclude that predisposing factors along with extensive flexion and fixation in prone position, mechanical stasis, thrombus formation, and spinal cord ischemia due to an inadequate spinal cord perfusion, establish a ground for neurological complications.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Fernstrom I, Johansson B. Percutaneous pyelolithotomy: a new extraction technique. Scand J Urol Nephrol 1976;10:257-9.
2. Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. Eur Urol 2007;51:899-906.
3. Miller RA, Kellett MJ, Wickham JE. Air embolism, a new complication of percutaneous nephrolithotomy. What are the implications? J Urol (Paris) 1984;90:337-9.
4. Hobin FP. Air embolism complicating percutaneous ultrasonic lithotripsy. J Forensic Sci 1985;30:1284-6.
5. Song SH, Hong B, Park HK, Park T. Paradoxical air embolism during percutaneous nephrolithotomy: a case report. J Korean Med Sci 2007;22:1071-3.
6. Lee JY, Jo YS, Na SJ, Lee KE, Kim YD. A case of cerebral air embolism after removal of subclavian venous catheter. J Korean Neurol Assoc 2005;23:712-4.
7. Kwon SC, Kang IG, Kim TW, Kang SC, Won S, Park JK. A case of air embolism during diagnostic hysteroscopy. Korean J Obstet Gynecol 2001;44:1922-6.
8. Basiri A, Soltani MH, Kamranmanesh M, Tabibi A, Mohsen Ziaee

 http://dx.doi.org/10.5213/inj.2014.18.1.45

SA, Nouralizadeh A, et al. Neurologic complications in percutaneous nephrolithotomy. Korean J Urol 2013;54:172-6.
9. Yeung CK, Sihoe JD, Borzi PA. Endoscopic cross-trigonal ureteral reimplantation under carbon dioxide bladder insufflation: a novel technique. J Endourol 2005;19:295-9.
10. Bhardwaj A, Long DM, Ducker TB, Toung TJ. Neurologic deficits after cervical laminectomy in the prone position. J Neurosurg Anesthesiol 2001;13:314-9.
11. Langmayr JJ, Ortler M, Obwegeser A, Felber S. Quadriplegia after lumbar disc surgery: a case report. Spine (Phila Pa 1976) 1996;21:1932-5.