Case Report

Abdominal Compartment Syndrome: A rare but fatal complication of Percutaneous Nephrolithotomy

Abstract:

Background:

Percutaneous Nephrolithotomy (PCNL) is the standard of treatment for large renal stones. Intrabdominal hypertension during PCNL due to extravasation of irrigation fluid in the peritoneal cavity may lead to organ dysfunction and may be fatal if not intervened on time.

Case Presentation:

We report a case of abdominal compartment syndrome as a complication of PCNL. After timely diagnosis, the case was managed successfully with percutaneous intraperitoneal drainage.

Conclusion:

It is imperative to be aware of raised intra-abdominal pressure during PCNL to prevent abdominal compartment syndrome and to avoid its fatal outcome.

Keywords: Abdominal Compartment Syndrome, Intra-abdominal Pressure, Peak Airway Pressure, Percutaneous Nephrolithotomy, Pigtail Drain

Background:

Percutaneous Nephrolithotomy (PCNL) is the standard treatment for large renal stones[1,1]. With increased rise of renal stone incidence, there has been a rise in PCNL but still the stone free rate and complications have been the kernel of discussion[2,3]. The outcome of PCNL is measured in terms of stone free rate and complications and the goal of this surgery is to provide maximum stone clearance with minimal morbidity. The most common complication of PCNL is fever followed by bleeding[3]. Nevertheless, other rare complications may be encountered and one of them is abdominal compartment syndrome (ACS) due to intraperitoneal extravasation of irrigation fluid. We discuss a case of ACS which occurred as complication during PCNL.

Case presentation:

A 28 year male who presented with right flank pain was found to have lower calyceal stone in ultrasound abdomen. His serum creatinine was 75 umol/L. Subsequently, he underwent CT urography (Figure 1) and mini PCNL was done in prone position. There was difficulty in puncture and the whole procedure took about 70 minutes. He had high peak airway pressure reaching upto 28 mmHg H_2O but with maintained vitals at the end of procedure. He had tremendously distended abdomen when turned supine and ultrasound abdomen revealed intraperitoneal fluid collection. Aspiration showed clear fluid. His arterial blood analysis revealed lactic acidosis. His intra-abdominal pressure (IAP) measured with intravesical perurethral catheter was 41 cm H_2O. He was not producing urine at that time. Pigtail drainage of intraperitoneal fluid was planned. At the meantime, his blood pressure gradually dropped to 75/50 mm Hg. About two litres of clear fluid was drained from the peritoneal cavity (Figure 2) and his blood pressure (BP) slowly increased to 90/70 mm Hg. His IAP dropped down to 28 cm H2O and urine output started increasing. His postoperative creatinine was 150

umol/L. He was extubated and observed in intensive care unit for one day and discharged on fourth postoperative day with normal creatinine and uneventful recovery.

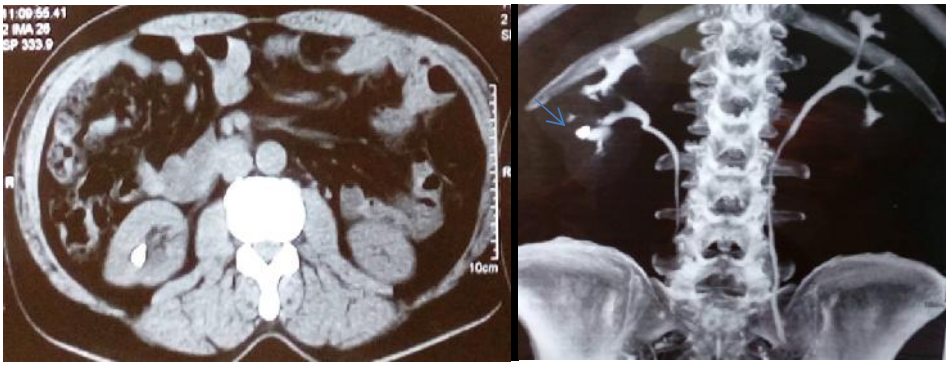

Figure 1. CT Abdomen plain (left) and CT urography (right) showing right sided lower calyceal stone

Figure 2. Placement of guidewire for pigtail drainage for the intraperitoneal collection as seen in ultrasound abdomen

Discussion and Conclusions:

PCNL is an effective modality for renal stone with overall stone free rates between 49-78% and even higher with reported rates of complication between 29% and 83%[3]. The Clinical

Research Office of the Endourological Society (CROES) PCNL group has reported complications in 20.5% of the cases with majority of complications being minor[3,4]. ACS as a complication of PCNL is rare and only few cases are reported in the literature.

ACS is defined as a sustained IAP > 20 mmHg (with or without an abdominal perfusion pressure < 60 mmHg) that is associated with new organ dysfunction / failure[5]. With direct compression, low pressure system like intestinal tract and portal-caval system collapse under high pressure. This leads to decreased venous return leading to decreased blood pressure ultimately resulting in decrease in cerebral perfusion pressure[6]. This leads to ischemia and anaerobic metabolism at cellular level with increase in lactate. There will be pressure-induced cephalad displacement of the hemidiaphragms creating a functional restriction of diaphragmatic excursion and pulmonary expansion resulting in high peak airway pressures during volume ventilation and decreases in tidal volumes when pressure modes are used[7,8].

Extravasation of irrigation fluid into retroperitoneum is a common phenomenon in PCNL. To have intraperitoneal collection, extravasation should be tremendously large enough to perforate the peritoneum. One of the reasons for large extravasation in our case may be due to use of mini-PCNL where there is high intrarenal pressure leading to increased extravasation. If there is no hydronephrosis resulting in limited space for placement of amplatz sheath in calyx, all the irrigation fluid straightway moves to the retroperitoneal space. This is aggravated by blockage of ureteric catheter and Foley catheter. In our case, the stone was located in the anterior lower calyx and there was no space in the calyx to place the Amplatz sheath. At the same time, Foley catheter got blocked leading to increased intrarenal pressure. Another reason for increased extravasation is inadvertent perforation of the renal pelvis or thinned-out renal parenchyma during puncture and dilatation of the tract or even during nephroscopy generating tremendous pressure leading to perforation. The risk of extravasation becomes high if the renal pelvis or kidney parenchyma is already weakened by prolonged

irritation or inflammation due to stone or infection. Other reasons for extravasation of irrigation fluid in the peritoneal cavity are through and through puncture and dilatation of the renal pelvis into the peritoneal cavity and misplacement of the Amplatz sheath outside the kidney into the peritoneal cavity. Furthermore, duration of the surgery plays a crucial role as the extravastion of fluid is proportional to the time taken for surgery.

Ozer et al reported difficulty in placing the dilator during pelvicalyceal intervention which, they stated, may have caused fluid leakage inside the intra-abdominal cavity[9]. Similarly, Etemedian et al found intact intraperitoneal viscera after laparotomy and in retroperitoneal exploration, there was rupture of kidney's thin and atrophic parenchyma at both poles leading to extravasation[10]. Twycross et al reported a case of abdominal compartment syndrome intraoperatively during ureteroscopy for the residual stone in a patient who had PCNL four days back[11]. The seepage of irrigation fluid through the nephrostomy tract was thought to be the cause for intraperitoneal extravasation. Tao and his colleagues also highlighted two cases of abdominal compartment syndrome after PCNL and purported that mucosal tear in the renal pelvis led to increased fluid absorption and intraperitoneal collection[12]. High-volume fluid resuscitation (>3500 ml/24 h) is known a risk factor for increased IAP[13].

It is necessary to be vigilant to detect ACS earlier as this is almost uniformly fatal with high mortality once multiorgan failure sets in[14]. The increase in peak airway pressure, tachycardia and abdominal distension are the harbinger of raised IAP as hemodynamic changes like decreased BP and oliguria may be the late signs[8]. Therefore, as the procedure is commonly done in prone position, there should be good coordination between anaesthesiologists and operating urologists to have high index of suspicion for timely diagnosis of intraabdominal hypertension.

It is crucial to be aware of raised intra-abdominal pressure during PCNL to prevent abdominal compartment syndrome and to avoid its fatal outcome.

Abbreviation:

PCNL-Percutaneous Nephrolithotomy

ACS-Abdominal Compartment Syndrome

IAP-Intra-abdominal Pressure

BP-Blood Pressure

CT-Computed Tomogram

Declarations:

Ethics approval and consent to participate- Not applicable

Consent to publish- Written informed consent was obtained from the patients for their anonymized information to be published in this article

Availability of data and materials- All data are presented in the article and additional file

Competing interests- The Authors declare that there is no conflict of interest

Funding- None received

Authors' Contributions- SP, MP, SC and PRG researched literature and conceived the study. SP, BRL, PRC and UKS were involved in data acquisition and interpretation. Manuscript was prepared by SP, BDKR and PD. All authors reviewed and edited the manuscript and approved the final version of the manuscript

Acknowledgements- None

References:

1. Labate G, Modi P, Timoney A, et al On Behalf Of The CROES PCNL Study Group J. The percutaneous nephrolithotomy global study: classification of complications. J Endourol. 2011; 25: 1275-80.

2. de la Rosette J, Assimos D, Desai M, et al. The Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy Global Study: indications, complications, and outcomes in 5803 patients. J Endourol. 2011;25:11-7.

3. Ghani KR, Sammon JD, Bhojani N, et al. Trends in percutaneous nephrolithotomy use and outcomes in the United States. J Urol. 2013; 190:558-64.

4. Soucy F, Ko R, Duvdevani M, Nott L, Denstedt JD, Razvi H. Percutaneous nephrolithotomy for staghorn calculi: a single center's experience over 15 years. J Endourol. 2009; 23:1669-73.

5. World Society of the Abdominal Compartment Syndrome. Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from the World Society of the Abdominal Compartment Syndrome. Intensive Care Med. 2013; 39:1190-206

6. Lynch FP, Ochi T, Scully JM. Cardiovascular effects of increased intraabdominal pressure in newborn piglets. Journal of Pediatric Surgery 1974; 9:621–6,

7. Walker J, Criddle LM. Pathophysiology and Management of Abdominal Compartment Syndrome. American Journal of Critical Care 2003; 12:367-71.

8. Ridings PC, Bloomfield GL, Blocher CR, Sugerman HJ.Cardiopulmonary effects of raised intra-abdominal pressure before and after intravascular volume expansion. The Journal of Trauma.1995;39:1071–5.

9. Ozer AB, Firdolas F, Aydin A. Abdominal hypertension characterised by severe haemodynamic changes as a complication of percutanous nephrolithotomy. BMJ Case Rep. 2012; doi:10.1136/bcr-2012-007646

10. Etemadian M, Shadpour P, Haghighi R. A rare, but life-threatening complication of percutaneous nephrolithotomy: massive intra-abdominal extravasation of irrigation fluid. Urol J. 2012;9:614–6

11. Twycross L, Dimovski D, Kara J. Life-threatening abdominal compartment syndrome during retroperitoneal surgery: A case report. Journal of Anaesthesia and Critical Care Case Reports. 2016; 2:15-7.

12. Tao J, Sheng L, Zhang H, Chen R, Sun Z, Qian W. Acute Abdominal Compartment Syndrome as a Complication of Percutaneous Nephrolithotomy: Two Cases Reports and Literature Review. Urology Case Reports. 2016; 8:12-4.

13. Cheatham ML. Nonoperative management of intraabdominal hypertension and abdominal compartment syndrome. World J Surg. 2009; 33: 1116-22.

14. Hecker A, Hecker B, Hecker M, Riedel JG, Weigand MA, Padberg W. Acute abdominal compartment syndrome: current diagnostic and therapeutic options. Langenbecks Arch Surg. 2016; 401:15-24.