Urology Case Reports 51 (2023) 102604

Contents lists available at ScienceDirect

Urology Case Reports

journal homepage: www.elsevier.com/locate/eucr

Endourology

Unusual complication after shock wave lithotripsy (SWL) for a renal stone: A subcapsular hepatic hematoma. A case report and review of literature

Moath K. Fentoukh *, Ali A. Alqahtani, Abdelwahab A. Salih, Abdelmoniem H. Koko

Department of Urology, Armed Forces Hospital, King Abdulaziz Air Base, Dhahran, Kingdom of Saudi Arabia

ARTICLE INFO

Keywords:
Shock wave lithotripsy (SWL)
Urolithiasis
Hepatic hematoma
Conservative measures

ABSTRACT

Urolithiasis is a common urological condition that affects around 8 per 1000 people every year. Management depends on multiple factors varying between stone related and patient related factors. In some cases, shock wave lithotripsy (SWL), one of the most popular noninvasive and safe procedures, is required where conservative measures fail. However, it can lead to life-threatening complications. Here we present rare case of hepatic hematoma in a 57-year-old female patient following SWL for right kidney stone on the 2nd day post-SWL. The patient was managed successfully with conservative measures.

1. Introduction

Shock wave lithotripsy (SWL) is one of the most commonly used treatment options for urolithiasis. It was first introduced in the year 1980.[1] In this procedure; external, extremely focused and high-intensity acoustic pulse attempts to break down the stones with minimal damage to the adjacent structures. The shearing force of the successive pressure pulses along with the cavitation bubbles formed around the stones breaks them into much smaller pieces and thus enabling those smaller pieces to pass through the ureter down to the lower urinary tract. Being noninvasive, SWL is considered as one of the safest options for management of urolithiasis. Complications following SWL arise in 3–7% of the cases; if occurs, in most of the patients, the complications are mild and rarely life-threatening.[2] As such clinically significant hematoma following SWL is rather rare, occurring in less than 1 % of the patients[3,4] and out of those clinically significant hematoma cases, only handful patients develop hepatic hematoma following SWL.[3–5] Here we present a case of clinically significant right liver lobe subcapsular hematoma following SWL done for urolithiasis. The hematoma resolved completely following conservative management and till the time of writing the case report the patient remained asymptomatic.

2. Case presentation

This is a 57-year-old Saudi female who was referred from Primary Health Clinic (PHC) as a case of chronic flank pain with a history of shock wave lithotripsy (SWL) for right renal calculi at a private set-up one year back. The patient complained of intermittent bilateral moderate flank pain more on the right side since the past 10-month that worsened by respiration. There were no other associated symptoms nor history of UTIs or spontaneous stone passage. Family history was remarkable for renal calculi. Her medical history was significant for hypertension (HTN), valvular heart disease (mitral valve prolapse and mitral regurgitation), dyslipidemia, glucose-6-phosphate dehydrogenase deficiency (G6PD) and a sickle cell trait. On examination, the patient's vitals were normal apart from slightly elevated blood pressure of 132/70 mmHg. She weighed 77kg with a body mass index (BMI) of 33.3kg/m^2 and a central obesity body habitus. General examination was unremarkable except for significant deep bilateral flank tenderness. Basic laboratory and urinalysis were normal. Initial abdominal X-ray showed multiple bilateral opacities at the level of L1-3 spinal vertebrae. Reconstructed computerized tomography (CT) scan revealed multiple bilateral non-obstructing renal calculi (Figs. 1 and 2). Patient then was counseled regarding SWL as first-line intervention or to go for other endourological measures and she preferred to start with minimally invasive with ESWL. Out of the five radio-opaque calculi in the right kidney, a single renal pelvis calculus measuring 6mm with a Hounsfield of 909 and a skin-to-stone distance of 12 cm was targeted. The machine used was Dornier and a total of 3000 shocks were delivered with a power of 5kV. The patient tolerated the procedure well with minimal pain, which was managed by simple analgesic. Patient then discharged on the same day on a satisfactory clinical condition with standard post-SWL instructions and medications including painkillers and medical expulsive therapy (MET) for stone disease.

* Corresponding author.
E-mail address: Moathalfentoukh@hotmail.com (M.K. Fentoukh).

https://doi.org/10.1016/j.eucr.2023.102604
Received 18 September 2023; Received in revised form 20 October 2023; Accepted 23 October 2023
Available online 4 November 2023

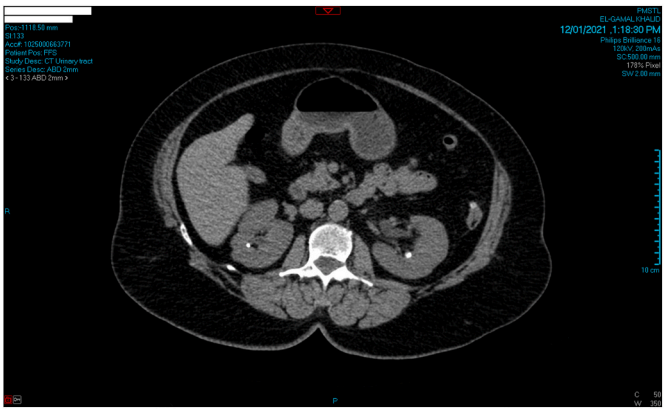

Fig. 1. MDCT of the urinary system demonstrates multiple bilateral non-obstructing small renal calculi with right renal pelvic calculus (pre-SWL).

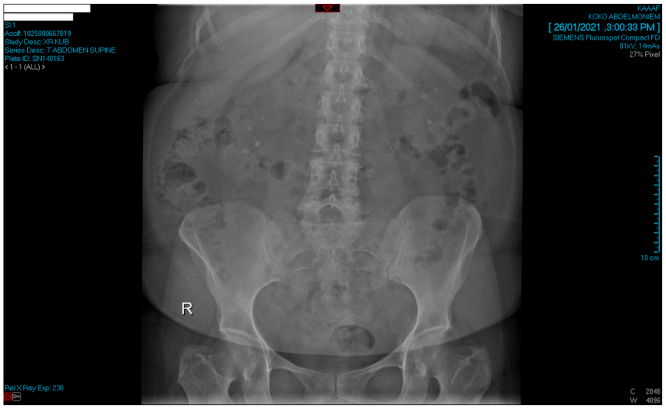

Fig. 2. Plain X-Ray KUB demonstrates multiple bilateral radiopaque shadows seen at the region of both kidneys likely representing renal calculi (pre-SWL).

The patient was reported to the accident and emergency (A&E) room 24 hours post-SWL with severe progressive right upper quadrant abdominal pain for 12 hours and mild nausea. On examination, patient appeared stable with no systemic signs of distress or shock. A recording of her vitals was normal, temperature of 36.5C, heart rate of 78bpm, blood pressure of 122/78 mmHg, respiratory rate of 20bpm and oxygen saturation of 99 % on room air. Initial blood work-up showed mildly elevated levels of aspartate transaminase (AST) of 40IU/L, gamma-glutamyl transferase (GGT) of 123IU/L and *lactate dehydrogenase (LDH) of 239IU/L. The hemoglobin level was 10.*8g/dL *with a hematocrit of 33.4 %. Renal function test was unremarkable. Urinalysis showed significant non-visible hematuria by* > 25RBCs *only.* Conventional abdominal X-ray revealed absence of accumulated fragmented stones. A Bedside ultrasound scan of the urinary system confirmed absence of renal and perirenal collection or hydronephrosis. A single dose of Tramadol 75mg was given intramuscularly and the patient's clinical status improved dramatically. Conservative approach with adequate pain management and repeat imaging was advised.

Three days later, patient presented to clinic. She was complaining of persistent, moderate, localized, dull right upper quadrant abdominal pain aggravated by respiration and motion. There was no history of fever, vomiting or change in mental status or urinary symptoms. On examination, her vitals were normal, she was not dehydrated or in shock. The abdomen was soft but moderately tender over the hepatorenal region and the liver was palpable two-fingers below the right costal margin. Repeated laboratory showed increased level of *alkaline phosphatase (ALP) of 153IU/L which was previously normal and* normalization of other liver function parameters. The *hemoglobin level was 10.*6g/dL *with a hematocrit of 32.6 %.* Both renal function and urinalysis were normal. Multidetector computed tomography urography (MDCTU) demonstrated a right lobe sub-capsular hepatic hematoma measuring 9.7 × 4.4 × 13cm besides earlier findings of bilateral renal calculi without associated backpressure changes (Fig. 3). Urgent consultation sought from general surgery team, and they recommended emergency admission for symptomatic control and close monitoring.

Initially, a conservative approach was followed consisting of frequent clinical examinations, absolute bedrest, pain management and daily blood samples. Patient was kept fasting for possible emergency surgical intervention and fluid therapy initiated. Three units of packed red blood cells (pRBC) were kept in hand. During hospitalization, the patient's clinical status improved gradually and her vitals remained normal. On the seventh day, clinically the abdomen was soft and lax and the liver was no longer palpable. Daily blood samples revealed mild elevation of *lactate dehydrogenase of 250IU/L* and a steady trend of both hemoglobin and hematocrit of 10.5g/dL and 32 % respectively. There was no leukocytosis or derangement of liver function parameters. She was discharged on a good clinical status with strict instructions to avoid any strenuous physical activity and a follow-up appointment for reassessment. On serial follow-ups, the patient remained asymptomatic with complete resolution of the hematoma on CT scan.

3. Discussion

Globally, the prevalence of kidney stone disease varies, ranging from 7 % to 13 % in North America, 5 %–9 % in Europe, and 1 %–5 % in Asia.[6] Deciding on the optimal treatment for a given patient is not always clear and depends on many variables including stone-related factors, renal anatomic factors, and clinical factors. The combination of these factors, availability of technology and equipment, and familiarity of the urologist with the different surgical techniques ultimately determines which treatment is preferred for a given patient. Generally, intervention is recommended for symptomatic stones, including those associated with pain, infection, obstruction, active stone growth, and significant hematuria. However, the available evidence is less clear on how to approach minimally symptomatic or asymptomatic renal calculi.

The first treatment of a human by SWL was in February 1980. The production and distribution of SWL lithotripter began in late 1983, and the US Food and Drug Administration approved SWL in 1984.[1,7,8] In general, for kidney stones measuring less than 1 cm in diameter, SWL achieves stone-free rates of approximately 50 %–90 % and effectiveness quotients of approximately 50 %–70 % [9,10]. SWL outcomes are improved when stones are not located in the lower pole, stone attenuation is less than approximately 900 HU and the skin-to-stone distance is

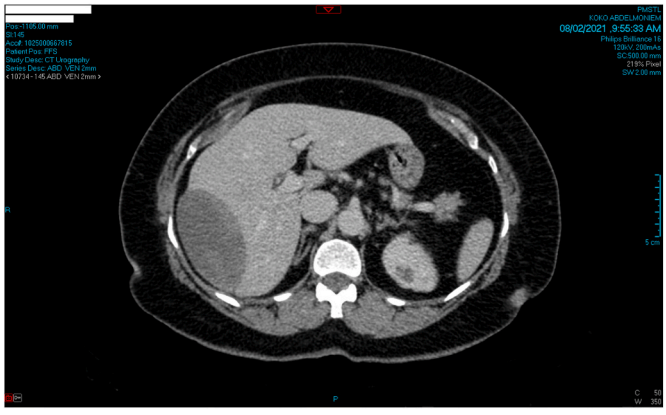

Fig. 3. MDCTU demonstrates an oval-shaped well-defined sub-capsular hypodense lesion that did not show contrast enhancement, located at the lateral aspect of the right lobe along segments 6/7 measuring 9.7 × 4.4 × 13cm. (post-SWL).

less than 10 cm. Shock wave lithotripter uses weak, nonintrusive waves that are generated externally, transmitted through the body, and focused onto the stone. The shock waves build to sufficient strength only at the target, where they generate enough force to fragment a stone. Stone fragmentation during SWL occurs as a result of mechanical stressors created by two mechanisms that can occur simultaneously or separately: (1) directly by the incident shock wave or (2) indirectly by the collapse of bubbles. The different mechanical stresses that result from SWL and contribute to stone fragmentation are as follows: acoustic cavitation, spall fracture, squeezing, shear stress, superfocusing, and dynamic fatigue. The mechanism for the traumatic effects of SWL is not known, although Delius et al. [11] have speculated that the violent collapse of cavitation bubbles generated by the shock waves is primarily responsible for the cellular changes. This cavitation concept is based on data showing that cavitation bubbles are present during shock wave application and that lithotripter shock waves can cavitate water and blood in vitro .[12] Zhong et al. [13] suggested that the expansion of bubbles in a vessel leads to rupture of the wall of that blood vessel, which has been tested and proven in an in vitro setting.

Although initially SWL was considered to be harmless for kidney tissue and adjacent structures; however, till date a number of complications have been described occurring after SWL.[5,14] It has been documented that around 7 % of the patients undergoing SWL is likely to develop at least some sort of mild complication like flank pain, urinary tract infection and hematuria. Under rare circumstances life-threatening complications might arise.[15] In our case, the patient had only mild pain during SWL session, which did not mandate stopping the procedure and was successfully controlled by analgesic. Bleeding occurs usually in patients with certain pre-existing conditions like hypertension, diabetes and clotting disorders. Hepatic hematoma is rather a rare complication of SWL with only handful of documented cases in the literature.[2,3,5,14,15,16] It is suggested that hematoma occurs due to the shock waves or because of the cavitation bubbles which can lead to rupture of the capillaries and subsequent bleeding in the renal tissue or in adjacent hepatic tissue in case of right-sided stone.[3,5] In most of the cases, the blood clot itself puts pressure on the ruptured capillaries caught between the liver tissue and the overlying parenchyma.[2,5]

In case of this type of hematoma, constant pain is the most presenting feature despite administration of analgesics; and this was the common pattern across all reported cases unlike ours which improved initially and temporarily by analgesic. Other associated symptoms might be mild degree of fever, episodes of syncope, dehydration or hypovolemic shock.[3,5] The Diagnosis is tricky, as it requires high degree of suspicion. Abdominal imaging in the form of computed tomography helps in the confirmation of the condition. If clinically stable, conservative treatment remains to be the cornerstone in the management of patients developing hepatic hematoma following SWL. In-hospital observation and close monitoring with clinical, laboratory and radiological assessments are vital. Embolization of the involved vessel or surgical intervention is required in severe cases that fail to respond to supportive measures.[15,17] Up to now, there have been only ten cases reported as sup-capsular hepatic hematoma formation after SWL. The outcome of one patient is unknown, one patient was treated with surgical intervention because of persistent abdominal pain and a rising liver transaminase level, one patient was treated by percutaneous drainage due to misdiagnosis as liver abscess, three patients were treated with transarterial embolization and four patients were treated conservatively. Our patient was managed conservatively.

4. Conclusion

In our case, the clinical stability of the patient together with the improved pain was mistaken as one of the expected post-SWL flank pains. Focused bedside ultrasound of the renal system was normal, so the patient was prescribed only medication for pain control. When a patient presents with flank pain that develops after SWL, one should think about the possibility of hemorrhage in addition to renal colic, and they should also closely observe the patient for clinical signs that are suggestive of hemorrhagic shock. Unusual complications can occur and anyone practicing SWL should have an idea about them despite their rarity.

Declaration of competing interest

The authors report no conflicts of interest in regard to this work.

References

1. Chaussy C, Fuchs G. Extracorporeal lithotripsy in the treatment of renal lithiasis. 5 years' experience. *J Urol*. 1986;92:339–343. PMID: 3794377.
2. Assaf E, Abou Zahr R, Ghabi E, Ghantous I. Perinephric hematoma with active arterial hemorrhage following extracorporeal shockwave lithotripsy. *Case Rep Urol*. 2019;2019:1–3. https://doi.org/10.1155/2019/1547437. PMID: **30723569**.
3. Sighinolfi MC, Sandri M, Eissa A, et al. The safety of extracorporeal shock wave lithotripsy: an undervalued issue. *Int Urol Nephrol*. 2019. https://doi.org/10.1007/s11255-018-2063-y. PMID: **30600441**.
4. Törő K, Kardos M. Fatal renal hemorrhage after extracorporeal shock wave lithotripsy. *J Forensic Sci*. 2008;53:1191–1193. https://doi.org/10.1111/j.1556-4029.2008.00809.x. PMID: 18637875.
5. Molina GA, Moyon MA, Myon FX, et al. Subcapsular liver hematoma after extracorporeal shock wave lithotripsy, a rare complication. *J Surg Case Rep*. 2019;2019(4):rjz114. PMID: 30997015.
6. Sorokin I, Mamoulakis C, Miyazawa K, et al. Epidemiology of stone disease across the world. *World J Urol*. 2017;35(9):1301–1320. PMID: 28213860.
7. Chaussy C, Fuchs G. Current state and future developments of noninvasive treatment of human urinary stones with extracorporeal shock wave lithotripsy. *J Urol*. 1989;141(Pt 2):782–789. PMID: 2645437.
8. Chaussy C, Schmiedt E. Extracorporeal shock wave lithotripsy (ESWL) for kidney stones: an alternative to surgery? *Urol Radiol*. 1984;6:80–87. PMID: 6740830.
9. Abdel-Khalek M, Kz Sheir, Mokhtar AA, et al. Prediction of success rate after extracorporeal shock-wave lithotripsy of renal stones—a multivariate analysis model. *Scand J Urol Nephrol*. 2004;38(2):161–167. PIMD: 15204407.
10. Micali S, Sighinolfi MC, Grande M, et al. Dornier lithotripter S 220 F EMSE: the first report of over 1000 treatments. *Urology*. 2009;74:1211–1214. PMID: 19815263.
11. Delius M, Jordan M, Eizenhoefer H, et al. Biological effects of shock waves: kidney haemorrhage by shock waves in dogs–administration rate dependence. *Ultrasound Med Biol*. 1988;14:689–694. PMID: 3212839.
12. Coleman AJ, Saunders JE, Crum LA, et al. Acoustic cavitation generated by an extracorporeal shockwave lithotripter. *Ultrasound Med Biol*. 1987;13:69–76. PMID: 3590362.
13. Xi X, Zhong P. Dynamic photoelastic study of the transient stress field in solids during shock wave lithotripsy. *J Acoust Soc Am*. 2001;109:1226–1239. PMID: 11303936.
14. Kim T-B, Park H-K, Lee K-Y, Kim K-H, Jung H, Yoon S-J. Life-threatening complication after extracorporeal shock wave lithotripsy for a renal stone: a hepatic subcapsular hematoma. *Korean J Urol*. 2010;51:212. PMID: 20414400.
15. Beatrice J, Strebel RT, Pfammatter T, Röhweder JH, Sulser T. Life-threatening complication after right renal extracorporeal shock wave lithotripsy: large hepatic haematoma requiring embolisation of the right hepatic artery. *Eur Urol*. 2007;52(3):909–911. PMID: **17321036**.
16. Budzyn J, Leavitt D. Life threatening hepatic hemorrhage after shockwave lithotripsy - a case report and review of literature. Published 2021 May 24 *Urol Case Rep*. 2021;38, 101724. https://doi.org/10.1016/j.eucr.2021.101724. PMID: 34136358.
17. Green CS, Bulger EM, Kwan SW. Outcomes and complications of angioembolization for hepatic trauma. *J Trauma Acute Care Surg*. 2016;80:529–537. PMID: **26670113**.