

CASE REPORT

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Air Embolism Complicating Percutaneous Ultrasonic Lithotripsy

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ABSTRACT: This is a report of a lethal venous air embolism complicating percutaneous ultrasonic lithotripsy. Sudden death occurred during the course of the procedure. Evidence of air embolism was detected at autopsy. Air embolism occurred because a suction pump was connected backwards, forcing air into the urinary tract rather than aspirating irrigating fluid as intended. This mishap has not previously been reported as a complication of this procedure.

KEY WORDS: pathology and biology, embolisms, lithotripsy

Percutaneous ultrasonic lithotripsy is a recently devised surgical procedure for the removal of kidney stones which obviates the necessity for open operation [1,2]. In the appropriate patient, the first step involves the establishment of a nephrostomy stoma. Usually, the nephrostomy is established in the flank area under local anesthesia in a location that provides direct access to the location of the stone. The resultant tract is dilated and established with a nephrostomy tube. After a suitable delay, the lithotripsy procedure is performed through a nephroscope which provides for fiberoptic visualization of the stone, access for an ultrasonic lithotrite to the stone, and a channel for irrigation. Continuous inflow and outflow is provided in the irrigation system to prevent as much as possible the dissemination of stone fragments in the urinary tract. Under direct visualization, the ultrasonic lithotrite is applied to the stone and the stone fragmented by ultrasonic waves. The individual stone fragments are continuously aspirated through the outflow tract.

This procedure was carried out on a 38-year-old female patient with a 2-cm round stone in the calyceal system of the left kidney. The nephrostomy stoma and tract had been established ten days before the lithotripsy. The lithotripsy was carried out under general anesthesia with the patient prone. The nephroscope was installed without difficulty and the irrigation system established. The stone was visualized and lithotripsy was started. Approximately 20 min after the start of the procedure, the patient suffered a sudden onset of bradycardia and hypotension, followed quickly by complete cardiac arrest. The lithotripsy procedure was terminated, the patient turned over, and resuscitation attempted. Despite vigorous efforts, resuscitation was unsuccessful and the patient died. The primary clinical diagnosis was massive pulmonary thromboembolism.

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Autopsy Findings

The body was that of a well developed and well nourished white female appearing the stated age of 38. It measured 160 cm (5 ft. 3 in.) in length and weighed an estimated 59 kg (130 lbs). The conjunctival surfaces were clear. There was slight cyanosis of the head and neck area with very minimal cyanosis in the hands. There was no subcutaneous emphysema over the anterior neck or chest area. There was a leftsided nephrostomy stoma with a guide wire protruding from it. The wound had clean edges and there was no evidence of exudation or excessive bleeding. On internal examination there was a finding of marked dilatation of the chambers on the right side of the heart.

The initial examination was for massive pulmonary embolism, and when the pulmonary truncus was incised, abundant bright red, frothy foam exuded from it. The right femoral venous system was filled with air and very abundant segmented air was present in the meningeal venous structures. Both lungs remained fully expanded, and there was no extra alveolar air in the mediastinal tissues. There was abundant soft tissue emphysema medial and superior to the left kidney. Careful attention was paid to the nephrostomy stoma and tract. The stoma had a very competent appearance without any defect identified. The renal pelvis and ureter on the left side also appeared entirely competent, without any mechanical defect identified. The renal calculus was identified and was impacted in the calyceal system. The kidney also appeared entirely intact except for findings of focal chronic active pyelonephritis, primarily demonstrated on microscopic examination. Significant negative findings included the lack of any evidence of recent or remote pulmonary thromboembolism, the lack of any significant occlusive coronary artery disease, and the lack of any finding to suggest a cardiomyopathy.

Discussion

It was concluded that the cause of death was air embolism complicating the lithotripsy procedure. The subsequent investigation carried out by the surgeon in an attempt to explain the mishap resulted in a discovery that the suction device for the irrigation system had been connected backwards. That is, rather than a continuous aspiration of fluid from the renal collecting system, air under pressure was being continuously pumped into the renal collecting system during the surgical procedure. The manufacturer of the device had provided for a safety design feature by requiring that inflow and outflow paths would use tubing with different diameters. In spite of this design feature, the tubing had been reversed.

It was not possible to demonstrate at autopsy the exact pathway by which essentially extracorporeal air took to enter the venous system. Nevertheless, it was apparent that the air was under sufficient pressure to escape into the paranephric soft tissues. Considering the very sudden clinical onset of bradycardia and cardiac arrest, it is estimated that a relatively large volume of air entered the venous system in a very short period of time. The manner of death was certified as accidental.

Previously recorded examples of air embolism complicating surgical procedures have involved air at positive and at atmospheric pressure, and have involved the arterial or venous circulation [3]. Previous reports of air embolism associated with this type of procedure have not been discovered. This is an example of venous air embolism occurring as a result of excessive positive air pressure in the urinary outflow tract as an initiating factor.

Summary

Lethal venous air embolism is reported as a complication of percutaneous ultrasonic lithotripsy. This is an example of a therapeutic misadventure caused by inappropriate operation of surgical equipment resulting in positive pressure venous air embolism. This complication had not previously been reported with this procedure and was unanticipated. The event was discov-

ered at autopsy. The mechanism of injury was discovered by the surgeon on a review of the surgical procedure.

References

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