Pneumomediastinum due to inadvertent bladder perforation during transurethral resection of the prostate

− A case report −

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Transurethral resection of the prostate (TURP) is a common procedure for managing benign prostatic hyperplasia (BPH), and this procedure is associated with low complication rates. Bladder perforation is an unusual complication of TURP, and it may create an air leak into the retroperitoneal space. Here we describe a case of pneumomediastinum, pneumoretroperitoneum and subcutaneous emphysema that were all due to a bladder perforation that occurred during performing TURP in a 74-year-old male patient with BPH. (Korean J Anesthesiol 2009; 56: 597–600)

Key Words: Bladder perforation, Pneumomediastinum, Pneumoretroperitoneum, Subcutaneous emphysema, Transurethral resection of the prostate.

CASE REPORT

A 74-year-old man was scheduled for TURP to treat BPH. He had acute obstructive symptoms of the lower urinary tract and gross hematuria. Medical history included hypertension and regular calcium channel blocker medication. Preoperative laboratory findings and chest X-ray findings were within normal ranges. Preoperative electrocardiography showed a normal sinus rhythm, and echocardiography showed normal left ventricular function except for mild aortic insufficiency.

Upon arrival at the operating room, his blood pressure (BP) was 155/95 mmHg, a heart rate (HR) was 95 bpm, and oxygen saturation was 97%. Routine monitoring was performed including non-invasive blood pressure measurement, electrocardiogram, pulse oxymetry, end tidal CO₂ and body temperature.

Anesthesia was induced using sodium thiopental, vecuronium, fentanyl, and sevoflurane, and was maintained using sevoflurane 2–3 vol%, N₂O 1 L/min and oxygen 1 L/min, with supplemental fentanyl and vecuronium.

Following massive bladder irrigation with normal saline, approximately 200 ml of blood clot was evacuated by an Ellik evacuator. Bladder distension was relieved immediately. TURP was then started using a 3.3% mixed solution of mannitol and sorbitol for bladder irrigation. Approximately 60 minutes after the beginning of the surgery, peak inspiratory pressure abruptly increased from 14 to 30 cmH₂O, and physical examination revealed a tense and distended abdomen. Then his BP suddenly decreased from 135/85 to 90/50 mmHg and electrocardiographs showed frequent premature atrial contractions. Physical examination revealed a crackling feeling around the chest wall and neck. Arterial blood gas analysis in 50% oxygen showed a pH 7.25, PaCO₂ 40 mmHg, PaO₂ 98 mmHg, HCO₃⁻ 17.5 mEq/L,
Base Excess $-9.1$, $\text{Na}^+ 129$ mEq/L, $\text{K}^+ 3.1$ mEq/L, and hematocrit 35%. Up to that time, 650 ml lactated Ringer’s solution and 150 ml colloid (Voluven®, Fresenius Kabi, Germany) had been infused.

We considered the possibility of inadvertent perforation of the bladder and notified that the surgeon had to cease the procedure immediately. To relieve acute abdominal distension, an angiocatheter was percutaneously inserted at the counter-McBurney point by the surgeon. About 1,000 ml pinkish-colored fluid was drained. The hematocrit decreased to 27%, and BP was 90–95/50–55 mmHg. A chest X-ray taken in the operating room showed extensive subcutaneous emphysema in the chest wall (Fig. 1). We stopped the administration of sevoflurane and $\text{N}_2\text{O}$, and awaked the patient from anesthesia. An urgent computerized tomography (CT) scan of the chest, abdomen and pelvis was performed without tracheal extubation. The CT showed a perforation of the anterior aspect of the bladder, retroperitoneal air and fluid collection, an extensive pneumoretroperitoneum, pneumomediastinum and subcutaneous emphysema (Fig. 2).

The patient was transferred to the intensive care unit (ICU) and closely monitored. One hour after arrival at ICU, careful extubation was done. BP was 110/65 mmHg, HR was 105 bpm and oxygen saturation was 98%. Postoperative serum sodium levels returned to normal by the first postoperative day ($\text{Na}^+ 138$ mEq/L, $\text{K}^+ 3.8$ mEq/L) and the pneumomediastinum and subcutaneous emphysema disappeared gradually. The patient recovered uneventfully and discharged on postoperative day 8. A cystogram on postoperative day 15 revealed an intact bladder.

**DISCUSSION**

TURP is a common procedure for BPH management. TURP-associated morbidity and mortality was decreased substantially due to advances in anesthesia and surgical techniques for TURP. Nevertheless, TURP can result in complications such as bleeding, transurethral resection syndrome, extravasation of irrigation fluids, bladder perforation, and injury of orifices or external sphincter [1].

Bladder perforation is an uncommon complication of TURP (incidence of approximately 0.7%) that may mostly result in abdominal pain, respiratory insufficiency, and electrolyte imbalance but open drainage is not often required [5,6]. Further...
more, infiltration of air into the body cavity and soft tissue as a complication of TURP is thought to be extremely rare. As far as we can tell, this is the first report to describe a case of pneumoretroperitoneum, pneumomediastinum and subcutaneous emphysema caused by bladder perforation during TURP.

Possible causes of bladder perforation during transurethral resection are repeated trials of tumor resection, sudden twitch caused by stimulation of the obturator nerve, extensive perforation of the prostate capsule and overdistension of the bladder using the Ellik evacuator [7]. In our case, we suggest an additional possible perforation mechanism whereby the depth of the cutting loop inadvertently exceeded the thickness of the bladder wall. The present patient suffered long-standing recurrent lower urinary tract obstruction which may have resulted in stretching and thinning of the bladder wall.

Bladder perforation can be classified as extraperitoneal or intraperitoneal from a urological point of view. Intraperitoneal bladder perforation is more serious, and can be complicated by systemic absorption of irrigating fluid and result in hypovolemia, hypotension, oliguria, acute renal impairment, and metabolic acidosis [6,8]. Extraperitoneal perforation is more common than intraperitoneal perforation, but is usually associated with less severe clinical manifestations [9]. Although our patient had both intraperitoneal and extraperitoneal perforations, we decided upon a conservative treatment for the bladder perforation rather than surgical repair because the CT scan revealed no apparent intraperitoneal lesion after percutaneous drainage.

Previous reports associated pneumoretroperitoneum, pneumomediastinum and subcutaneous emphysema complications with colon perforation or diverticulitis [2-4], and urological surgery [10,11]. In our case, massive pneumoretroperitoneum, pneumomediastinum and subcutaneous emphysema were caused by air originating from the perforated bladder. Air can be introduced into the bladder via cystoscope or/and irrigation tube through leakage. Undue instrument manipulation or neglected massive air irrigation via the Ellik evacuator may result in an overt pneumoretroperitoneum. The likely passage of air is from the retroperitoneal pelvic compartment through the kidney and great vessels, through behind the crus, aortic hiatus and caval foramen of the diaphragm, and then into the mediastinum. Also, air can travel from the mediastinum and the retroperitoneum to the subcutaneous soft tissues because these areas are connected by fascial planes [12].

In our opinion, the present patient may have had an anatomical variation such as an abnormal hiatus or opening defect which allowed air to spread widely throughout the body within an hour. In addition, nitrous oxide administration was not discontinued until taking chest X-ray because pneumomediastinum and subcutaneous emphysema were not detected. Therefore the air cavity in the retroperitoneum may be expanded and the air traveled to the mediastinum and subcutaneous tissues. In general, nitrous oxide should be stopped immediately when air within the body cavity is clinically suspected.

The most important step in the anesthetic management of these patients is early recognition of bladder perforation using physical examination and clinical signs. Such indications should cause anesthesiologists to notify the surgeon to cease the procedure immediately, and nitrous oxide should be discontinued because of expansion of air spaces during general anesthesia. Pneumomediastinum and subcutaneous emphysema does not usually pose a lethal threat and may require nothing more than bed rest, medication to control pain and supplemental oxygen [13]. However, since they can progress to a life-threatening condition in rare cases, vigilant observation is required. If there is extensive fluid collection and concerns about infecting perivesical tissue, percutaneous drainage should be instituted [14]. Morbidity and mortality can also be reduced by surgical drainage of the retroperitoneal fluid, but this treatment seems only to be necessary when there is massive intravascular absorption [6]. The administration of hypertonic saline is indicated when the adverse effects of hyponatremia are observed or if the serum sodium concentration falls below 120 mEq/L. Diuretic therapy may be required when pulmonary edema occurs [15].

The present report describes a pneumoretroperitoneum, pneumomediastinum, and subcutaneous emphysema associated with bladder perforation during TURP. While bladder perforation is a relatively uncommon complication during TURP, anesthesiologist should be aware of the possibility of this complication, especially in elderly patients with overdistended and thinned bladder walls. To prevent a massive pneumomediastinum, it is important to vigilantly monitor clinical signs.

REFERENCES