Failed endovascular abdominal aortic aneurysm repair due to *Mycobacterium bovis* infection following intravesical bacillus Calmette-Guérin therapy

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**ABSTRACT**

A mycotic aneurysm after intravesical instillation of bacillus Calmette-Guérin (BCG) for early-stage bladder cancer is a rare, but life-threatening, complication. In the present report, we have described the case of a patient who had undergone endovascular aneurysm repair for a rapidly growing saccular abdominal aortic aneurysm after BCG therapy. Three months after endovascular aneurysm repair, the patient had developed an abscess that required open surgery. Cultures from a blood sample and the abscess revealed *Mycobacterium bovis* BCG. A mycotic aneurysm due to BCG therapy should be suspected in patients with a history of BCG treatment. Such patients should immediately start antitubercular therapy. (J Vasc Surg Cases Innov Tech 2022;8:807-12.)

**Key words:** bacillus Calmette-Guérin; endovascular aneurysm repair; infectious aortic aneurysm

Intravesical instillation of bacillus Calmette-Guérin (BCG) is widely used to treat superficial bladder tumors.1 Although the procedure is generally considered safe, serious complications have been reported.2-5

In the present study, we have described a case of an abdominal aortic aneurysm (AAA) secondary to *Mycobacterium bovis* infection after intravesical BCG therapy. The infection was exacerbated by endovascular aneurysm repair (EVAR) and required open surgery. The patient provided written informed consent for the report of his case details and imaging studies.

**CASE REPORT**

A 72-year-old man had been admitted to our hospital with a chief complaint of fever lasting for >1 month. The patient also complained of fatigue, a poor appetite, and a weight loss of 2 kg. Contrast-enhanced computed tomography (CT) revealed perivascular inflammation of the abdominal aorta (Fig 1, A). Because bacterial cultures of his blood samples were negative, antimicrobial therapy was not administered.

Three years before the current admission, the patient had been diagnosed with superficial transitional cell carcinoma of the bladder and idiopathic thrombocytopenic purpura, for which he had received oral steroid therapy (5 mg of prednisolone once daily for 6 months) and undergone two transurethral resections. The patient had subsequently received two courses of intravesical instillation of BCG (Immunobladder; Nippon Kayaku Co, Tokyo, Japan). The first course (six times, once a week) had been completed 3 years before admission, and the second course (six times, every 3 months) had been completed 2 months before admission.

Two months later, a follow-up CT scan revealed a saccular AAA with a diameter of 4.2 cm (Figs 1, B, and 2). The patient had a 40-pack-year smoking history, body mass index of 21 kg/m², pulse rate of 64 bpm, and blood pressure of 124/82 mm Hg and was afebrile. The laboratory tests showed a leukocyte count of 5.7×10⁹/L, hemoglobin level of 135 g/L, and C-reactive protein level of 50.8 mg/L, indicating a significant inflammatory response. Because of its rapid formation, the aneurysm was suspected to be mycotic, and the CT findings suggested an impending rupture. EVAR (AFX; Endologix, Irvine, CA) was selected because of the patient’s favorable aortic anatomy (Fig 3). An angiographic catheter was used intraoperatively to collect a blood sample from the area directly adjacent to the aneurysm for bacterial culture. Tazobactam/piperacillin (9.0 g/d for 15 days) was administered intravenously. The patient was discharged on postoperative day 14, and oral antibiotics (750 mg of amoxicillin daily for 24 days) were prescribed. Because *M. bovis* BCG infection was not suspected at the time, antitubercular therapy was not initiated.

A bacterial culture in Ogawa medium showed BCG-induced *M. bovis* 6 weeks after EVAR. A polymerase chain reaction test was positive for the *Mycobacterium tuberculosis* complex. Oral antitubercular therapy with isoniazid (100 mg once daily), ethambutol (10 mg once daily), and rifampicin (150 mg once daily) was initiated.

A follow-up CT scan performed 3 months after EVAR showed significant abscess formation in the retroperitoneal space (Fig 4). Emergency surgery was performed with the patient...

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under general anesthesia. We began with right axillofemoral bypass (Intergard AXL-BIF, 8 x 8 mm; Getinge, Gothenburg, Sweden), followed by laparotomy. The abscess around the aorta extended up to the origin of the superior mesenteric artery. However, we were unable to dissect the aorta up to that point because of significant adhesions and inflammation. Therefore, the supraceliac aorta was dissected and clamped. The celiac artery, superior mesenteric artery, and bilateral renal arteries (clamp time, 20 minutes for left side and 111 minutes for right side) were reconstructed with artificial grafts (Hemashield Gold, 14 x 7 mm²; Getinge; and Propaten, 6 mm; W.L. Gore & Associates, Flagstaff, AZ), which were covered with an omental pedicle flap. The stent graft was removed, and the infected aneurysm wall and abscess were debrided extensively. After surgery, the patient had developed abdominal compartment syndrome, which caused acute renal failure and necrosis of the left hemicolon. Two days after onset, emergency left hemicolecotomy was performed. The patient subsequently underwent open abdominal management and hemodialysis. Because of his prolonged ventilator dependence and extended hospital stay, the patient had required a tracheostomy. Administration of enteric antitubercular preparations was continued via a jejunostomy tube. After a 6-month stay in our hospital, the patient was discharged to a hospital in his community for further convalescence. No infection had recurred during the 11-month follow-up period.

A culture of a pus sample from the abscess in Ogawa medium yielded M. bovis-related BCG. Pathologic examination of permanent sections showed abscess formation and granulation tissue with histiocytic aggregation, plasmacyte infiltration, and lymph follicle formation. Non-necrotizing epithelioid granulomatous formations were also observed. Ziehl-Nielsen staining, periodic acid-Schiff staining, Gram staining, and Grocott staining were performed but did not reveal bacilli.
LITERATURE REVIEW

To the best of our knowledge, to date, 20 patients (including our patient) with a mycotic aortoiliac aneurysm who had undergone EVAR after BCG therapy have been reported (Table). All 20 patients were men, and their mean age at diagnosis was 71 years (range, 57-82 years). The aneurysms had been diagnosed at a mean interval of 19 months (range, 0-69 months) after BCG therapy. The most common aneurysm location was the abdominal aorta (n = 13; 65%), followed by the descending aorta (n = 5; 25%). Of the 20 patients, 6 (30%) had undergone emergency surgery for aneurysm repair.

Fig 3. Intraoperative angiogram of a patient with Mycobacterium bovis infection taken during endovascular aneurysm repair (EVAR). A, Initial angiogram of abdominal aortic aneurysm (AAA). B, Angiogram taken after EVAR.

Fig 4. Contrast-enhanced computed tomography (CT) images of abdominal aorta of a patient with Mycobacterium bovis infection. A, Significant abscess formation was visible 3 months after endovascular aneurysm repair (EVAR). B, Coronal CT reconstruction image at 3 months after EVAR. The stent graft was deployed just below the renal arteries. The abscess around the aorta extended to the level of the origin of the superior mesenteric artery (arrowhead). C, Sagittal CT reconstruction image at 3 months after EVAR.
Table. Characteristics of reported cases of endovascular aneurysm repair (EVAR) for mycotic aortoiliac aneurysms due to *Mycobacterium bovis* infection after intravesical bacillus Calmette-Guérin (BCT) therapy.

| Investigators          | Age, years | Sex | Interval from BGC therapy, months | Aneurysm location | Size, mm | Rupture | Aortoenteric fistula | Psoas abscess | Spondylodiscitis | Outcome                  |
|------------------------|------------|-----|-----------------------------------|-------------------|----------|---------|---------------------|--------------|----------------|------------------------|
| Rozenblit et al        | 76         | M   | 69                                | AA                | NS       | No      | No                  | No           | No             | Died of myocardial infarction |
| LaBerge et al          | 75         | M   | 8                                 | AA                | 60       | No      | No                  | Yes          | No             |                         |
| Santbergen et al       | 58         | M   | 22                                | AA                | NS       | No      | No                  | Yes          | Yes            |                         |
| Mizoguchi et al        | 81         | M   | 24                                | AA                | 70 × 45  | No      | No                  | Yes          | No             |                         |
| Leo et al              | 81         | M   | 36                                | AA                | NS       | Yes     | No                  | Yes          | No             |                         |
| Flores et al           | 57         | M   | 14                                | AA                | 86       | Yes     | No                  | No           | No             |                         |
| Smith                  | 69         | M   | NS                                | AA                | 20       | No      | No                  | No           | No             |                         |
| Witjens et al          | 60         | M   | 0                                 | AA                | NS       | No      | No                  | Yes          | No             |                         |
| Duvnjak et al          | 63         | M   | 7                                 | CIA               | NS       | No      | No                  | No           | No             |                         |
| Leeman et al           | 71         | M   | 10                                | CIA               | 92       | Yes     | No                  | Yes          | No             |                         |
| Wadhwani et al         | 73         | M   | 6                                 | DA                | 63 × 56  | No      | No                  | No           | No             |                         |
| Higashi et al          | 65         | M   | 12                                | DA                | 25 × 19  | Yes     | No                  | No           | No             |                         |
| Viviani et al          | 69         | M   | 12                                | CIA               | 115      | Yes     | No                  | No           | No             |                         |
| Ribeiro et al          | 79         | M   | 30                                | DA                | 48 × 32  | No      | No                  | No           | No             |                         |
| Berchiolli et al       | 70         | M   | 3                                 | AA                | 45       | Yes     | Yes                 | No           | No             |                         |
| Koteraizawa et al      | 80         | M   | 20                                | DA                | NS       | No      | No                  | No           | No             |                         |
| Liechty et al          | 82         | M   | 61                                | AA                | 14       | Yes     | No                  | Yes          | Yes            |                         |
| Akabane et al          | 76         | M   | 12                                | DA, AA            | 39 × 35, 52 × 47 | No | No | No | No |                         |
| Flynn et al            | 72         | M   | 7                                 | AA                | 31       | No      | No                  | No           | No             |                         |
| Present case           | 72         | M   | 2                                 | AA                | 42       | No      | No                  | Yes          | No             |                         |

| Antitubercular therapy duration before EVAR, months | Intervention | Device | Interval from EVAR to OS, months | Follow-up duration, months | Outcome |
|----------------------------------------------------|--------------|--------|---------------------------------|----------------------------|---------|
| 8                                                  | EVAR         | Barone | NA                              | 15                         | Died of myocardial infarction |
| 0                                                  | OS after EVAR | NS     | NS                              | NS                         | NS      |
| 0                                                  | OS after EVAR | NS     | 6                               | 18                         | Alive   |
| 0                                                  | OS after EVAR | Zenith | 30                              | NS                         | NS      |
| 0                                                  | EVAR          | NS     | NA                              | 12                         | Died of cerebral hemorrhage |
| 0                                                  | EVAR          | Zenith | NA                              | 3                          | Alive   |
| 0                                                  | EVAR          | NS     | NA                              | 9                          | Alive   |
| 0                                                  | EVAR          | NS     | NA                              | 6                          | Alive   |
| 9                                                  | EVAR          | AFX    | NA                              | NS                         | Alive   |
| 3                                                  | OS after EVAR | Endurant | 3                              | 9                          | Alive   |
| 0                                                  | TEVAR         | NS     | NA                              | 6                          | Alive   |
| 0                                                  | TEVAR         | NS     | NA                              | 11                         | Alive   |
| 5                                                  | EVAR          | Endurant | NA                             | 17                         | Alive   |
| 12                                                 | TEVAR         | Zenith | NA                              | 6                          | Alive   |
| 0                                                  | OS after EVAR | AFX    | 10 days                         | 25 days                    | Died of infection |
| 10                                                 | TEVAR         | NS     | NA                              | 24                         | Alive   |
| 0                                                  | EVAR          | Excluder | NA                             | 14                         | Alive   |
| 0                                                  | TEVAR + OS    | C-TAG  | NA                              | 12                         | Alive   |
| 0                                                  | EVAR          | NS     | NA                              | 8                          | Alive   |
| 0                                                  | OS after EVAR | AFX    | 3                              | 7                          | Alive   |

AA, abdominal aorta; CIA, common iliac artery; DA, descending aorta; M, male; NA, not available; NS, not specified; OS, open surgery; TEVAR, thoracic endovascular aneurysm repair.
rupture. Another six patients (30%) had undergone endograft removal and open aneurysm repair 10 days to 30 months after the initial endovascular surgery, and five of the six patients had not received antitubercular therapy before endovascular surgery. In contrast, 5 of the 14 patients who had not undergone endograft explant surgery had received antitubercular therapy for 5 to 12 months before endovascular surgery and had survived for 6 to 24 months.

**DISCUSSION**

Since 1988, 51 cases of a mycotic AAA attributable to BCG therapy have been reported. 4-5,8,10-12,19,21-38 In our patient, infectious aortitis had progressed rapidly, and a saccular AAA or pseudoaneurysm had developed within 2 months after BCG therapy. In hindsight, a follow-up CT scan should have been performed sooner to monitor for any aneurysmal changes.

Furthermore, the introduction of the stent graft into the infected area without wide debridement of the infected tissue had exacerbated the infection and led to abscess formation. Failure to administer antitubercular preparations further worsened the situation. In the case of our patient, a follow-up CT scan should have been performed earlier than 3 months after EVAR, especially after positive blood culture results had been obtained. In addition, an aortic cuff above the aortic bifurcation might have been a better choice than the bifurcated stent graft used for greater ease of explantation.

Given the presenting symptoms of our patient, our choice of EVAR as the initial surgery was a clinical judgment error, and we have learned from that error. If such aneurysms have been sterilized with antitubercular therapy before EVAR, this treatment might have long-term benefits.

**CONCLUSIONS**

A mycotic aneurysm due to BCG therapy should be suspected in patients with a history of BCG treatment and indicative clinical characteristics. EVAR is not appropriate for patients stable enough to undergo open repair. EVAR should be considered only for cases of rupture in which the patient’s life is threatened and should be used as a temporizing measure to the long-term solution. The device of choice for EVAR should be a device without suprarenal fixation to allow for relatively easy explantation.

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