

Tuberculosis, Bronchiectasis, and Infertility: What Ailed George Orwell?

John J. Ross

Division of Infectious Diseases, Caritas Saint Elizabeth's Medical Center, Boston, Massachusetts

In the last and most productive years of his life, George Orwell struggled with pulmonary tuberculosis, dying at the dawn of the era of chemotherapy. His case history illustrates clinical aspects of tuberculosis with contemporary relevance: the role of poverty in its spread, the limited efficacy of monotherapy, the potential toxicity of treatment, and the prominence of cachexia as a terminal symptom. Orwell's ordeals with collapse therapy may have influenced the portrayal of the tortures of Winston Smith in the novel *1984*. I discuss unifying diagnoses for Orwell's respiratory problems and apparent infertility, including tuberculous epididymitis, Young syndrome, immotile cilia syndrome, and cystic fibrosis.

George Orwell (1903–1950), novelist, essayist, and creator of Big Brother and “doublethink,” had a complex medical history that has confused his biographers. This article reviews Orwell's battles with bronchiectasis and tuberculosis, revisits bygone treatments of tuberculosis, and provides a unifying diagnosis encompassing his apparent infertility.

ORWELL'S MEDICAL HISTORY

Orwell was born as Eric Blair in Gaya, India. His father Richard was a starchy official in a sordid imperial bureaucracy, the Bengali Opium Service, overseeing the lucrative export of narcotics from the Indian subcontinent to China. His mother Ida was much younger, with bohemian, socialist, and literary inclinations. When Eric was a few months old, his mother brought him and his sister to England, while his father remained behind, an arrangement that was not unusual among Anglo-Indian families. Richard Blair's family saw him rarely until his retirement on a modest pension in 1912, having attained the rank of Sub-Opium Agent Class 1 [1–5].

Eric had several episodes of bronchitis in infancy, in-

cluding one when he was 18 months of age that was severe enough to confine him to bed for a week. He was described as a “chesty” and “bronchial” child [1, p. 26]. Despite this, he appears hearty and chubby in childhood photographs. At the age of 8 years, he was enrolled in a preparatory school of probably average snobbery and brutality. As a middle-class student accepted at reduced tuition because of his academic promise, he was under enormous pressure to bring luster to the institution by winning a scholarship to an elite English public school. His respiratory complaints also became more intense. Years later, Blair recalled, “In winter, after about the age of ten, I was seldom in good health. . . . I had defective bronchial tubes and . . . a chronic cough” [6, p. 396]. When he was 14 years old, a neighbour noted, “Eric has a bit of a cough. He says it is chronic” [2, p.106].

Eric did win a scholarship to Eton, but he failed to apply himself to his studies. In 1922, he went to Burma as an imperial policeman, seemingly destined, like his father, for a career in the obscurity of a bleak colonial outpost. He became quickly disenchanted with “the dirty work of Empire at close quarters” [7, p. 266] and resigned during his first leave in England in 1927. His family was shocked at his gaunt appearance, attributable to recent pneumonia and dengue fever, and his now heavy smoking.

Blair determined to become a writer, spending the next years on the wretched fringes of French and English society. These experiences became the source material for his first book, *Down and Out in Paris and*

Received 23 June 2005; accepted 20 July 2005; electronically published 19 October 2005.

Reprints or correspondence: Dr. John J. Ross, Div. of Infectious Diseases, Caritas St. Elizabeth's Medical Center, 736 Cambridge St., Boston, MA 02135 (jrossmd@cchcs.org).

Clinical Infectious Diseases 2005;41:1599–603

© 2005 by the Infectious Diseases Society of America. All rights reserved.
1058-4838/2005/4111-0008\$15.00

London, published under the pseudonym George Orwell. If he was not infected with tuberculosis before, during childhood, or while in Burma, it is almost certain that he was exposed during these years of tramping, poverty, and vagabondage.

Orwell had at least 4 bouts of pneumonia between the ages of 15 and 34 years [1, p. 240]. His adult health was poor. Although Orwell stood 1.9 m tall, his highest recorded weight was 77 kg [2, p. 358]. As an adult, he was “a bit chesty,” and had “a cough every winter” [2, p. 262]. Some time after his return from Burma, he “was tested for TB, but the result was negative, or so he said” [2, p. 185]. In 1929, he was admitted with pneumonia to an archaic Parisian hospital, where treatments included cupping and mustard poultices. Orwell captured the callous attending physician’s teaching rounds in a classic description:

There were many beds past which he walked day after day, sometimes followed by imploring cries. On the other hand if you had some disease with which the students wanted to familiarize themselves you got plenty of attention of a kind. I myself, with an exceptionally fine specimen of a bronchial rattle, sometimes had as many as a dozen students queueing up to listen to my chest. It was a very queer feeling—queer, I mean, because of their intense interest in learning their jobs, together with a seeming lack of perception that the patients were human beings. [8, p. 263–4]

In 1937, Orwell fought with the Republican side in the Spanish Civil War, against the fascist troops of Francisco Franco. After somehow surviving a bullet wound to the neck (the bullet injured his brachial plexus, causing transient right arm paralysis, and injury to his recurrent laryngeal nerve left him with a permanently weak voice [3, p. 222]), he almost succumbed to the labyrinthine politics of the Civil War. Orwell had fatefully and rather arbitrarily joined a militia dominated by anti-Stalin Trotskyites and anarchists. As the Stalinists increased in power in Spain, the anarchists and Trotskyites were purged. Press accounts of these events, both in Spain and abroad, were widely distorted. Orwell was a marked man, but before fleeing Spain himself, he tried to secure the release of an arrested comrade in an act of quixotic recklessness [2].

Spain wrecked his health, but it also provided him with his great theme: the enmity of power and truth. Had Orwell died in Spain, he would likely be forgotten today, but paradoxically, the progression of his illness coincided with the flowering of his talent and with the writing of his 3 masterworks: *Homage to Catalonia*, *Animal Farm*, and *1984*.

ORWELL’S DIAGNOSIS OF TUBERCULOSIS

Back in England in March 1938, Orwell had an episode of major hemoptysis, and was treated at Preston Hall Sanatorium by his brother-in-law Laurence O’Shaughnessy, coauthor of a contemporary textbook on tuberculosis. The clinical impression was chronic bronchiectasis of the left lower lobe, after the

results of initial investigations for tuberculosis were negative [4, p. 290]. However, a late addendum to the chart noted, “TB confirmed” [3, p. 239], presumably on the basis of cultures on solid media or by the more sensitive method of guinea pig inoculation, as noted in O’Shaughnessy’s textbook [9].

Sanatorium treatment consisted of bed rest and maximum nutrition. As patients gained weight and manifested radiologic improvement, they were slowly allowed to increase their ambulation. Immobility was sometimes enforced in draconian fashion by sandbags on the shoulders or by swaddling patients like infants [10, 11]. These extreme restrictions may have served a physiologic purpose. Bed rest diminished functional residual capacity and minute ventilation, leading to less static and dynamic tension on the cavity walls and mechanically favoring cavity closure [10]. A therapeutic effect was sometimes ascribed to a sanatorium’s supposedly salubrious location; this was perhaps true of sanatoria in the mountains, because of the protective effect of hypoxia [12].

Orwell’s condition improved significantly over several months, and he was discharged. In 1939, he saw the Harley Street pulmonologist Herbert Morlock, who thought he had nothing more serious than chronic bronchiectasis [3]. Morlock’s breezy optimism delighted Orwell and strengthened a tendency toward denial of illness on Orwell’s part, common among patients with tuberculosis before and since. In one study, 9% of tubercular patients disbelieved or doubted their diagnoses [13].

During the Second World War, Orwell’s precarious health stabilized somewhat because of sulfapyridine therapy [3]. This probably did little for his tuberculosis [14] but may have temporarily quelled his chronic bronchiectasis.

COLLAPSE THERAPY AND THE MINISTRY OF LOVE

In 1946, depressed by the death of his wife and sick of the urban squalor of London, Orwell moved to the sodden, remote, windswept Scottish island of Jura. One biographer called this “one of the many ill-judged decisions in a life littered with misjudgements” [3, p. 364]. While writing the first draft of *1984*, Orwell’s health declined precipitously. He developed fever and night sweats, and he lost 13 kg in weight. On Christmas Eve of 1947, he was admitted to Hairmyres Hospital near Glasgow. Orwell described his pneumoperitoneum therapy in matter-of-fact fashion:

[The] treatment they are giving me is to put the left lung out of action, apparently for about 6 months, which is supposed to give it a better chance to heal. They first crushed the phrenic nerve, which I gather is what makes the lung expand and contract, and then pumped air into [actually under] the diaphragm, which I understand is to push the lung into a different position...I have to get “refills” of air in the diaphragm every few days, but later it gets down to once a week or less. [2, p. 535]

Collapse therapy aimed to close tuberculous cavities. Cavity formation is the most ominous event in the pathogenesis of tuberculosis. Liquefaction and expulsion of caseum allows tubercle bacilli to flourish in an environment of higher oxygen tension (optimal growth of *Mycobacterium tuberculosis* occurs at a partial pressure of oxygen level of 140 mm Hg). Bacilli may then spread to other regions of the lungs via the bronchi, as well as infect other people. The enormous number of bacilli in tuberculous cavities, compared with the solid caseum, make drug-resistant tuberculosis a likely outcome if an inadequate number of drugs are used or if the duration of therapy is too brief [15].

It had long been noted that some patients with tuberculosis remitted if spontaneous pneumothorax occurred. As early as 1821, the Scottish physician James Carson advocated artificial pneumothorax therapy, arguing that normal respiration and pulmonary elastic recoil hindered the healing of tuberculous cavities [16]. The anaerobic conditions created by collapse therapy may also have forced *M. tuberculosis* organisms into a dormant state [17].

Artificial pneumothorax therapy was frequently limited by the presence of pleural adhesions. In 20% of patients, no pleural space could be found for air introduction, and in another 41%, only partial pneumothorax was obtained. Tuberculous empyema from inadvertent or deliberate rupture of adhesions occurred in up to 18% of patients. Air embolism was another dreaded and often deadly complication [10, 16].

Phrenic nerve crush and pneumoperitoneum, which collapsed the lung from below, had the advantage of relative freedom from lethal complications and was also useful for patients with lower lobe disease, like Orwell. However, many patients did not achieve adequate pulmonary collapse, and phrenic nerve paralysis, although usually reversible, impaired respiration in the contralateral lung because of mediastinal flutter [10].

In thoracoplasty, the posterior and lateral sections of several ribs were stripped off the periosteum, and the lung pushed inward, usually in 2 or 3 operations. The preserved periosteum regenerated ribs in the collapsed position, stabilizing the chest wall and minimizing the risks of chest wall paradoxical motion and impaired cough [10, 16, 18–22].

Finally, in subcostal plombage thoracoplasty, the periosteum was stripped off the ribs, and the space created was filled with a foreign body (or “plomb”), which was usually balls of Lucite (DuPont; methylmethacrylate) or polyethylene. Less satisfactory materials were also used, including paraffin, fiberglass, olive oil, gauze, rubber, bone grafts, pectoral muscle flaps, and fat grafts, using omentum, lipoma tissue, or abdominal wall fat from the same patient or from another patient [16, 23]. Ideally, the plomb was removed after the periosteum had regenerated a stable bony plate in the collapsed position, minimizing the risk of infection or migration of the plomb [19, 24]. Plombage collapsed the lung in a single operation. Because the first rib and spinous transverse

processes were not removed, it also resulted in less-severe chest and spinal deformity than thoracoplasty [10, 19].

Retrospective data suggest a significant benefit for collapse therapy. In one large study, 58% of patients treated with a variety of collapse therapies developed negative smear results, compared with 14% of patients treated with bed rest only [18]. Postmortem examination of patients treated with collapse therapy showed that cavities were reduced to fibrous clefts [16].

The pneumoperitoneum therapy stoically endured by Orwell may have influenced the depiction of the tortures of Winston Smith in the Ministry of Love in 1984 [3]. Another reflection of Orwell’s illness may be seen in Winston Smith’s severe cachexia:

But the truly frightening thing was the emaciation of his body. The barrel of the ribs was as narrow as that of a skeleton: the legs had shrunk so that the knees were thicker than the thighs...the curvature of the spine was astonishing. The thin shoulders were hunched forward so as to make a cavity of the chest, the scraggy neck seemed to be bending double under the weight of the skull. At a guess he would have said that it was the body of a man of sixty, suffering from some malignant disease. [25, p. 218]

Wasting was prominent in patients with tuberculosis and was known in the 19th century as “consumption” or “phthisis” (Greek for dwindling or wasting). This is usually attributed to high levels of proinflammatory cytokines, although the precise mechanism remains elusive. Even with current treatment, tuberculosis is associated with a prolonged anabolic block [26, 27].

Streptomycin was not commercially available in the United Kingdom, but Orwell purchased it from the United States using his royalty money from *Animal Farm*, and he obtained an import license through the political connections of the publisher David Astor. Orwell improved with receipt of streptomycin, but he unluckily developed a rare adverse effect, toxic epidermal necrolysis [28], which he described with startling detachment:

A sort of rash appeared all over my body, especially down my back...after about three weeks I got a severe sore throat, which did not go away and was not affected by sucking penicillin lozenges. It was very painful to swallow and I had to have a special diet for some weeks. There was now ulceration with blisters in my throat and in the insides of my cheeks, and the blood kept coming up into little blisters on my lips. At night these burst and bled considerably, so that in the morning my lips were always stuck together with blood and I had to bathe them before I could open my mouth. Meanwhile my nails had disintegrated at the roots. [2, p. 539–40]

A recent Orwell biographer summarizes his medical history as follows:

The progress of Orwell’s illness is difficult to map. He seemed to have inherited bronchiectasis, a condition that would have made him susceptible to lung infection from birth. His recurrent influenza and bronchitis, his persis-

tent cough, and his several bouts of pneumonia would be symptoms of that susceptibility. But the condition would also make him especially vulnerable to tuberculosis, and he might well have been infected since childhood. By the time he was finally diagnosed with tuberculosis at the age of 35, he had exposed himself to risk on several occasions. [3, p. 390]

EVIDENCE FOR ORWELL'S INFERTILITY

Because Orwell may have been sterile, it is tempting to seek a unifying diagnosis linking his respiratory and fertility problems. Orwell and his wife Eileen had a childless marriage for 8 years before they adopted a son in 1944. Eileen blamed her husband for their fertility problems [5], although her uterine fibroids may have been a contributing factor. These were symptomatic enough that she required a hysterectomy in 1945, dying unexpectedly of a reaction to anesthesia. Orwell also believed he was responsible for their failure to conceive. Writing to a female friend in 1945, he stated, "I am also sterile I think—at any rate I have never had a child, though I have never undergone the examination because it is so disgusting" [5, p. 242].

Little is known of Orwell's early sexual relationships, but Orwell suspected he was infertile prior to his marriage to Eileen. In 1934, he told one girlfriend that he "was incapable of having children" because he had "never had any" [3, p. 163]. Orwell also confided his doubts about his fertility to Pamela Warburg, the wife of his publisher [1], and to his friend Rayner Heppenstall [2].

A UNIFYING DIAGNOSIS?

There is no definitive evidence that Orwell was infertile, and even if he were, his infertility may have been unrelated to his respiratory problems. However, there are at least 4 intriguing explanations for the apparent conjunction of infertility and bronchiectasis in Orwell's case. Men with cystic fibrosis (CF) are almost always infertile as a result of congenital bilateral absence of the vas deferens [29], and infertility is an increasingly common reason for the diagnosis of CF in adults [30]. However, the duration of survival for CF was brief in the preantibiotic era [29], and it seems implausible that Orwell lived until the age of 46 years with CF and tuberculosis.

Primary ciliary dyskinesia (immotile cilia syndrome) is an autosomal recessive genetic disease characterized by recurrent upper respiratory tract infections and bronchiectasis. Fifty percent of patients have situs inversus (Kartagener syndrome). Most men have immotile spermatozoa and are therefore infertile. Lung function declines slowly, and life span is near normal, provided that patients abstain from smoking and that antibiotics are available to treat infections, neither of which was true in Orwell's case [31]. However, Orwell did not have prominent rhinitis and sinusitis, as do almost all patients with immotile cilia syndrome.

Young syndrome is the association of bronchitis, bronchiec-

tasis, or sinusitis with obstructive azoospermia. Ciliary structure and function are normal in patients with Young syndrome; obstruction occurs because of abnormally thick secretions in the efferent ductules in the head of the epididymis [32]. Young syndrome is linked to childhood exposure to calomel (mercurous chloride) in teething powders and worm medication. In Orwell's childhood, mercury was "the everyday treatment of infants at the time of teething" [33, p. 297]. Some patients have provided a history of childhood acrodynia (pink disease), with painful red digits, irritability, rashes, asthenia, and anorexia due to mercury exposure [32]. The incidence of Young syndrome in the United Kingdom decreased dramatically after 1955, when calomel-containing medications were withdrawn from the market. Although pink disease was more common in middle-class families such as Orwell's than in poor ones [33], Orwell is not known to have had pink disease or calomel exposure in childhood.

Another possible link between Orwell's tuberculosis and infertility is the possibility of tuberculous epididymitis. The epididymis is the most common urogenital site of involvement of tuberculosis in men [34]. Most patients with genital tuberculosis do not have systemic symptoms [35]. Painless scrotal swelling is the most common presenting complaint [36]. Many patients have palpable genital abnormalities, but 40% do not. Abnormalities in sperm number, morphology, or motility are seen in 75%–100% of affected men [37]. The proportion of patients with tuberculous epididymitis who have a history of pulmonary tuberculosis is highly variable: it was up to 78% in an older series [36] but only 0%–25% in more recent series [35, 38]. Tuberculous epididymitis is a common cause of male infertility in regions where tuberculosis is endemic [39].

Orwell's "difficult" medical history may perhaps be synthesized as follows: he developed bronchiectasis after a viral respiratory infection in infancy, with winter viral and bacterial exacerbations thereafter. Tuberculosis may cause bronchiectasis [40], but childhood tuberculosis is less likely, given Orwell's chubby appearance in youth and impressive adult stature. Also, tuberculous bronchiectasis tends to occur in the well-drained upper lobes and is thus known as "dry bronchiectasis" [15]. Sometime in adulthood, in Burma, during the "down and out" years, or in the trenches and hospitals of Spain, he was infected with *M. tuberculosis*. Concomitant infertility in Orwell could be explained by tuberculous epididymitis or perhaps by Young syndrome.

ORWELL'S END

Orwell left Hairmyres in July 1948, but he quickly experienced relapse under the heroic ordeal of revising and completing *1984*. He spent 1949 at Cotswold Sanitarium near Cranham, later moving to University College Hospital, London, under the care of Dr. Andrew Morland, who had once attended D. H. Lawrence. Morland professed vague optimism, although Dr. Howard Nich-

olson, his junior consultant, later said, "When I first saw him, I had no serious doubt that he was dying" [2, p. 574].

1984 was a commercial and critical success. Orwell admitted to friends that its gloom had much to do with his illness [3]. He received *p*-amino salicylic acid, a bacteriostatic drug, as monotherapy, which helped briefly. An ill-advised rechallenge with streptomycin almost killed him after he received the first dose. He received painful injections of penicillin into his wasted muscles, presumably intended to treat bronchiectasis, as it was already known that penicillin was not active against tuberculosis [41]. Late in 1949, in his hospital room, he married the troubled beauty Sonia Brownell, the model for Julia in 1984. Many were skeptical of Brownell's motivations in marrying a now wealthy, desperately ill man, but at the least she proved to be a formidable literary widow, ferociously protective of Orwell's posthumous reputation.

Obstinate to the last, Orwell shocked everyone by rallying once again; it seemed he might confound them all and live. However, he began to deteriorate anew, and he died suddenly and alone in his hospital bed of massive hemoptysis in the early morning of 21 January 1950. A fishing rod in the room stood mute testimony to his forlorn hope of escape to the alpine lakes of Switzerland.

Acknowledgments

Potential conflicts of interest. J.J.R.: no conflicts.

References

1. Taylor DJ. Orwell: the life. New York: Henry Holt, 2003.
2. Crick B. George Orwell: a life. Harmondsworth: Penguin Books, 1982.
3. Bowker G. Inside George Orwell. New York: Palgrave Macmillan, 2003.
4. Sheldon M. Orwell: the authorized biography. New York: Harper-Collins, 1991.
5. Meyers J. Orwell: wintry conscience of a generation. New York: WW Norton, 2000.
6. Orwell G. Such, such were the joys. In: Orwell S, Angus I, eds. Collected essays, journalism, and letters. Vol. 4. Harmondsworth, England: Penguin Books, 1970:379–422.
7. Orwell G. Shooting an elephant. In: Orwell S, Angus I, eds. Collected essays, journalism, and letters. Vol. 1. Harmondsworth, England: Penguin Books, 1970:265–72.
8. Orwell G. How the poor die. In: Orwell S, Angus I, eds. Collected essays, journalism, and letters. Vol. 4. Harmondsworth, England: Penguin Books, 1970:261–72.
9. Kayne GG, Pagel W, O'Shaughnessy L. Pulmonary tuberculosis. London: Oxford University Press, 1939.
10. Gaensler EA. The surgery for pulmonary tuberculosis. Am Rev Respir Dis 1982; 125:73–84.
11. Tolson J. Pilgrim in the ruins: a life of Walker Percy. New York: Simon & Schuster, 1992:169.
12. Vargas MH, Furuya ME, Perez-Guzman C. Effect of altitude on the frequency of pulmonary tuberculosis. Int J Tuberc Lung Dis 2004; 8:1321–4.
13. Williams LR, Hill AM. The patient's reaction to a diagnosis of tuberculosis. N Engl J Med 1930; 203:1129–31.
14. D'Esopo ND. Clinical trials in pulmonary tuberculosis. Am Rev Respir Dis 1982; 125:85–93.
15. Moulding T. Pathophysiology and immunology: clinical aspects. In: Schlossberg D, ed. Tuberculosis, 3rd edition. New York: Springer-Verlag, 1994:41–50.
16. Alexander J. The surgery of pulmonary tuberculosis. Philadelphia: Lea & Febiger, 1925.
17. Voskuil MI, Visconti KC, Schoolnik GK. *Mycobacterium tuberculosis* gene expression during adaptation to stationary phase and low-oxygen dormancy. Tuberculosis 2004; 84:218–27.
18. Alexander J. The collapse therapy of pulmonary tuberculosis. Springfield IL: Charles C. Thomas, 1937.
19. Strieder JW, Laforet EG, Lynch JP. The surgery of pulmonary tuberculosis. N Engl J Med 1967; 276:960–5.
20. Gale GL, Delarue NC. Surgical history of pulmonary tuberculosis: the rise and fall of various technical procedures. Can J Surg 1969; 12:381–8.
21. Langston HT. Thoracoplasty: the how and the why. Ann Thorac Surg 1991; 52:1351–3.
22. Dormandy T. The white death: a history of tuberculosis. London: Hambleton and London, 1999.
23. Shepherd MP. Plombage in the 1980s. Thorax 1985; 40:328–40.
24. Weissberg D, Weissberg D. Late complications of collapse therapy for pulmonary tuberculosis. Chest 2001; 120:847–51.
25. Orwell G. Nineteen eighty-four. Harmondsworth, England: Penguin Books, 1954.
26. Schwenk A, Hodgson L, Wright A, et al. Nutrient partitioning during treatment of tuberculosis: gain in body fat mass but not in protein mass. Am J Clin Nutr 2004; 79:1006–12.
27. Paton NI, Chua YK, Earnest A, Chee CB. Randomized controlled trial of nutritional supplementation in patients with newly diagnosed tuberculosis and wasting. Am J Clin Nutr 2004; 80:460–5.
28. Hmouda H, Laouani-Kechrid C, Nejib Karoui M, Denguezli M, Nouira R, Ghannouchi G. A rare case of streptomycin-induced toxic epidermal necrolysis in a patient with tuberculosis: a therapeutic dilemma. Ann Pharmacother 2005; 39:165–8.
29. Oermann CM. Fertility in patients with cystic fibrosis. Chest 2000; 118:893–4.
30. Gilljam M, Ellis L, Corey M, Zielinski J, Durie P, Tullis DE. Clinical manifestations of cystic fibrosis among patients with diagnosis in adulthood. Chest 2004; 126:1215–24.
31. Afzelius BA, Mossberg B, Bergstrom BE. Immotile cilia syndrome (primary ciliary dyskinesia), including Kartagener syndrome. In: Scriver CR, Beaudet AL, Sly WS, Valle D, eds. The metabolic and molecular bases of inherited disease, 8th ed. New York: McGraw Hill, 2001:4817–27.
32. Hendry WF, A'Hern RP, Cole PJ. Was Young's syndrome caused by exposure to mercury in childhood? BMJ 1993; 307:1579–82.
33. Dally A. The rise and fall of pink disease. Soc Hist Med 1997; 10: 291–304.
34. Wechsler H, Westfall M, Lattimer JK. The earliest signs and symptoms in 127 male patients with genitourinary tuberculosis. J Urol 1960; 83:801–3.
35. Simon HB, Weinstein AJ, Pasternak MS, Swartz MN, Kunz LJ. Genitourinary tuberculosis: clinical features in a general hospital population. Am J Med 1977; 63:410–20.
36. Ross JC, Gow JG, St Hill CA. Tuberculous epididymitis: a review of 170 patients. Br J Surg 1961; 48:663–6.
37. Sole-Balcells F, Jimenez-Cruz F, de Cabezon JS, Rosello AS. Tuberculosis and infertility in men. Eur Urol 1977; 3:129–31.
38. Ferrie BG, Rundle JS. Tuberculous epididymo-orchitis: a review of 20 cases. Br J Urol 1983; 55:437–9.
39. Moon SY, Kim SH, Jee BC, Jung BJ, Suh CS, Lee JY. The outcome of sperm retrieval and intracytoplasmic sperm injection in patients with obstructive azoospermia: impact of previous tuberculous epididymitis. J Assist Reprod Genet 1999; 16:431–5.
40. Cleveland RH, Mark EJ. Case records of the Massachusetts General Hospital. Case 31-1998: an eight-year-old boy with bronchiectasis. N Engl J Med 1998; 339:1144–51.
41. Smith MI, Emmart EW. The action of *Penicillium* extracts in experimental tuberculosis. Public Health Rep 1944; 59:417–23.