ORIGINS OF RENAL DISEASES

Professor Eric G.L. Bywaters, Acute Kidney Injury and the "forgotten" letter

Michael Almond

Southend University Hospital Renal Unit, Westcliff-on-Sea, Essex, UK

Address correspondence to: Michael K Almond; Southend University Hospital Renal Unit, Westcliff-on-Sea, Essex, UK, SS0 0RY; Tel:0170 2385250 Fax:0170 2385908 e-mail: mike.almond@southend.nhs.uk

Abstract

The Bywaters' seminal 1941 British Medical Journal paper on the crush syndrome was important both for its written content and for using a photomicrograph demonstrating 'pigmented casts' in the renal tubules. He appeared to be reporting the first cases of renal failure secondary to crushing injuries. Most at this point would have been content yet Bywaters demonstrated both determination and humility by publishing a letter in the BMJ 4 months later. This letter, now almost forgotten and rarely referenced, significantly corrected his original paper. He identified that descriptions of the syndrome had been made before, not least by German pathologists in World War 1. The letter recognised various pathologists and surgeons, Colmers (1909) reporting on casualties from the Messina earthquake suffering from "acute pressure necrosis" and Frankenthal (1916) describing soldiers who had been buried in the trenches showing oedema, bloody urine and post mortem ischaemic muscle necrosis. Others were credited as describing similar cases in inaccessible journals or in "inaugural dissertations". Hackradt (1917) described injuries from burial with oedema of the leg and bloody urine containing albumin and casts, necropsy showed muscle necrosis and tubular degeneration in the kidneys with blood casts and Lewin (1919) described 3 similar cases. Bywaters subsequently credits Minami (1923) a Japanese dermatologist working in Germany for summarizing the literature and providing a description that tallied exactly with his own. Finally Bywaters puzzles why the standard textbooks on war surgery available in Great Britain and the U.S.A. in 1941 make no mention of this entity.

Key words: acute kidney injury, Bywaters, crush syndrome, letter, muscle necrosis, pigmented casts

Introduction

The most remarkable fact in Prof Eric Bywaters' career and its relation to the crush syndrome is that he was not a nephrologist but rather a rheumatologist. In a career spanning more than 60 years, he spent only seven working on renal disease. Having qualified in medicine in London in 1933 he found himself immediately prior to World War 2 in the USA working at the Massachusetts General Hospital investigating patients with systemic lupus erythematosis. In 1939 he returned to the UK to work at the Postgraduate Medical School in the Hammersmith Hospital, London, once again pursuing a career in rheumatology. It was here that Bywaters was working when World War 2 began.

The crush syndrome

The concentrated bombing of London, ''The Blitz'', began in September 1940. Within a fortnight Bywaters recalls seeing his first two victims when two casualties were admitted having been buried underneath debris but apparently relatively well when rescued. However, within a few hours they collapsed, became pale and hypotensive. Despite resuscitation with plasma they died from uraemia 5 to 6 days later [1]. Very quickly increasing numbers of cases were seen by Bywaters and colleagues around London with this familiar pattern being repeated. Autopsies although difficult under the circumstances, Bywaters describes taking shelter from a bombing raid under the autopsy table [1], were completed with histological examination of the muscles of the back and pelvis and crucially the kidneys. It was noted that patients rescued from entrapment, developed limb swelling due to the accumulation of serum and that surgical incision revealed muscle necrosis.

In 1941 Bywaters and other colleagues submitted two papers to the British Medical Journal (BMJ) describing the clinical course and pathology of patients admitted to London hospitals after rescue from collapsed buildings. Both papers were published in the same March 1941 edition of the journal. The lesser referenced paper described a single case of the crush syndrome but contained no histology [2]. The second, usually recognised as the Bywaters' seminal paper on the crush syndrome, was important not only for its written content but for using a photomicrograph of the histology of the kidney demonstrating 'pigmented casts' in the tubules [3].

The 'forgotten' letter

The four cases presented in the Bywaters' paper confirmed that crushing injuries, primarily to the limbs, produced shock which despite restoring circulation and even after recovery resulted in the patients developing nitrogen retention and dying. Renal histology showed degenerated changes in the tubules and pigmented casts in the nephron which were subsequently confirmed to be myoglobin.

Most authors would at this point have been content to have been recognised as being the first to have described a 'new' pathological entity and satisfactorily described the pathophysiology leading up to renal failure. Bywaters however continued to

search the literature, which given the circumstances of bombing, manual searching of documents and language barriers must have been a considerable effort during a period of simultaneous intense clinical work.

Bywaters subsequently identified a substantial body of literature predominantly in German texts describing previous cases mirroring his own experiences. In a letter to the BMJ published in July 1941 [4], just 4 months after his original paper Bywaters clearly and humbly gave credit to a series of German pathologists and surgeons for their earlier descriptions, even more remarkable given the time and circumstances of his writing.

In this rarely referenced letter [4], in comparison to the original BMJ paper [3], he first gave credit to Colmers (Franz Colmers-Coburg) who attended in 1909 casualties of the 28 December 1908 earthquake in Messina, Italy which claimed some 70,000 lives. Colmers described among 83 casualties 19 suffering from “acute pressure necrosis" and one case had a history of bloody urine and oliguria.

Next he gave significant merit to 3 doctors supporting the German Army in World War 1. Firstly, Ludwig Frankenthal who volunteered as an army surgeon in 1914 and in 1916 described serious injuries to three soldiers who had been buried and showed oedema, bloody urine and post mortem ischaemic muscle necrosis. Secondly, Hackradt in 1917 working in Max Borst's laboratory, who had set up Germany’s systematic ‘war pathology’ service, described tissue from a soldier experiencing a nine-hour burial with oedema of the leg, blisters and bloody urine containing albumin and casts, the patient dying on the fifth day. Necropsy in this case showed muscle necrosis and tubular degeneration in the kidneys with blood casts. The last of this trio was Lewin, a student of Ludwig Pick, who briefly described 3 cases in 1919.

Bywaters’ explanation for these cases not being referenced or commented upon in his original paper lay with them being in inaccessible journals or in "inaugural dissertations".

Most importantly he gives recognition to Siego Minami a Japanese dermatologist working in Germany, also under Prof Pick in 1923 who summarized the chaotic literature and investigated more completely material from the three cases that had been already described by Lewin. His description of one of these cases tallied exactly with Baywaters’ own; a soldier buried by a grenade explosion for an unknown time, on the second day showed a painful swelling of the left thigh; on the fourth day scanty bloody urine and tenderness in the kidney region; on the fifth day 200 c.cm. of urine only, less pigmented, was found, and on the sixth day, when death occurred, the urine was still scanty (but now yellow) and contained red cells and hyaline casts. Necropsy showed grey muscle necrosis and oedema of the lungs. The kidney showed normal glomeruli, degeneration of the convoluted tubules, and pigmented masses and ribbons in the collecting tubules and in Henle's loops [5].

It was clearly stated in the letter that by the end of World War 1 the crush syndrome and its consequences for the kidney was well recognized by German pathologists, and included in their textbooks of war surgery. However, in Great Britain it appeared to have been both unrecognized and undescribed. At the time of his writing and in the midst of a second great conflict Bywaters wonders why there was no reference to the German findings in any of the six standard textbooks on war surgery published in Great Britain or the USA.

Recommendations

Bywaters’ work on the crush syndrome did not end with his pathological description and pathophysiological causes. Further work on animal models led him to make recommendations on ways by which the kidney could be protected in these circumstances. His recommendation for early fluid resuscitation, ideally to produce an alkaline diuresis, and crucially whilst the patient remains trapped under the wreckage [6] remains true today.

Bywaters’ letter ends with sage advice for those engaged in providing medical support to casualties of war (or in fact civil catastrophes). He points out that the surgeon under these conditions is often too busy to give detailed consideration to anything beyond what is absolutely necessary for the well-being of the patient. He explains this is where co-operation between surgeons, physicians, and research workers becomes of the utmost importance: clinical, chemical, and pathological observations adequate enough to make any rational deductions regarding treatment are in many of these conditions far beyond the capabilities of any single, even full-time, worker. The advantages of group research were thus obvious to him.

References

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