Desmond Beall — a Canadian's contribution to understanding rhabdomyolysis

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Summary

A pioneer in multiple areas of biochemical research, Desmond Beall made important contributions to Canadian medical history. His legacy laid the foundation for several modern scientific advances, extending from his doctoral work in Toronto on equine estrogen (which led to the development of conjugated estrogens) to landmark work on rhabdomyolysis during World War II. Though some theoretical understanding of the pathophysiology of traumatic rhabdomyolysis existed previously, Beall and his colleague Eric Bywaters substantially advanced this field of study with their publications on patients treated during the 1940 Blitz bombings. After the war, Beall shifted to working in industry and was able to translate his scientific advances into products affecting the lives of patients worldwide. Drawing from published works and personal communications with family members, this article is a memorial to a remarkable yet relatively unknown scientist.

Canadian scientist Dr. Desmond Beall played an important role in several 20th century medical breakthroughs. These included characterizing rhabdomyolysis, developing the chemistry for conjugated estrogens, and organizing the production of penicillin in Canada. Despite his important contributions to modern medical research, Beall's pioneering role in Canadian medical history has received disproportionately little recognition.

Desmond Beall was born in Germiston, South Africa, on Feb. 2, 1910. He was the third of Clara and Percy Beall's 4 children (Charles Beall: personal communication, 2021). The family moved to Canada, settling first in Calgary, Alberta, in 1913 and then in New Westminster, British Columbia, in 1920, where Beall lived until he graduated from the University of British Columbia (UBC) in 1932. Following the completion of his undergraduate degree at UBC, he entered a doctoral program in biochemistry at the University of Toronto (Charles Beall: personal communication, 2021).

In 1935, Beall completed his doctorate on the extraction of estrogen compounds from the urine of pregnant mares, research that led to the development of conjugated estrogens (Charles Beall: personal communication, 2021). Following the completion of his doctorate, Beall moved to London, England, for a position with the Medical Research Council preparing the international progesterone standard for the League of Nations. He was awarded the prestigious Beit Memorial Fellowship in 1937 for his continued research in the United Kingdom (Charles Beall: personal communication, 2021). It was there, during World War II, that he and Eric Bywaters published work that provided the foundation for our modern understanding of rhabdomyolysis.

At the beginning of World War II, Beall was working as a researcher for the newly formed British Postgraduate Medical School, associated with Hammersmith Hospital in London (Charles Beall: personal communication, 2021). In September of 1940, the German Luftwaffe began its Blitz on the city, an unremitting bombing campaign that resulted in 40 000 civilian

deaths and damage to more than a million houses. Hammersmith Hospital, located outside of central London, received many patients who initially appeared stable enough for triage to the periphery but then died of uremia. This observation would spark modern rhabdomyolysis research.

While there are historic accounts of what was likely rhabdomyolysis, the condition was neither broadly known nor understood at the outset of World War II. An association between traumatic injury and uremia had been reported by Franz von Colmers following the 1908 Messina earthquake.[1] In 1918, it was described again in a German case report by Ludwig Frankenthal stemming from observations from World War I. However, the pathophysiology of rhabdomyolysis had never been investigated.

Our modern understanding of rhabdomyolysis began when a 1941 issue of the *British Medical Journal* published a case report of what Beall, Bywaters, Ronald Belsey and J.A.R. Miles described as the "crush injury syndrome."[2] The case was that of a 20-year-old leather worker who was injured in a bombing of his hostel in January 1941 and ultimately died, having sustained only a crush to his left leg. The case report was accompanied in the same issue by a case series entitled, "Crush injuries with impairment of renal function."[3] In this second article, Beall and Bywaters describe the cases of 4 patients with crush injuries and associated renal dysfunction who presented to Hammersmith Hospital between September and December 1940. All of the patients in the series were described as having incurred crush injuries to a limb and initially appearing "in good condition." However, the patients showed delayed-onset renal injury with decreased urine output and eventual systemic decline.[2,3] In autopsies of the patients, all were found to have muscle necrosis and degenerative changes of the renal tubules with "casts containing brown pigment." Bywaters and J.K. Stead later identified the nephrotoxic agent as myoglobin in 1943.

In their case series, Beall and Bywaters stated that treatment of the condition at that time had "so far been by trial and error."[3] Their suggestions included "restoring urinary function by means of heat to the loins," by use of diuretics such as caffeine, and even by "decapsulation" of the kidney.[3] One recommended strategy that has held up despite decades of additional research has been to increase glomerular filtration force with saline infusion.[3] Further work by Bywaters and Stead in the ensuing years validated the need for aggressive use of intravenous fluid therapy to treat rhabdomyolysis; however, by that time, Beall had returned to Canada and turned his attention to new projects (Charles Beall: personal communication, 2021).[3]

In 1941, Beall was recruited to head Canada's penicillin production for Ayerst, McKenna & Harrison Ltd in Montréal (Charles Beall: personal communication, 2021). He was responsible for bringing into existence the first commercial penicillin unit in Canada. Later, he continued work on conjugated estrogens that would enable the young pharmaceutical company to create and market Premarin (Charles Beall: personal communication, 2021).[4] Over the next 4 decades, this medication would eventually become the most prescribed medication in the United States and Canada's top pharmaceutical export.

In recognition of his own contributions to scientific advancement in Canada, Beall was awarded the Fellow of the Royal Society of Canada in 1944. In 1953, he moved to the United States to continue his work with Ayerst, McKenna and Harrison at their American plant in Rouses Point, New York (Charles Beall: personal communication, 2021).

Beyond Beall's many scientific achievements, he was a loving husband and father. He was known for his volunteer efforts with Scouts and his local church (Charles Beall: personal communication, 2021). According to his son Charles, he was a skilled craftsman and enjoyed working with his hands in and outside the laboratory. Beall died of cancer in Wilmington, North Carolina, 4 days before his 89th birthday. He was survived by his wife, 5 children and 9 grandchildren (Charles Beall: personal communication, 2021). The breadth of his scientific work has left a lasting legacy across many areas of modern medicine, and he remains an important figure in Canadian medical history.

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