Alexis Carrel receives the Nobel Prize for Medicine

One hundred years ago, in October 1912, Alexis Carrel received the Nobel Prize for Physiology or Medicine. He was not yet 40 years old and was the youngest recipient at that time, as well as being only the third surgeon to receive this award. Indeed, to the present day only nine surgeons have been so honoured. Who was this remarkably talented man, and what were his contributions to medical progress?

Alexis Carrel was born in 1873 in the little village of Sainte-Foy-lès-Lyon, on the banks of the river Rhône near the ancient city of Lyon. His father was a prosperous textile manufacturer. After education at a Jesuit school, Alexis entered the Faculty of Medicine at the University of Lyon in 1890. He qualified 3 years later and completed his surgical training at the Hôtel Dieu at Lyon, interrupted only by his year of military service with the mountain troops.

Carrel was deeply affected by the death of the French President, Sadi Carnot, who died in hospital in Lyon in 1894 from an assassin's stab wound to the abdomen, which lacerated the portal vein. Carrel realized that the president's life might have been saved if effective vascular repair had been used. Up to that time, suture of blood vessels was in its infancy. Carrel's own chief, Mathieu Jaboulay, was experimenting with end to end vascular anastomosis. In 1897, after extensive animal studies, John B Murphy in Chicago carried out the first successful repair of a gunshot wound of the femoral artery, invaginating the proximal into the distal stump of the artery by means of fine silk sutures.

Carrel set up an extensive research programme into this problem. He visited the famous lace workers of Lyon and obtained from them their incredibly fine needles and silk thread for his work. He developed a triangulation technique to oppose the ends of the vessels and was able to carry out a wide range of vascular repairs in dogs, including arterio-venous anastomoses between the carotid artery and jugular vein. In the mean time he wrote his doctoral thesis on thyroid cancer, which was accepted in 1901.

In 1904, Carrel joined the Hull physiology laboratory at the University of Chicago. Here he collaborated with a young American research worker, Charles Guthrie. It was a fruitful partnership. Over the next couple of years, they jointly published 21 papers on various types of experimental vascular anastomosis. They established the need for meticulous surgery, carried out under careful aseptic technique. Carrel predicted that vein grafts would be used to replace damaged arteries in man – a prediction that came true 50 years later. He successfully re-implanted the completely amputated leg of a dog; limb re-attachment in man was first performed in 1962.

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Carrel performed experimental grafting of kidney, ovary and thyroid in dogs and showed that organs could be transferred to other sites and would still function – for example, a graft of kidney to the neck of the dog. However, when grafts were performed between different animals, after a short period of function, the grafted kidney would cease to secrete and would die.

Carrel stated that he had solved the technical problems of transplantation, only the biological problems remained. Again, it was not until the development of effective anti-rejection drugs (the first being 6-mercaptopurine) in the 1960s, that this dream became a reality.

In 1906, Carrel was invited to join the newly opened Rockefeller Institute for Medical Research in New York, where he was to spend the rest of his active career. Here he showed that blood vessels preserved in cold storage could be used to replace the aorta, carotid and other vessels and could be carried out across species (we now know that the freeze-dry process destroys the tissue antigens). It remained for Charles Dubost, in Paris in 1951, to replace an aortic aneurysm with a freeze-dried human aorta in man. Carrel also studied cardiac surgery in the dog, including digital exploration of the mitral valve. His suggestion that this could be used in mitral stenosis in man came to fruition in the 1950s.

In 1912 came the award of the Nobel Prize. His citation included these words: 'Your animal experiments have multiplied the means of cure of wounds and diseases which strike us all and have created great renown for the name of Carrel in the domain of Medicine.'

At the outbreak of World War I in 1914, Carrel immediately returned to France. In Lyon he set about studying the dreadful problem of wound infection in high velocity missile wounds. Together with the chemist Henry Dakin, an Englishman working in New York, he established a special hospital at Compiègne. Here he developed the Carrel–Dakin technique – wound excision, removing all damaged and ischaemic tissue, then continuous perfusion with a dilute solution of sodium hypochlorite ('Dakin's solution').

The post-war years were spent at the Rockefeller Institute, where he carried out extensive studies on tissue culture and organ perfusion and preservation – again, fundamental to later work on organ transplantation. Carrel reached the retirement age of workers at the Institute, 65 years, in June 1939 and returned to France – he had never given up his French citizenship and indeed spent every summer holiday in his homeland. Of course, France was soon engulfed in the second World War and German occupation. He died of heart failure in Paris on 5 November 1944 at the age of 71 years, soon after the city had been liberated by the allied forces. **BJHM**

Professor Harold Ellis *is Emeritus Professor of Surgery, Guy's, King's and St Thomas' School of Biomedical Sciences, London SE1 1UL*

Conflict of interest: none.