The Remarkable Dr. Abildgaard and Countershock

The Bicentennial of His Electrical Experiments on Animals

THOMAS E. DRISCOL, M.D., OSCAR D. RATNOFF, M.D., F.A.C.P., and ODDVAR F. NYGAARD, M.D.,
Cleveland, Ohio

In 1775 Peter Christian Abildgaard, a Danish veterinarian and physician, conducted experiments on electrical countershock on animals. He succeeded in first rendering fowl lifeless by an electric shock and then reviving them by a countershock applied to the chest. Ventricular fibrillation and defibrillation were not known and could not be documented at that early date, but his report suggests he accomplished these changes long before other physiologists described them. Dr. Abildgaard’s long and varied career included many significant contributions to veterinary and human medicine, biology, zoology, botany, physics, chemistry, and mineralogy. He also took an interest and was active in politics, economics, and community affairs. This short biography is intended as a fitting, though belated, tribute to his pioneer work on effects of electric shock.

Two hundred years ago Peter Christian Abildgaard, a remarkable Danish veterinarian and physician, published a summary of his experiments on the effect of electric shock on animals. His experiments were published 124 years before Prevost and Battelli (1, 2), in 1899, described the fibrillating effects of a weak current on the heart and defibrillation by strong currents, and about 150 years before serious experiments on defibrillation. Although we cannot be certain that Abildgaard induced fibrillation and defibrillation, his report to the Medical Society of Copenhagen in 1775 (3) may lead the reader to his own conclusion.

With very few exceptions, almost all reports of beasts and men, slain by a bolt of lightning, state that nothing in such bodies, when dissected, was found which was sufficient to be called the cause of death; for, very rarely did the internal organs seem affected, nor were traces of the impact or the touch of the lightning found, except occasionally on the surface of the skin. On the very few occasions when internal injuries were evident, either the lungs were swollen with blood, or the pulmonary vessels had been ruptured with an accumulation of blood in the head, as if it were in a vacuum. Only a single example of notable destruction is known to me, reported by Mussem-Broekio concerning a flock of sheep, killed by a bolt of lightning, where the broken bones had been so crushed, that the flesh, filled with small bone fragments and torn, could not be eaten. In truth, such observations of evident damage by the shock are very rare; most commonly is the opposite, where no injury is evident in the bodies of the dead.

Therefore, concerning the cause of death in beings killed by lightning without apparent injury of the organs, it is still rightly asked:

Whether a rarefaction of the air in the same manner by which it occurs from an air pump causes death
Or ruptures of sinews or blood vessels
Or a swooning from the violent convulsion of the sinews and then death?

In order to answer these questions I have undertaken the design of electrical experiments on animals, and after various familiar exercises done with electricity on various animals, I attempted to kill a three-month old horse with a shock of electricity, in order to see whether I was able to arouse the dead animal by another shock, which I believed ought to happen, if the apparent death were nothing except a swooning.

It sustained the most powerful shocks on the head from 10 glass jars enveloped with strips of tin without any injury, indeed it fell to the ground under some shock, a violent occurrence, but soon it arose and with no amount of effort could I kill (this) Herculean animal, nor on account of the violence of the shocks, which broke out with sufficiently awesome uproar, did I dare to use more jars.

Therefore reluctantly leaving the horse, I took a hen, which I knocked down with the first shock directed to the head from one jar, in such a way that it lay without any feeling as if completely dead and was unable to be aroused by any stimulus. After yet another shock given in vain on the head, I believed I had erred in (my) hope of resuscitation; for it remained dead, even after repeated shocks to the head. Too little satisfied with this outcome, I tried an electric shock directed through the chest to the spine of the back, and not without success; for suddenly it rose up and, set loose on the ground, walked about quietly on its feet.

Then happy with the discovery I repeated the experiment with the same outcome, for, with a shock to the head, the animal was rendered lifeless, and arose with a second shock to the chest; however, after the experiment was repeated rather often, the hen was completely stunned, walked with some difficulty, and did not eat for a day and night; then later it was very well and even laid an egg.
I attempted the same experiment with a domestic cock, which, after many successive shocks to the head, appeared completely dead, so much so that blood flowed from its nostrils and jaws; (then) indeed, at a shock in the chest, it briskly flew off, threw the electric jar on the ground and broke it.

Next I undertook to find out whether without the resuscitating shock to the chest and of its own will the animal, lifeless from the lethal shock, was able to revive. I took a different hen, along with the same cock, upon which I had conducted the second experiment. I left both on the ground convulsed and made lifeless by one shock from one jar. But on the next morning I found them completely dead and very cold, and I was unable to revive them with the electrical machine with any amount of trying.

On the next occasion I shall not forsake to convey to the Society the continuation of the experiments and the conclusions, which thence I believe are able to be deduced.

Despite this last reassurance, we have been unable to find any subsequent writings by Dr. Abildgaard on this subject. His experiments did not go totally unnoticed at the time. In a monograph entitled, "The Observations on Animal Electricity in Explanation of the Metallic Operation of Dr. Perkins" (4), John Vaughan in 1797 wrote: "The ingenious Dr. Abildgaard has deprived fowls of all sensation and motion by passing violent shocks through their heads; and reanimating them, by gentle shocks passed through the heart and lungs." The anonymous compilers of a 1779 review journal wrote: "The experiments by Dr. Abildgaard may . . . perhaps (lead) to important discoveries with respect to the means of recovery in . . . case (of death from lightning)" (5). But cardiovascular physiology and electrophysiology were unprepared to deal with this remarkable phenomenon that Dr. Abildgaard had come upon. First, there had to come a more fundamental understanding of the biology of the heart and then a need for application of this knowledge. The increasing number of fatalities from electrocution brought about by the rising demands of industrial and commercial use of electricity provided the need. Fifty years of experimentation and engineering have brought us modern methods and equipment for cardiac resuscitation and defibrillation. Writing in 1936 about the effects of electric shock on the heart, Ferris and his collaborators (6) made brief reference to Abildgaard's 1775 report. Still, Abildgaard seems an unsung hero. That defibrillation by electric shock may have been accomplished 2 centuries ago led us to examine the story of this remarkable Danish veterinarian. What emerged is the picture of an individual possessed with tremendous industry and intellect and a passion for natural and physical sciences (7-9).

Early Education

Peter Christian Abildgaard was born in Copenhagen on 22 December 1740. His father, Søren, was an artist and illustrator making drawings and sketches of national monuments, seals, handwritings and the like, and was one of Denmark's curators. He had some interest in the natural sciences, which seems to have been passed to young Peter.

From his mother, Anne Margrethe, Peter was said to have inherited wisdom and gentleness. With these traits he began an illustrious career encompassing veterinary science, medicine, biology, zoology, botany, physics, chemistry, mineralogy, politics, economics, and community affairs.

Not much is written of Peter Abildgaard's first 12 years, but he apparently had sufficient aptitude for future schooling because he entered the Cathedral School in Copenhagen in 1752 over his father's objections. Judging from his later achievements the 4 years there must have been productive, but in 1756 he was taken out of school because his father could not support his son financially, and he was apprenticed to a well-known apothecary of his time, Cappel. This new adventure brought him into contact with F. H. Müller, who was to become one of the great chemists of that time. Abildgaard attended to his apothecary duties in the daytime and pursued school studies and conducted chemistry experiments at night. He put to use his talent at drawing, a skill learned from his father, by painting attractive signatures on drug boxes at the hospital. Some of these boxes have survived.

Abildgaard very much wanted to be a student, and his bright intellect and inclination to study and work prevailed. Over his parents' objections, he took the philosophy examination and matriculated at the college in Copenhagen in 1760. He immediately gained the admiration of his teachers and his fellow students. He was a favorite of the professors and showed respect for all branches of knowledge. In 1762 (7)*, he received a bachelor's degree, writing his thesis on "The Value of Chemistry in the Economy of the State." He then turned to the study of medicine at the Copenhagen Medical College. After 2 years, his rare

* Reference 9 gives 1761 as the year he received his degree.
energy and talent enabled him to be selected as one of three students sent to France at the government's expense to study veterinary medicine. A combination of events put into motion the circumstances that directed his future career.

Experiences at the Lyon Veterinary School

The recurrent cattle plague of Europe emerged again in 1762. That year, Bourgelat opened the new veterinary school in Lyon. Count Bernstorff, the prime minister and foreign secretary of Denmark, persuaded his colleagues to send three medical students to Lyon to learn methods for controlling and limiting the cattle plague. The next year, Abildgaard began a 2½-year period of study that set the pattern of his future professional career. Because he recognized its importance to his native Denmark, he studied veterinary science and veterinary medicine diligently. He was admired for his conscientiousness and became a favorite of Bourgelat himself. Opposition to some of the means of plague control and an application to study with Vitet, Bourgelat's rival, almost lost him this favor.

The school at Lyon was primarily concerned with theoretical aspects of veterinary medicine, particularly as applied to horses, the most costly domestic animals. Abildgaard wrote that the therapy used at the sick stables could only be called experiments and that science had not yet been firmly established there. He believed that these experiments were not carried out in such a way as to acquire any solid insight into the nature of the diseases and the effects of drugs. This failure, he thought, was because students rather than teachers carried out the studies. Lectures were written by eminent professors, but these were explained to the students by lesser persons who lacked experience in the veterinary field. According to custom, it was not considered suitable for distinguished men to deliver the lectures in person. To supplement his veterinary education, Abildgaard continued his study of medicine while at Lyon, attending lectures on chemistry, anatomy, materia medica, obstetrics, and surgery at the famous Hôtel Dieu in Lyon.

Return to Copenhagen

Abildgaard returned to Copenhagen in 1766 as a well-educated hippiatrician and attempted to establish a Danish school of veterinary medicine. Unfortunately, one of his supporters, King Frederik V, died, and the new government had little interest in this enterprise. Although Abildgaard was given a 2-year scholarship to continue his studies of the cattle plague, he felt a growing pessimism about the future of a veterinary school and concentrated instead on medicine. He received his doctor's degree on 7 September 1768, writing his thesis on “Blood Letting in Suppression of Menstruation.” Although many of his colleagues admired him, some town residents scorned his practice of veterinary medicine. As ever, there was the question of providing for his family. Bernstorff, a member of the new government, encouraged the establishment of the veterinary school, which opened in Copenhagen in 1773 with Abildgaard as its principal director at an annual salary of $1200. Veterinary science was still primarily concerned with horses, and the new school was devoted almost exclusively to the care of the royal stables. In 1776-1777, the school became a royal institution and, with a firm charter, attracted especially educated candidates.

Abildgaard managed to continue his dual role as veterinarian and physician, and in 1775, the year he reported his results of his electrical trials on animals, he was appointed State Physician in Copenhagen. As such, he was an active and eager participant in the midwife and quarantine commissions and later in the Society for Revival of the Drowned. Because the new veterinary school consumed his time, he finally retired from the practice of medicine in 1782. He was then free to devote his time and energy to veterinary medicine, and he traveled extensively in many countries, including Sweden, Spain, Germany, Italy, Portugal, and Norway. On these trips he collected much useful knowledge through personal contact with leading scientists of his time. His varied interests are reflected in the wide range of subjects on which he wrote and studied.

Scientific Accomplishments

The physical sciences occupied much of his time, and he contributed copiously to the fields of mineralogy and geology. He discovered that kryolith contained fluor and aluminum. He also wrote about stalactites and classified a variety of stones found in Norway and Greenland. He wrote about the last eruption of Mount Vesuvius, conducted chemical experiments with coal, and described a new way to remove brownstone from iron. His extensive and valuable mineral collection is now at the University museum.

Abildgaard was thoroughly familiar with many branches of physics, which may explain his interest in the effects of electricity on animals. He co-authored a large textbook of physics, writing the chapters on light, electricity, magnetism, and earth himself. He carried out studies on such varied subjects as the use of sea salt to prevent freezing of water, the generation of gas by means of a galvanic battery, and the significance of the alleged greater weight of iron at the pole than at the equator. He also initiated experiments with a hot air balloon and, in 1783, constructed an “aerostatic” machine. After an initial unsuccessful ascent, on 5 January 1784 Abildgaard's aeronaut was launched from the driveway of Christianborg castle and floated over the city roofs.
Abildgaard's isolation and extermination procedures were successful method of control. This idea met with considerable opposition from those favoring inoculation, but Abildgaard was able to show that his idea was right. Abildgaard's isolation and extermination procedures were carried out by governmental decree, and, by 1786, the disease had been conquered.

Dr. Abildgaard belonged to many famous national and international societies, including the Royal Danish Academy of Science, the Royal Medical Society, and the Natural History Society. He was a founder of the Scandinavian Literary Society and Danish Agricultural Society.

Abildgaard (who sounds more and more like his fellow student of electricity, Benjamin Franklin) did not confine his interests and activities to science. In his younger days, he was a correspondent and contributor to several critical and aesthetic journals, writing under a pseudonym. He also wrote on freedom of the press and served on a commission for improving the local fire department.

Some insight is gained into the nature of Abildgaard's character from his many scientific works and by the admiration for him by those around him. His kindness and charity extended even to those who at times opposed him vigorously. He was said to have had a meekness, though strength of spirit, but could be volatile and explosive as well. He was described as a knowledgeable teacher with a communicative nature and was a generous helper to his students, motivating them to pursue a career.

Physically, he was a handsome man of medium stature, with rather inlaid ears and a bald pate with a snowy white base. An illness during his early years was said to have left him with some residual weakness. His health, for instance, prevented him from accepting an appointment as professor of physics. On 21 January 1801, having just turned 50, Peter Christian Abildgaard died of a cerebrovascular accident.

Dr. Abildgaard's accomplishments in veterinary medicine have not been forgotten in his native land. But his experiments on resuscitation through electric shock have not received due recognition. Abildgaard reminds us that what seems to be random or esoteric research today may provide clues to pragmatic results tomorrow.

