AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

1

Guy Fontaine : An International Scientist

Guy Fontaine was born in 1936 in the city of Corbeil Essonnes in France. He attended primary school in a Loyola institution and received high secondary school education at the Lycée Montesquieu in Bordeaux prior to moving to Paris. During World War II he lived in the city of Orléans. After its end he completed his secondary school in Paris.



La Salpétrière 1974 with R Frank and N Proust Murray Kornfeld Lecture Boston 1989 « Arrhythmogenic Right Ventricular Dysplasia »

For the last 40 years he has been in the frontier of electrocardiography and clinical electrophysiology. His training in electrical engineering, together with his medical degree was an excellent background to enable him to contribute to this field. When he first started his career in the 1960s, this was a time of rapid development in medical electronics. In the late 1960s he built and designed different electronic devices for the treatment of patients with cardiac electrical disorders, including a device to synchronize DC shocks on the QRS complexes for the treatment of atrial fibrillation. Some of this equipment is now in the Museum of the Assistance Publique in Paris. Later he used his knowledge of electrical phenomena to make significant advances in pacemaker technology in rapid development at that time. One device presented in his medical thesis was used for studying the cardiac pacing threshold of patients waiting for pacemaker implantation. In 1966, he received his doctoral degree with "high distinction" for his work entitled "Contributions to Electrical Stimulation of the Human Heart". This led him to propose new ideas which have been incorporated by the pacemaker industry in their equipment. These include a design to test the cardiac stimulation threshold and later a system to evaluate the pacing threshold automatically and continuously.

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

2

In 1967, he was the first physician in Paris to implant permanent pacemakers using intracardiac leads. Because of his expertise in this area he was referred patients with difficult arrhythmia problems from Europe and abroad. In 1968, he joined the cardiology staff at the Hôpital de la Salpêtrière in Paris in the department of Professor Jean Facquet. In the following years he declined several offers of academic positions in order to devote his efforts to clinical research in cardiac pacing. This attitude was based on the fact that under the supervision of his first master and mentor Pr JJ Welti he was absolutely convinced after multiple autopsies showing "hearts too good to die" that the eradication of sudden death due to atrioventricular conduction disturbances was possible by solving technical and biotechnical problems. In those early days of pacemaker technology, it was a challenge to implant endocardial leads that would remain in a stable position providing a low pacing threshold after the initial normal rise of this parameter. Patients considered for implantation were the most severe cases. Therefore pacing failure was frequently followed by tragic events. He worked with computer programmers to develop the software to study the histograms of 2400 threshold measurements. Each patient had right ventricular leads connected to an external pacemaker. When the threshold stabilized at an acceptable level, the pacemaker was implanted, if not the endocardial lead was repositioned. He took personal meticulous care of the dressing when the leads emerged from the skin to prevent infection. This complication never occurred.

In 1975, he became interested in tachycardias and their treatment by pacemakers. He observed that many episodes of chronic ventricular tachycardia were preceded by extrasystoles. They were inducing their own repetition following the "rule of bigeminy". He therefore used a properly timed stimulation of the ventricle to shorten the recovery pause after the extrasystole preventing ventricular tachycardia. This concept was later applied to obtain the same result by stimulating the atrium instead of the ventricle. This was achieved for permanent pacing by incorporating a resistor in the ventricular lead and connecting this lead with a regular atrial lead to the output of the first single chamber digital pacemaker (Vitatron DPG-1). This design based on an in-depth knowledge of electricity and biophysic parameters was recognized as an intellectual tour de force.



Lead Arrangement and Proper Programming Function

1000*

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

3

In 1976, he published the book "The Essentials of Cardiac Pacing", co-authored with his mentors and colleagues, Professor Y Grosgogeat and JJ Welti. This work was translated from French into English, German and Spanish. At that time he worked simultaneously at la Salpêtrière and implanted pacemakers in a private hospital in the center of Paris. He participated in the training of many colleagues in this field and personally financed his own research.

Dr. Fontaine was fascinated by the first surgical attempts to ablate the accessory bypass tract in the WPW syndrome first performed successfully in 1968 at Duke University (USA). After six months of work in the experimental surgical laboratory of Christian Cabrol in Paris, he developed with Dr Guiraudon the technique of epicardial mapping in 1971. They performed the first European successful surgical ablation of an accessory pathway. He refined the technique of mapping by designing amplifiers with summation, rectification and filtering properties to simultaneously record signals from three electrodes located at the distal end of a specially built curved probe. This was designed to record potentials originating on the diaphragmatic ventricular surface without the need to lift the beating heart at the time of surgery. A grid based on anatomical landmarks independent of the size of the heart was designed and was later used worldwide by researchers in this field. In 1977 the first representation of isochrones of epicardial activation drawn by a computer program was developed. He designed a method to reliably measure ventricular activation times despite the irregular rhythm produced by atrial fibrillation with the use of a tape recorder combined with an oscilloscope.





Epicardial Mapping Grid



Analogic Delay is Produced by a Tape Recorder for Precise Mapping During Atrial Fibrillation

Dr. Fontaine and his associate Dr. Robert Frank, then perfected the technique of epicardial recording which permitted them to obtain the first recordings of epicardial late potentials in humans confirmed six months later by endocardial recording.

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

4



,

Endocardial Delayed Potential Note the absence of Pot 3 on the First Beat (Subtricuspid Cath in ARVD)

Using the same hand held probe that was previously used for mapping the accessory bypass tract, Drs. Fontaine, Frank and Guiraudon began to map the reentrant circuits in patients with ventricular tachycardias during surgery. They demonstrated for the first time the interruption of the reentrant pathway and prevention of recurrent ventricular tachycardia with a "simple ventriculotomy". This approach documented that reentry was the mechanism of most chronic forms of ventricular tachycardia, a concept that was controversial at that time.

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03



The Lifetime of Achievement – One hundred - 2005

5

Mapping of the Reentrant pathway in a patient with Uhl's anomaly. The bidimensional structure of remaining myocardium suggests that the pathway is properly determined. However VT entrainement (sometimes concealed) should have been performed on each test point of the circuit to definitely proof perfect pathway delineation

Another interesting contribution of Dr. Fontaine and his group was to demonstrate the delayed activation of normal myocardium after a period of about 100 milliseconds after pacing in a zone where late epicardial potentials were recorded.

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03



The Lifetime of Achievement – One hundred - 2005

6

This again reinforced the concept of a reentrant phenomenon in heart muscle and definitely excluded the mechanism of triggered activity, another challenging mechanism extensively studied in the laboratories of experimental electrophysiology. From this observation and following the remarkable work on "entrainement" in atrial flutter made by Dr Albert Waldo who trained in Columbia University in New-York (NY) where they first met, Dr Fontaine was able, after three days of intensive work with only pen and paper, to propose a new technique of identifying the critical zone of slow conduction in ventricular tachycardia (concealed entrainement). That was his second intellectual tour de force ! This zone is the most appropriate for ablation of a circus movement tachycardia. This approach was later extended by others for the same purpose to other forms of reentrant arrhythmias. It is now a commonly used method in the electrophysiological laboratory.

Pacing in the Zone of Slow Conduction with Time Dependent Properties Note the Delay between the Pacing Stimulus and the Ventricular Response

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

7

The Zone of Slow Conduction



Schematics of the Result of Stimulation in the Zone of Slow Conduction Pathway Critical for the Perpetuation of a Reentrant mechanism (Left Top) and Outside this Zone (Left Bottom) Intermediate situation Recorded during EPS in chronic VT (Right)

Dr. Fontaine relocated in 1979 to the Hospital Jean Rostand continuing the care of referred patients with supraventricular and ventricular tachycardias who were unresponsive or intolerant of antiarrhythmic drugs.

It was just before this phase of his work that Dr. Fontaine suggested the term of "Arrhythmogenic Right Ventricular Dysplasia" (ARVD) to describe a new clinical entity found in young patients with ventricular tachycardia originating in the right ventricle showing replacement of myocardial tissue by fat and fibrosis (1977). In these patients the left ventricle was apparently normal. This work led to the publication of a clinical profile of this condition in collaboration with Pr Frank Marcus from Tucson Arizona (USA) who spent a sabbatical year at Jean Rostand hospital in 1979. Dr. Fontaine continued to contribute to our understanding of this condition by many observations including the discovery of late potentials on the surface electrocardiogram (Epsilon wave) and its effect on the understanding of the electrical field of the heart.

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004

International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

8

He developed several software programs to permit the first recording of late potentials on the thorax by the summation averaging technique, the creation of a program simulating the

The First Recording of Signal Averaging ECG



Analogic Recording of Late potentials on the Surface ECG by High Amplification and Filtering



genesis of potentials recorded by a unipolar versus a bipolar electrode system. This facilitated understanding of late and fragmented potentials. He developed other computer programs for the automatic exploration of the atrioventricular conduction properties of the heart in which the computer was used for stimulation of the heart, analysis of data as well as the automatic drawing of curves expressing the results.



Above : Computer Simulation of delayed Potentials

Right : Electrogenesis of Fragmented Potentials





EPS by Computer Stimulation and Drawing of Curves expressing the results

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

9

Subsequently, several of these concepts such as epicardial maps, summation averaging, automatic programs to facilitate electrophysiologic testing were developed in the United States.



Late Potentials on the Epicardial Maps in a Patient with Almost Incessant Infundibular Tachycardia (Original Grid and Computer built Epicardial Map)

Recently Dr. Fontaine made the important observation that patients with right ventricular dysplasia have a parietal block which results in a QRS complex that has a longer duration in lead V1, V2 or V3 compared with that in V6.

This, in combination with computer processing should be of clinical value for screening or for assisting in verification of this condition. He recently introduced new terms in the classification of bundle branch blocks : the "more than complete" and "more than incomplete" bundle branch blocks. These terms express the prolongation of QRS complexes recorded in the right precordial leads of the ECG as compared to all the other leads. They suggest a trouble in conduction restricted to the right ventricular myocardium in addition to the classical ECG patterns of complete or incomplete right bundle branch block. They could be among other applications, another ECG marker of right ventricular dysplasia.



AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

10



Epsilon Waves or Late Potentials in a Patient with Minor Symptoms (This Tracing has been sent on the request of the Archives of the Heart Rhythm Society)

This work has been recently extended in collaboration with the French Atomic Energy Commission by the creation of a numeric model of electrical activation of the heart. This work was started in 2002 in collaboration with Dr Adriaan van Oosterom from the University of Nimegue (Holland).

Together with Dr. Fontaliran it was found that patients with ARVD appear to be prone to an inflammatory process of unknown etiology involving the right as well as the left ventricular myocardium *superimposed* on the genetic background of ARVD. This mechanism which may be also genetically determined, has been recently extended to all forms of cardiomyopathies. It has important prognostic implications.

Dr Fontaine made an important contribution regarding the pathology of ARVD. He was consulted as to the cause of death of a 17 year old woman who died suddenly. The histological section from the left ventricle showed an area of fat and fibrosis. Since even small areas of fat in the left ventricle appear to be specific for ARVD, it was suggested that the patient may have had ARVD. Subsequent examination of the right ventricle confirmed the diagnosis of dysplasia. This was the first case in whom the disease was identified from the study of the left ventricle.

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

11

An exciting discovery by Dr. Fontaine in conjunction with Dr. Mallat, Dr. Fontaliran and other colleagues is that there is evidence of apoptosis in right ventricular dysplasia that may provide insight into the pathogenesis of this inherited condition. In the normal heart apoptosis is an important mechanism in cardiac embryogenesis by suppression of excessive tissue without necrosis. This process, genetically determined, was identified for the first time in human myocardium in ARVD in 1996.

This disease and its variants is being more frequently recognized, it is a rare but important cause of sudden cardiac death during sports. It is now included in the latest classification of cardiomyopathies proposed by the World Health Organization in 1996 under the more general term of "Arrhythmogenic Right Ventricular Cardiomyopathy".

Dr Fontaine was instrumental in organizing and was President of the First International Symposium devoted to Right Ventricular Dysplasia held in Paris in 1996. Since it is known that this disease is genetic, a challenging problem is how to define the risk of sudden death or identification of this condition in family members. This and other considerations have led Dr. Fontaine to initiate the French registry of right ventricular dysplasia in 1999 and to participate in the European Registry coordinated by Dr Gaetano Thiene in Padua. Other investigators include Drs McKenna in London, Wichter in Germany, Wlodarska in Poland, Protonotarios in Greece as well as other members of Padua University . This registry is collaborating with the North American Interdisciplinary Study of ARVD under the direction of Dr. Marcus.

Dr. Fontaine also did extensive research to help understand ablation using direct current energy. This culminated in further research leading to a doctoral thesis in sciences awarded with "high distinction" from the University of Orsay in 1991. The title of this Thesis was "Physical, Biophysical and Electrophysiological Effects of Fulguration : Application to the Treatment of Cardiac Arrhythmias".



Natural History of a Fulguration Bubble at

Electrical Parameters of a Fulguration Bubble in Voltage, Intensity, Energy and Impedance (WaveForms Recorded / Calculated with a Tektronix 7854 Oscilloscope)



Collapse

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

12

He is frequently sought for his expertise in catheter ablation of cardiac arrhythmias, especially for ventricular tachycardia, and has participated as a consultant on this procedure in a number of laboratories in the United States. He also performed the first Kent bundle ablation in Shanghai in 1990 where 4 patients were treated successfully by fulguration in 3 days, the first successful radiofrequency ablation of the His bundle in St Petersburg in 1992, in Warsaw and Sofia in 1993 and in Portugal in 1995.

Dr. Fontaine is considered as the epitome of the international scientist. He is invited to lecture in Europe, South America, the USA, Japan and China. Notable lectures include one at the American Heart Association in the Main Arena in 1978 (Dallas), The Texas Heart Institute (Houston) in 1981, the Schiaparelli lecture in Venice in 1985, the Mikamo lecture in Osaka in 1986, the Murray Kornfeld Memorial lecture in Boston in 1989 and the Great Wall Cardiologic Conference in Beijing in 2003. He is an active participant in the major international congresses. He was co-director of the University Department of Cardiovascular Electrophysiology at Jean Rostand hospital in Ivry/Seine, a close suburb of Paris, until 2001.

Dr. Fontaine has always stressed international cooperation in medicine. He realized that the traditional French policy of insisting that international congresses in France have to be conducted in French impeded this goal. In 1985, he organized an International Symposium in Paris on the subject of Fulguration and Lasers in cardiac arrhythmias. This was the first scientific event in cardiology held in Paris and conducted entirely in English – a revolutionary development at that time.

The world of micro-computer technology has not left Dr. Fontaine behind. He learned the dBase programming language to evaluate his series of patients treated by high energy DC ablation. The same computer skills are used for the statistical analysis of the data from a population of ARVD patients as compared to a control group.

Dr Fontaine is currently working together with Pr Daniel Thomas, Jean-Philippe Metzger and Iraj Gandjbakhch (Cardiac Surgery) heads of the new "Institut de Cardiologie" in the Hôpital de la Salpêtrière, where ARVD was first identified. He is continuing to study ARVD in 7 French departments/laboratories in Assistance Publique des Hôpitaux de Paris and the French medical research institution INSERM (5 teams).

He was instrumental in convincing Dr William McKenna London (UK) and his group to identify the gene of Naxos disease (a variant of ARVD) and Dr Jeff Saffitz, an expert in confocal microscopy, from Washington University in St Louis, Missouri, (USA) to explain abnormal electrical conduction properties in the myocardium of patients with this condition.

Some recent contributions obtained by the analysis of ARVD patients from the French registry was to demonstrate that older patients with ARVD progress to congestive cardiac failure. He also was the first to report at the American College meeting in 2001 that some of them can be treated by dynamic anterior cardiomyoplasty. This operation wraps the right ventricle with a skeletal muscle partially disconnected from the back of the body. This technique which may prevent heart transplantation was originally developed by Dr Juan Carlos Chachques, Alain Carpentier and Jean Noel Fabiani in Hôpital Broussais and Hôpital Européen Georges Pompidou in Paris.

Since 2003 he has been a consultant for Albert Cansell PhD, General Director of the French department of the Schiller company for the study of light weight defibrillators designed for the treatment of out-of-hospital cardiac arrest.

He is the author of more than 840 scientific articles of which 430 are written in English. There are 216 book chapters of which 150 have been published in English. He is the author or editor of six books on different subjects of Electrocardiography or Electrophysiology. He is a corresponding member of the French Académie Nationale de Médecine since 1993. He has received the Pr Pierre Rijlandt Prize of Electrophysiology in 1995 together with Dario di Francesco, Milano (Italy) and Allan Scher, Seattle (USA).

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

13

For all these contributions Dr Fontaine was the only French investigator of the XXth Century included in the book "Profiles in Cardiology" edited by 3 famous American cardiologists Dr Willis Hurst, Richard Conti and Bruce Fye in 2003. This book which include 18 Frenchmen presents the biography of 216 individuals who have made a significant contribution to Cardiology and Cardiovascular disease since the XIVth Century. He will receive the prestigious award of : "Pioneer in Pacing and Electrophysiology" given by the Heart Rhythm Society in 2005.

Profiles in Cardiology

Editors : Willis Hurst, Richard Conti, Bruce Fye

Foundation for Advances in Medicine and Sciences 2003

French Authors :

XVème

1. Jean-François Fernel (1497 – 1558)

XVIème

2. René Descartes (1596 – 1650)

XVIIème

3. Jean-Baptiste de Sénac (1693 – 1770)

XVIIIème

- 4. Jean-Nicholas Corvisart (1755 1822)
- 5. René-Joseph-Hyacinthe Bertin (1757 1828)
- 6. Julien Jean César Legallois (1770 1814)
- 7. Marie-François-Xavier Bichat (1771 1802)
- 8. René T H Laennec (1781 1826)
- 9. Jean-Baptiste Bouillaud (1796 1881)

XIXème

- 10. Claude Bernard (1813 1872)
- 11. Pierre Carl Potain (1825 1901)
- 12. Etienne Jules Marey (1830 1904)
- 13. Etienne Louis Fallot (1850 1911)
- 14. Auguste Désiré Waller (1856 1922)
- 15. Alexis Carrel (1873 1944)
- 16. Louis Gallavardin (1875 1957)
- 17. André Cournand (1895 1998)

XXème

18. Guy Fontaine (1936 -)

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

14

Dr Fontaine has two hobbies. He likes classic music and to improvise on his grand piano in his house in St Mandé. He is also interested to make genuine calligraphic painting.



Tribute to Van Dongen

(Oil 30x100)

(Oil on Acrylic40x100)

Brancusi

The Candle and the Solar Timer

Oil (125x125)

AAIBC GuyFontaineM051204.doc Created : 15/06/2002 Updated : 04/12/2004 International Biographical Center Cambridge (UK) 24/03/05 11:03

The Lifetime of Achievement – One hundred - 2005

15

Dr. Fontaine is fortunate to have a devoted wife. She is psychiatrist and practices in Paris. They have four children who are accomplished in their own ways. His eldest daughter lives in London. She has a degree in business management. His son, is a computer expert and works in Los Angeles, California. One daughter is a resident in ophthalmology at the University of Bordeaux, his youngest daughter is practicing rehabilitation Medicine in the city of Grasse on the French Riviera.

Dr. Fontaine is an accomplished scientist and an international scholar. He continues to contribute to our understanding of the basics of right ventricular cardiomyopathies their diagnosis, prognosis and treatment.