Neuroradiology and the Great War

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Abstract This review is a tentative historical survey of what could be called “Neuroradiology” meaning any radiological approach of what concerns the skull content i.e. the brain and its envelope and the vertebral column (spine). The celebration of the 100 years of WWI by the International Society for the History of the Neurosciences (ISHN) (Brussels 1st of July 2014) gave the opportunity for a speech about the “Neuroradiology in the trench-coat” and for the official international presentation of the book published about this topic.

Keywords WW1, Neuroradiology, Great War, 1914-18, History of Radiology, History of Medicine, Belgium

1. Introduction

Neuroradiology is a now well recognized subspecialty worldwide of Medical Imaging concerning the diagnosis and the treatment of the nervous system (head and neck, spine... etc.) using all the neuroimaging techniques.

Today the imaging modalities include uttermost CT (computed tomography) and MRI (magnetic resonance imaging).

Plain radiography is nowadays very limited in usage and angiography and interventional radiology are used with a therapeutic goal.

This wasn't always the case.

The celebration of WWI was the occasion to stress the role and the place of radiology in the management of the wounded soldiers on the battlefield. The question arose then: since which moment what could we speak about “neuro” radiology?

This was the purpose of this presentation.

2. Material and Methods

This presentation results from a work provided within the context of the Belgian Museum for Radiology (Military Hospital Brussels, Belgium) and its collections (in Ghent and Brussels : artefacts, books, library on line etc.) concerning

not only the Belgian but also the European and American history of Medical Imaging (cfr. <http://www.radiology-museum.be>).

3. Results

Our publication is a tentative essay about the history of this subspecialty.

This history can be artificially divided in different periods: we called them the prehistory (before 1914) during the war (1914-1918) and thereafter.

The first official international congress of Neuroradiology took place in Belgium in 1939.

Less than 20 years after the discovery of X-rays by W.C. Roentgen at the end of 1895, radiology was already a recognized fact.

In 1914: the use of X-rays for medical diagnosis was called Roentgenology or Electro-radiology, because the technical burden of this new form of diagnosis was still so difficult and complicated a serious initiation in Electricity was compulsory for the interested physician.

To speak about neuroradiology at that time seems a little paradoxical.

And why does such a theme precise in Belgium? The question is if neuroradiology didn't exist at that time, how could Belgium participate in this story?

We can assume that a specialty or subspecialty as such is born, does exist and is alive from the moment an official congress takes place and signals the actual beginning of the specialty.

Indeed this was the case: the first Congress of Neuroradiology worldwide took place in Belgium, much later nevertheless, just before WWII, that's more or less 20 years after the end of the Great War.

And so may our dedication go to the honour of the forefathers of Neuroradiology: Chaussé, Stenvers, Ziedses des Plantes, Schüller are all names well known to the older radiologists, and they were all reunited together with Bertoloni and Thienpont. (Fig. 1)

And they were reunited in 1939 for the first international meeting of Neuroradiology in Antwerp. This meeting was

organized by Dr. Thienpont at the Tropical Institute of Antwerp.

At that time it was still a very important and prestigious institution, with international fame worldwide. Congo had officially been the colony of Belgium, since the death of King Leopold II in 1909. Twenty years later the scientific, geographic, ethnographic and medical investment of Belgium in its colonies was enormous (not only Congo but also after the first WW, Ruanda-Urundi came under Belgian rule and was turned into Protectorates in 1920).

So, this institution had the ability and the expertise to organize such an international meeting and Thienpont succeeded in bringing together all of the most illustrious international Colleagues at that time.

Figure 1. The first Symposium Neuroradiologicum in Antwerp, July 1939. From left to right: the first person is unknown. Then Chaussé, Stenvers, Ziedses des Plantes, Schuller, Bertoloni and Thienpont (Belgian museum for Radiology)

4. The Prehistory

What had been done before that time, before 1914? If we define Neuroradiology as imaging of the brain and its envelope (the skull), then the first publication had already appeared at the end of the XIXth century, in 1896 in UK, more precisely by Dr. Arthur Schuster [1] in Nelson, a town near Liverpool. In April 1896 a certain Mrs. Hurtleley was shot by her jealous husband and died three weeks later, in May 1896. Dr. Schuster had diagnosed a bullet in her brain, as you can see here on the plain film. But no surgery was possible. (Fig. 2)

Figure 2. The Nelson Murder Case [1]

At the same time, also in April 1896, a first side-effect of the intensive use of X-rays was described in the *Journal Science* by Prof. John Daniel [2] of the Vanderbilt University. By the way, Daniel was a Belgo-American citizen.

The case here happened also after trying to locate a bullet, this time in the head of a child. Daniel was working together with Dr. Dudley, the Dean of this University and Dr. Dudley lent himself to an experiment before exposing the child. In this experiment an X-rays tube was placed at one and a half inches from the head of the Dean but with an exposure time of 1 hour. 21 days later a bald spot of two inches in diameter was the proof and the aftermath of this experiment. The exact signification of this consequence was not fully understood.

It was indeed still necessary at that time to expose a radiological plate for such a long period because there was still no screen available.

In 1897 a summary of different X-rays exposure-times was published by François Foveau de Courmelles. [3] The duration of exposures with the first X-ray tubes varied according to the length of the electric arc giving the discharge: 20 cm, 30 cm or even 40 cm for the latest brand-new tube. The power given to the tube was proportional to the length of this arc. (Fig. 3)

The longer the arc between two metallic points, the stronger the power, depending on the capacity of the electrical *bobine*... the measurement between the two points was made by a so-called *spintermeter*. It was not possible to reduce the exposure length as much as wanted. From 20 cm to even 40 cm, the exposure time remained prohibitive between 40 and 50 minutes, because as we know the skull is nothing but bone...

BOBINE RADIGUET			
	Modèle dit de 20 cm. d'étincelle.	Modèle dit de 30 cm. d'étincelle.	Modèle dit de 40 cm. d'étincelle.
Main.....	5'	3'	2'
Bras.....	10'	6'	4'
Avant-bras...	8'	5'	4'
Thorax { Homme	45'	30'	20'
{ Enfant	30'	15'	10'
{ de 5 ans.	50'	40'	30'
Ventre { Maigre.	60'	50'	40'
{ Obèse.	30'	20'	10'
Cou.....	30'	20'	10'
Tête.....	50'	45'	40'
Cuisse.....	20'	12'	8'
Genou.....	30'	15'	10'
Jambe.....	25'	12'	8'
Pied.....	5'	3'	2'

Figure 3. Before the Great War. X-ray Exposure Times without screens (in 1897) [3]

Initial progress was to increase the power of the tube by maintaining the temperature of the tube as low as possible. The cold cathode X-rays tube was this evolution.

The tube was refreshed by an external water tank. The problem with the former hot tubes was indeed a progressive loss of electrons in the remaining gas of the tube due to the heat. When there are no more free electrons in the tube, there are also no more X-rays produced. And so the tube stops working.

In the first years of the history of Radiology it was necessary to replace the tube itself for cooling: so several tubes were successively used for the same exposure: it was necessary to do so to take certain difficult pictures... (abdomen...etc.)

The invention of the regulator was intended to regenerate the electrons inside the tube by cooling it .That was definitely a considerable progress and made a great difference in the practical use of medical X-rays.

Before the first WW, the aim and purpose of radiology of the skull and head was principally the search for and localization of metallic foreign bodies, before hypothetical surgery. An interesting case of haematomyelia was first described in the USA by Harvey Cushing [4], in November 1896 at the Johns Hopkins Hospital, in Prof. Halsted's service. But it remained an isolated case report. (Fig. 4)

Figure 4. Before the Great War [4]

The first book on Neuroradiology was a treatise by Arthur

Schüller [5] in 1905. Schüller who can be called the Father of Neuroradiology as early as 1905, was a *Privatdozent* in Vienna. His publication was about the base of the skull, normal and post-traumatic as seen and analyzed by X-rays. In 1912 he published another treatise about the contribution of X-rays in the diagnosis of illnesses of the head.

Also in 1912, the visibility of the ventricles on a living human being was first mentioned in the USA by William Luckett [6]. Visibility was made possible by air contrast inside the ventricles following fracture of the skull. So the possibility of the ventricles being depicted by air had already been demonstrated before WWI (fig. 5) and that was long before the technique of air-ventriculography following lumbar puncture was described by Dandy [7] just after the war.

Figure 5. Before the Great War. Ventriculography (USA, 1912) [6]

5. During the War

During the war itself it became rapidly obvious that better localization of foreign bodies was an absolute necessity before and during surgery. Every effort was made to obtain more precise localization.

Stereoscopy was a trendy mode in photography at that time with a double capture of images with a slight difference in angulation giving the impression of 3D-vision afterwards for the spectator looking through stereoscopic glasses... the process was thus well known and popularized in the western world. So the application of this technique for the taking of X-rays pictures was rapidly developed.

The stereoscopic and stereographic X-rays tube had already been invented and built by Elihu Thomson [8] as early as 1896.

It was a very expensive and fragile tube with 2 anodes and 2 cathodes within it. So a double film was made simultaneously and later interpreted with the help of double stereoscopic glasses like the ones used for 3D-photography.

Figure 6a and 6b. Trigonometrical approach for localizing foreign bodies [9]

At the same time and for the same purpose radiologists around the world developed all the mathematical and trigonometrical theories for practicing the localization of foreign bodies elsewhere in the body and also in the head. (fig. 6a and b) So for example Hirtz [9] developed his eponyme compass in France. Hirtz was not only a doctor interested in Neuroradiology, he was also a professional French soldier by career. His compass was based on the usage of Thompson's double tube and supported by a lot of trigonometric calculations. However this was not an easy method in wartime and the need for a more practical and easier technique was evident. The ultimate purpose was to define and view precisely any foreign body inside the head, by erasing all the structures close to it, at the front and at the rear of the object and also by suppressing all the bony structures around it.

This suppressive technique is called tomography from *temnein*, *tomos* to cut (in slices) (fig. 7). Throughout the world, every electro-radiologist was searching for such a result. Ziedses [10] in Netherlands (Ziedses des Plantas was descended from a French Huguenot family) but also Bocage [11] in France, Deman in Antwerp in Belgium (he called it the Biotome: cutting the living in slices). The need for such a technique was so urgent that it was bound to be discovered. Kieffer [12] in the USA, Vallebona [13] in Italy, Grossmann [14] in Germany and many others can all claim part of this invention...

Figure 7. Tomography [14]

And so the war went on. At the beginning it was expected to be a short war but there was no step forward in any

direction and the belligerents continued the fighting and the cruelest battles in world History.

Whilst in Europe the radiologist and his assistants were still using hard plates on glass for taking X-ray pictures, soft film was invented by George Eastman [15] in the USA just before the beginning of the war and imported to Europe by the US troops for their own usage when the USA entered the war. In wartime that was naturally tremendous progress (fig. 8).

Figure 8. The soft film was really a revolution (Belgian Museum for Radiology).

Another advance brought to Europe by the US troops was the Coolidge [16] tube, with a variable cathode. The quantity of electricity could now be modulated by a filament circuit acting like a rheostat. So the problem of the necessity of cooling the tubes was finally solved and many more pictures could be taken with this Coolidge tube.

Most surgical procedures were still made under radiosopic control during the war. The surgeon working opposite the radiologist, wearing a special device, sort of binoculars called a *Dessane bonnette*: in fact a fluoroscopic screen integrated in kind of monstrous spectacles. It was the radiologist who was guiding the surgeon: *a little more to your right hand, deeper, more to your left...a.s.o.* (fig. 9)

But it was also during this war that a special and very effective electromagnetic device was created by Etienne Henrard [17] a Belgian military radiologist for the rapid extraction of metallic foreign bodies. This was actually a great help to the neurosurgeon (fig. 10).

Figure 9. Collaboration between the surgeon and the radiologist: extraction under radiosopic control.

Figure 10. During the War: Electro-magnetic device for metallic foreign body extraction [17].

And finally on November 11th, 1918 the ceasefire was declared.

The war was over. As usual the only benefits of this war were manifested in a lot of inventions, not only for the Army but also in Medicine and in particular in the field of Radiology.

6. After the War

After the war we rapidly saw the generalization and the improvement of all the discoveries made during the war. Tomography would be of general use, and specific apparatus were developed and specially built for brain and skull exploration and diagnosis, like the *craniostat*. (Fig. 11)

Figure 11. After the Great War: Craniostat

Air ventriculography was described as an aid to neurodiagnosis by Walter Dandy in the USA just at the end of WWI in 1918.

Further steps were only taken ten years later in 1927 by Sicard and Forestier [18] in France with the use of Lipiodol as contrast medium in Lipiodol myelography. Lipiodol was till then used for injections in joints for rheumatological purposes to relieve pain by a supposed anti-inflammatory action ... (fig. 12)

Figure 12. Lipiodol myelography[18]

The same year 1927, Egas Moniz [19] in Portugal described the use of natrium iodine, a contrast medium, which allowed him to perform the first carotid angiography.

Angiography and myelography remained the bases of Neuroradiology until the emergence of the computer in the seventies and the development of CT and MRI at the end of the XXth century... But that is another story.

7. Discussion

It is difficult to put a date of birth for the subspeciality presently known as neuroradiology.

Medicine has no precise birthdate.

There is a precise date for radiology (1895).

The problem to define a birthdate for neuroradiology is a problem of definition of what determines this subspecialty *in se*.

If it is everything concerned by the content of the skull and the spine, then we can say that 1896 was the date, and UK the place.

But Belgium is a cornerstone in this History.

That was the thesis of this work and what we tried to demonstrate.

So there are as such two birthdates for neuroradiology: 1896 in practice and 1939 for the international recognition of the name of this subspecialty.

8. Conclusions

A little more than a century remains a very short time in History, but for neuroradiology this period has been an eventful and exciting one.

And now the future for neuroradiology is certainly bright. But let's not forget all our predecessors: as it is written somewhere in Douaumont, he who does not honour the Past, is not worth the Present.

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