

Interview with Prof. Hiroshi Fukuda: the 50-year history of boron neutron capture therapy

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Editor's note

The 18th International Congress on Neutron Capture Therapy (ICNCT) was successfully held in Taipei, Taiwan from October 28 to November 2. Researchers came from different countries, such as Japan, USA, Italy, Argentina, Germany, Finland, etc. to attend this grand meeting. The gathering of researchers in the fields of radiology, chemistry, physics, nuclear medicine and pathology has enriched and stimulated discussion during the meeting. AME editorial team had the honor to interview Prof. Hiroshi Fukuda from Tohoku Medical and Pharmaceutical University (*Figure 1*). Prof. Fukuda gave a speech on “Fundamental and pioneering achievements in basic and clinical study for BNCT”. During the speech, Prof. Fukuda shared four main points: (I) sodium borocaptate (BSH) & boronophenylalanine (BPA)—the only two boron compounds used in clinical boron neutron capture therapy (BNCT); (II) pharmacokinetics of BPA in humans and relative biological effectiveness (RBE) of BNCT for human skin; (III) the clinical contribution of radiologists, Dr. Morris, Dr. Coderre and Prof. Ono; (IV) technical development in BNCT.

Expert introduction

Prof. Hiroshi Fukuda (*Figure 2*) is Dean of Faculty of Medicine at Tohoku Medical and Pharmaceutical University. Prof. Fukuda finished his education and obtained the educational degree of MD and PhD at Tohoku School of Medicine and Tohoku University in 1970s. He was the Professor of Institute of Development, Aging and Cancer at Tohoku University and had been the Director of the Institute from 2006 to 2012. Prof. Fukuda has done many projects in different research fields, including experimental and clinical study of BNCT for malignant melanoma, fundamental and pioneering study on positron emission tomography (PET) in oncology and development and aging of the human brain-analysis of a large-scale brain



Figure 1 Photo with Prof. Hiroshi Fukuda after the interview.



Figure 2 Photo of Prof. Hiroshi Fukuda.

magnetic resonance imaging (MRI) database.

Interview

TRO: Please briefly introduce yourself to our readers (*Figure 3*).

Prof. Fukuda: I started and joined BNCT project in 1974. That means 44 years ago and I would be one of the oldest



Figure 3 Interview with Prof. Hiroshi Fukuda: the 50-year history of BNCT (1). BNCT, boron neutron capture therapy.

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members in the society. I performed many biological studies and started the study of BNCT for malignant melanoma, which is a kind of skin cancer that begins with black pigment cells. I treated melanoma patients with BNCT successfully and have published papers on that topic. This is a brief history of mine.

TRO: *Could you briefly share the main points of your speech, “Fundamental and pioneering achievements in basic and clinical study for BNCT” (Figure 4)?*

Prof. Fukuda: I will present and summarize the 50-year history of BNCT. In particular, I will show some of the pioneering and fundamental studies that contribute to clinical trial of BNCT. First of all, boron compound is essential for BNCT. Fifty years ago, the first known boron compound, biodistribution of BSH was introduced to BNCT. This year is the 50th anniversary of the first case of BSH-BNCT used in brain tumor. Later, another boron compound, BPA was introduced to BNCT and has been used in melanoma patients ever since 1987.

Another important point is the kinetics of boron compound. We administer boron compound by intravenous infusion for many hours and then we irradiate neutrons. That means we need the behavior of BPA first after infusion in the patients. It is a very crucial step and I have published a paper on this in the early 1990s.

The third point will be focusing on the radiobiology of BNCT. Many important achievements were performed by Dr. Coderre from USA, Prof. Ono from Japan, and a little bit from me.



Figure 4 Prof. Hiroshi Fukuda was giving his speech, “Fundamental and pioneering achievements in basic and clinical study for BNCT”.

TRO: *Could you share with us some of the research projects that you have done?*

Prof. Fukuda: I started BNCT project in 1974. After that I started PET project in 1980. PET is a nuclear medicine imaging technique that enables the visualization of metabolic processes in the body. The radiolabeled drugs are injected into patients and a special camera is used to detect the radiotracers' location. The image is very helpful for medical diagnosis.

PET is also indispensable for BNCT because we use BPA for BNCT. Fortunately, we can use fluorine-18 (¹⁸F) labeled BPA. This drug can be detected by PET system. We will be able to know where is BPA located in human body. And we will be able to determine if a patient is qualified for BNCT or not through the injection of FBPA. The decision will then depend on the amount of FBPA accumulated in the human body. If the accumulation is too low, then the patient is not a proper candidate for the BNCT project. Therefore, I proposed FBPA-PET system should be used for BNCT at that time.

TRO: *Do you have any suggestions for young scientists who would like to devote into multiple specialties?*

Prof. Fukuda: I think multiple specialties is very important in the BNCT project, but it is indeed very difficult at the same time. Now, all of the fields develop fast and it is already very difficult to follow just one field. Yet, multiple fields mean two or more different areas of knowledge. It is very difficult, but essential that one project should include

at least two or more specialties. This is my message to young scientists.

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(Science Editor: Wei-En Fan, TRO, tro@amegroups.com)