

# Abass Alavi. A distinguished physician scientist and a pioneer in molecular imaging

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Hell J Nucl Med 2014; 17(2): 74-77

Epub ahead of print: 5 July 2014

Published online: 7 August 2014

## Abstract

Abass Alavi is a world renowned physician-scientist and has made substantial contributions to development and translation of modern imaging techniques to the day-to-day practice of medicine. Among his accomplishments, the introduction of fluorine-18-fluorodeoxyglucose (<sup>18</sup>F-FDG)-positron emission tomography (PET) has truly revolutionized the field of medicine worldwide. The impact of using <sup>18</sup>F-FDG-PET along with computed tomography (CT) (and soon magnetic resonance imaging-MRI) in managing so many serious diseases and disorders is unparalleled by any other technique in recent history. He has received many awards for his outstanding contributions to the field of molecular imaging. Currently, he is actively involved in conducting research on a full time basis.



Abass Alavi was born in 1938 in Tabriz, a city in the Azerbaijani region of Iran. He was the second of three children to Mohsen Alavi and Fatemeh Nilchibar. Alavi's paternal family originally hailed from Marash in Syria, and had filled various religious positions in Iran for many generations. His paternal grandfather was a hakim, a traditional herbal doctor. His maternal family, on the other hand, worked in the textile industry, and derived their name from nil, an indigo dye used in textiles.

To fight the brutal cold in the winters, when temperature would fall well below freezing, many of the homes in Tabriz were heated by charcoal braziers. Kerosene lamps were used for lighting, until electricity was installed during Abass's high school years, when the electric company began providing service for a few hours every night. The homes also lacked running water, and so it fell on Abass as a young man to walk to a deep well in a mosque, about half a kilometer away, to collect drinking water for the family. In order to bathe, Abass and his family traveled every week to a *hammam*, a public bath house. Their home was furnished with nothing more than cheap carpets, cushions, and mattresses.

Abass recalls that his schools were just as primitive. His first-grade class was housed in a single classroom that was shared by several grades. Later, he transferred to a boys' school, where rote learning and religious education were emphasized and corporal punishment

was common. The school had no central heating, and students were expected to bring money for the logs that were burned for heat.

Life became difficult for Abass and his family after his father suffered an untimely death due to gangrene. In this pre-antibiotic era, the family had turned to prayer. At the time of her husband's passing, Abass's mother was in her twenties and uneducated. With three young children and no source of income, she returned to her father's home, which she and her children shared with her father's four wives and their children. Abass was raised by his mother in these humble circumstances and had the importance of education stressed upon him from an early age. Food was not plentiful for Abass and his family; they ate meat infrequently and gained much of their nutrition from nuts, dried fruit, and bread. Abass recalls frequently standing in line for bread, reading his textbook all the while. For most of his high school years, Abass wore his father's ill-fitting clothes. Abass wore his shoes until snow began seeping through the soles, at which point he would visit the neighborhood shoemaker, who used pieces of old rubber tires to make new soles for the shoes.

Despite these challenges, Abass and his siblings were motivated by their mother to excel in their academic lives. They received scholarships and became the first in the family to complete high school and attend college. Abass excelled in all sciences including physics, chemistry, biology, mathematics, geometry and calculus. He was inclined to choose a career in life that heavily emphasized sciences and was based on logical approaches to solving complicated problems. As such, he had planned to become a pure scientist soon after graduating high school. However, having been deeply affected by her husband's suffering, Abass's mother constantly emphasized to him that becoming a physician would be a more rewarding and gratifying profession. She said, "Your father cried because of the severe pain from his disease for 6 months before he died. Therefore, I want you to become a physician, so that you can minimize human suffering in any way that you can. There is no profession that is as re-



**Figure 2.** With Jane, his wife and Mama at the De Henesy Award Ceremony, 2004 (Reproduced with permission from *J Nucl Med* 2004; 45(9): 36N, 52N).



**Figure 3.** Abass, receiving the prize from the Minister of Education for achieving the highest distinction in mathematics in Iran, 1956.



**Figure 4.** The village doctor. Abass traveled on horseback to care for his peasant patients.

warding as medicine." Abass's mother's wishes and desires were very instrumental in Abass's decision to follow his grandfather's footsteps and become a doctor. Alavi enjoyed reading his grandfather's old hand-written notebooks, which described the herbs he used in his practice for a plethora of maladies.

After graduating from medical school, Abass enlisted for mandatory military service. Following basic training, he was assigned to serve the medical needs of a village in the mountains west of Tehran. With little more than a jeep and basic medical supplies, Abass arrived in the village as its only doctor. A particularly memorable case involved a man who walked in with a hugely swollen face. After learning that the man had cut himself shaving and had later carried a dying sheep over his shoulder, Abass diagnosed probable anthrax and immediately drove the patient to Tehran to obtain antibiotics. The patient made a full recovery and returned to the village in a matter of weeks. Another unforgettable patient came in for deafness, which had lasted for many years. Doctors had given him multiple medications, but nothing had worked. Apparently, no doctor had ever examined his ears, since upon his initial inspection, Abass discovered a huge amount of wax bilaterally. After a few days of self-administering glycerin drops, the patient returned for an ear washing. When the giant plug was expelled, the man jumped up from the chair and ran into the street, crying, "I can hear! The man performs miracles!" Such experiences were gratifying for the young doctor, but not the kind of practice he dreamed of working in for the rest of his career.

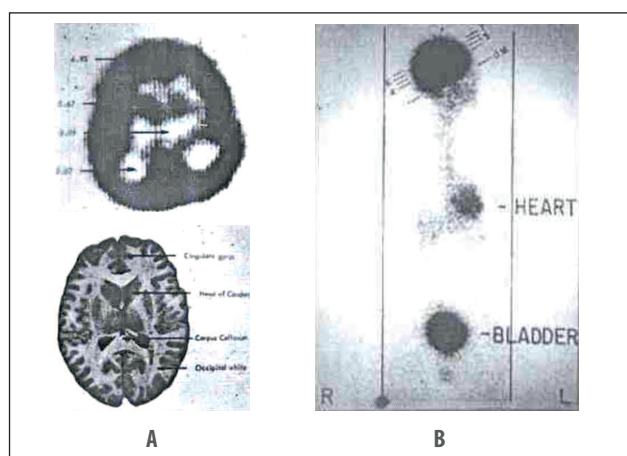
After his military service, Abass wanted to study more advanced medicine, which required him to leave Iran. He and many of his classmates applied for internships in the US, which was accepting foreign-trained doctors in large numbers at the time. After applying in 1966, Abass was offered an internal medicine position at Einstein Medical Center in Philadelphia.

American medicine was strikingly different for Abass - he had never seen a patient with a heart attack before, nor had he heard of immunoglobulins. He found he had much to learn. After realizing that there were several levels of hospitals in the country, Abass determined that he needed to move on from his community hospital to one affiliated with a medical school. And so he applied for and was accepted to the residency program at the Medical College of Pennsylvania Hospital. He completed a year-long fellowship in Hematology at the Veterans Administration Hospital, which was affiliated with the University of Pennsylvania. There, he decided that he wanted to remain in the United States, and resolved to find a science-based specialty most suited to his interests.

In time, Abass discovered Nuclear Medicine and soon began a fellowship at the University of Pennsylvania in that field after one year of residency at Harvard affiliated Beth-Israel Hospital in Boston. At last, he was happy with his work! In 1971, he married another fellow at the University of Pennsylvania, Dr. Jane Bradley Alavi, who later became a faculty member, and with whom he collaborated on many research projects.

When Abass began working as a research fellow under Dr. David Kuhl at the University of Pennsylvania in 1971, tomographic imaging was unique to Penn. Alavi had the opportunity to be on the front line, applying many novel





**Figure 5.** A: First brain  $^{18}\text{F}$ -FDG image. B: First whole-body  $^{18}\text{F}$ -FDG image (*Seminars in nuclear medicine* 2002; 32(1): 2-5).

methodologies and collaborating with the chemistry group at Brookhaven National Laboratory. Abass, along with Kuhl and Martin Reivich, was the first to introduce radioactively-labeled glucose as fluorine-18-fluorodeoxyglucose ( $^{18}\text{F}$ -FDG). In an effort to acquire tomographic images of the brain and planar scans of the whole body, Abass became the first to administer  $^{18}\text{F}$ -FDG to a human subject in 1976 and perform tomographic images of the brain by the home made single-photon emission tomography (SPET) machine and planar images of the whole body by rectilinear instrument. His group pioneered the utilization of  $^{18}\text{F}$ -FDG in imaging the normal brain, as well as brain disorders such as dementia, stroke, glioma, schizophrenia, and brain trauma. He also has been a pioneer in introducing  $^{18}\text{F}$ -FDG-PET for imaging cancer, infection, inflammation, atherosclerosis, clot detection and muscle disorders. Since entering the fledgling field in the early 1970s, Alavi has made numerous contributions in virtually every area of Nuclear Medicine. He became a faculty member at the University of Pennsylvania in 1973 and was the Division Chief of Nuclear Medicine for 3 decades.

Since acquiring the first  $^{18}\text{F}$ -FDG images of the brain and the entire body alongside Kuhl and Reivich in 1976, Abass has been one of the most productive investigators in medical imaging. His extraordinary and creative research in conventional nuclear medicine, modern therapies, and positron emission tomography (PET) has made an incredible impact on this specialty. He and his colleagues have conducted pioneering research in modern imaging techniques including PET, SPET, computed tomography (CT) and magnetic resonance imaging (MRI).

The applications of these modalities have improved the detection of cancer and a host of other disorders, including dementia, seizures, cardiovascular disease, and infection. Abass's training in internal medicine allowed him to also contribute to such varied subjects as skeletal disorders, sickle cell anemia, gastrointestinal bleeding, cardiac calcification, pulmonary embolism, thyroid disease, complicated diabetic foot, malignancies, islet cell transplantation, and inflammation. He has been a pioneer in investigating the dopaminergic and other neuroreceptor systems with PET and SPET over the past three decades. His ground breaking

research on children with hyperinsulinism has helped to substantially improve the management of this life threatening disorder. Most recently, he has applied  $^{18}\text{F}$ -FDG-PET imaging techniques to the investigation of atherosclerosis and is very interested in potential applications for the treatment of this widespread disorder.

Throughout his career, Abass has published extensively in the scientific literature. His publication record includes more than 1000 original papers, numerous book chapters, and more than 30 books and periodicals. He is the consulting editor of PET Clinics and also serves as an editorial member of several important scientific journals. After four decades of work, Abass has become one of the most cited physician-scientists in the country, as well as the most cited faculty member at University of Pennsylvania. In addition to serving as an editor for numerous editions of the *Seminars in Nuclear Medicine*, Abass has given countless lectures throughout the world. His annual citations are approximately 3000 over the past few years. All his citation indices are 39,160 and since 2009 are 14,043. His h-index is 100 and since 2009, 55. His i10-index is 536 and since 2009, 305.

Abass has been the recipient of many distinctions, among which are the highest awards in nuclear medicine: the Georg Charles de Hevesy Nuclear Pioneer Award, which was given by the Society of Nuclear Medicine, in 2004, for his pioneering work in the development of PET; the Cassen Prize of the Society of Nuclear Medicine, considered the Nobel prize of the discipline; and honorary degrees from the University of Bologna, the University of the Sciences in Philadelphia, and Shiraz University in Iran. Abass was extremely happy that his beloved mother was able to be present at the de Hevesy ceremony, and see that her sacrifices had been worthwhile.

Abass served as a member and chairman of scientific study sections at the National Institute of Health and the American Cancer Society. In addition to being a productive researcher, Abass is a dedicated teacher; his former students and research fellows now occupy important positions in Nuclear Medicine throughout the world.

He has been a long-time supporter of educational and research opportunities for students in this field. He supports the Alavi-Mandell Awards, which recognize trainees and young scientists who publish articles as senior authors in the *Journal of Nuclear Medicine*, as well as the Pilot Research Grants and the Bradley-Alavi Student Fellowship Awards funded by the Education and Research Foundation of the Society of Nuclear Medicine.

Abass currently holds appointments as Professor of Radiology and Neurology and Director of Research Education in Department of Radiology at the Perelman School of Medicine of the University of Pennsylvania.

#### *Concluding Remarks from Professor Philip Grammaticos:*

During my long career in medicine, I have interacted with many prominent physicians and scientists and have carefully assessed their contributions to modern medicine and its evolution to what it is today. Among these distinguished colleagues I profess that Abass Alavi stands out as having the most creative and innovative mind and his accomplishments have truly revolutionized the field of medical imaging. Additionally, his humble personality and human values are quite unique in spite of his outstanding achievements and

recognition around the world. His strong and unquestioned support of colleagues and students globally is truly inspirational and a testimony to his dedication to bringing the best scientific minds to med-

icine. I will quote Abraham Lincoln's phrase, "Charity for all" as Abass's unquestioned mission in his dedicated life for humanity and for minimizing suffering of mankind.



Fernando del Rincon-Madrid (15th century). Saints Cosmas and Damianos (Greeks from Asia Minor) have amputated the gangrenomatous leg of a patient and transplanted to him the leg of a dead Mauritian (seen at the lower part of the painting). One of the Saints is preparing a medicine for the transplanted leg. The patient is anesthetized and holds a twig of mandragora (sleeping drug). At the right lower part of the painting another "miracle" is described: the Saints have withdrawn a snake that a man had swallowed.