Careers in Science

Dr. Mark Andrew Lipsett, Anesthesiologist

«««« By Stan Taylor
Stan Taylor is a retired elementary school teacher. He currently does science workshops for Scientists in School and is a member of the *Crucible* and *Elements* Editorial Committee (CEEC). He is the author of *Taylor's Pneumatic Toys*, published in December 2012. It is available through various online retailers.

Curriculum Connection: Grade 12 Space; Workplace Science.

Mark Andrew Lipsett was born in Port Alberni, British Columbia. He attended North Island College, Simon Fraser University, Monash University in Melbourne Australia, McGill University, University of British Columbia, University of Victoria, Memorial University and the International Space University. He is currently at Queen's University. I had an opportunity to talk with Mark recently. Let's learn more about this diverse young man.

Q: What's the story behind your numerous moves and university experiences?

A: "I am originally from Vancouver Island and thus I spent my first year in my home town at North Island College. I then moved to Vancouver/Burnaby to complete my BSc in Kinesiology (human physiology and biomechanics) at Simon Fraser University. I then went to Australia to continue my education at Monash University in Pharmacology and Anatomy. Following completion of that, I came back to Simon Fraser University to start a Master's program. Originally I was going to study human physiology in environmental extremes. Unfortunately my prospective supervisor had a medical tragedy while I was in Australia.

I then completed my MSc in Kinesiology, looking at the potential of an adult pancreas to regenerate insulin-producing beta-cells in the setting of a diabetogenic (diabetes) insult.

This then led to my PhD degree at McGill University where I studied the potential of adult human pancreatic tissue to transform and regenerate insulin-producing cells and I helped create a human pancreatic islet isolation and transplantation laboratory.

My next step was medical school. I was accepted at the University of British Columbia, so I moved back to the west coast. I attended the Island Medical expansion program at the University of Victoria.

During med school I applied to the Canadian Space Agency for a medical fellowship at NASA, which I was fortunate to receive. Following completion of my medical degree I started my anaesthesiology residency training at Memorial University in St. John's Newfoundland. The anaesthesiology department there was very supportive of my space medicine research and supported me returning to NASA during which time I furthered my research in "cardiac arrhythmias" and "increased intra-cranial pressure" along with a number of other projects.

While at Memorial University I was requested to be a lecturer at the International Space University. This led to a request for me to attend a Space Studies Program. Again I was incredibly fortunate to receive a fellowship through the Canadian Space Agency and the Canadian Foundation for the International Space University to complete this course.

I am now at Queen's University in Kingston, Ontario completing my anaesthesiology training as well as a concurrent critical care (ICU) fellowship.

Q: Why the International Space University? What is your fascination with space?

A: Simply, because I wanted to! It's a bit difficult to summarize the longer reason. To some extent it was simply an evolution of the request that they made to me regarding my telemedicine[1] lecture. As well Dr. Robert Thirsk, as you know, is fairly active in the International Space University and he felt it would be a good experience for me to participate in the Space Studies Program.

As to what is my fascination regarding space and when did it start: I can remember always being awed by the beauty and vastness of space. I cannot remember when that started. Was it when my parents brought home my first Space LEGO set? Was it from watching *Star Wars: Empire Strikes Back* on opening day? Was it my first telescope? I don't clearly remember when, I just know that our universe is utterly amazing and that space exploration is an incredibly alluring adventure of the unknown.

Q: Why did you choose science as a career?

A: I was always interested in understanding how things worked. I was also forever asking questions to garner these answers. I found math and science were the tools to learn the answers. I never said, "I will become a scientist." I just followed what interested me and what I found fun.

Q: How did you become interested in your field of science?

A: I became interested in how the human body worked. I enjoyed learning about human physiology and patho-physiology.[2] I then became interested in how humans reacted in environmental extremes. All of these learning adventures slowly led me down the path to where I am today.

Q: What is, in your opinion, the most interesting or intriguing part of your job?

A: I love the continual learning.

Q: What do you like least about your job?

A: The time it takes away from my family.

Q: How is science and technology mostly used in your job?

A: Science and technology is used in almost every aspect of my job. Computers are obviously ubiquitous today. From an anaesthesiology perspective we use imaging devices such as ultrasound, X-ray, EKG and CT/MRI machines. As well, we use ventilators and numerous other technological devices to place intravascular lines and monitor patients to ensure safety during surgeries.

Q: What did you take in school (high school and/or post-secondary) which prepared you for your career?

A: I took general science courses in high school including chemistry, physics, biology, math and calculus as well as computer science and psychology. Virtually all of my post-secondary studies have helped prepared me for my current career including: human physiology, pharmacology, anatomy, diabetes research, image analysis, stem cell culture and disease therapy, transplantation research, as well as my space studies.

Q: Where should students start if they want to pursue a career like yours (elementary and secondary students)?

A: I believe students should start by following what they are interested in, no matter what it is. What helped me the most was just following what I liked to do, what I was interested in because that made the learning fun and easy. If you try to push yourself into a direction that may not fit you, it can make things harder on yourself. If you are interested in space studies, no matter what you do for your educational background you will find a way to transition your education into a meaningful space science career. Becoming a physician is a bit more regimented where the medical schools have specific requirements for application, including mainly basic science courses.

Q: What other skills do you need to be successful in this field?

A: One definitely needs a desire to continually learn, the ability to communicate, adaptability, and, knowing how to enjoy life and to have fun.

Q: What is the most significant change in your field that you've seen over the course of your career thus far?

A: My anaesthesiology career is fairly young right now, but as far as in my educational career, I would say the impressive ubiquitization of computer technology enabling information transfer. Having a smart phone in your hand — in which you have access to the world's information and the answer to virtually any question anywhere you go with cellular access — is just absolutely amazing and so empowering.

Q: What are some of the major issues you deal with in your field?

A: The sickness of patients and the impact this has on them and their loved ones is pretty major.

Q: What are the most rewarding aspects of your career? Conversely, what don't you like about it, or what do you wish was different?

A: The ability to take away fear and misunderstanding, to help educate and give solace during very challenging times is by far the most rewarding aspect. As well, my career allows me to continue "playing" and to have fun researching and answering so many questions. I only wish that I had more time to walk down so many other interesting educational paths.

Q: What other kinds of opportunities might be available for someone with your educational background?

A: There are numerous potential opportunities including an inordinate number of opportunities solely within the medical field. Then there are the opportunities in basic science research, education, aerospace studies and many more fields. It is difficult to list them all.

Q: What have you accomplished so far that you are really proud of?

A: Following through with my dreams and not letting myself be side-tracked from what I found fun even when there were obstacles in my way.

Q: If you can say, what specifically and currently are you working on?

A: I am currently completing my FRCS Anaesthesiology degree. As well, I am working on aerospace medical research, including the pathophysiological changes resulting in increased intra-cranial pressure and incidence of cardiac arrhythmias in astronauts.

Q: What do you mean by "pathophysiological changes resulting in increased intra-cranial pressure and incidence of cardiac arrhythmias in astronauts? What is causing the intracranial pressure? What is causing the incidence of cardiac arrhythmias in astronauts?

Is there a correlation between increased intracranial blood flow and intra-cranial pressure and/or cardiac arrhythmias in astronauts? (see https://blogs.commons.georgetown.edu/.../high-altitude-cerebral-edema/)

I'm just guessing. I don't have an MD. For an un-MD like myself, is the increase in intracranial blood flow the result of:

- ***a rocket blasting off into outer space***
- ***changes in air pressure inside a space capsule in which they are sitting***
- ***changes in air pressure inside space suits or inside the ISS?***
- ***all of the above?***

What are cardiac arrhythmias?

A: The bottom line is we do not know, but we have a number of hypotheses. As to intra-cranial pressure (ICP) dysregulation, a number of factors may be playing a role. One of potential reasons is that in constant free-fall, as experienced in the ISS, gravity does not cause blood to pool in our legs as it does while here on Earth. The result is that there is increased blood flow to the upper body. This can in turn lead to increased pressure in the brain. As well, this is another potential mechanism for stimulating cardiac dysrrhythmias (atrial stretch — due to increased return of blood to the heart — can stimulate atrial fibrillation).

Another potential mechanism for increased ICP is increased levels of carbon dioxide. Carbon dioxide stimulates dilation of cerebral (brain) blood vessels, which causes increased blood flow to the brain. Since the skull is virtually a fixed volume, increased blood flow to the brain without an increased outflow will lead to increased ICP. Carbon dioxide is denser than air, so on Earth it falls to the ground under the influence of gravity. In constant free fall, the effects of gravity are not felt and if there is not air flow to push the carbon dioxide away, it will stay right where you exhaled it. With your next breath, you can breathe more in and your intra-vascular carbon dioxide level can rise, leading to cerebral vasodilation and increased blood flow to the brain, and potentially increased ICP. There are a few other potential mechanisms we're looking at as well.

So a cardiac arrhythmia, or dysrrhythmia, is when the heart does not contract in a "normal" manner. There are many different types of dysrrhythmias. Atrial fibrillation is one, and is seen at an increased rate in astronauts. As described above, increased atrial stretch is one proposed mechanism of atrial fibrillation. The pacemaker cells of the heart are in the sinoatrial node of the right atria. They are the "pacemaker" cells simply because they have an increased density of leak current channels, so their membranes are "leakier" than regular cardiac cells which results in these cells most likely to depolarize first. Once they depolarize, the electrical energy goes through an ordered pathway that leads to the heart contracting in an organized fashion. If the atrial gets stretched, other cells can become more "leaky" and start depolarizing as well. This leads to multiple uncoordinated sites initiating contraction of the heart. In turn, the heart beats irregularly and its efficiency can dramatically decrease. Imagine the situation as if a metronome or conductor of an orchestra is replaced by many conductors, thereby leading to chaos.

Regarding your questions about pressure: During the initial blast-off/launch there are increased gravitational forces. These forces can lead to pooling of the blood in the extremities. In the following eight minutes (approximately), the blood is rapidly reduced back to almost normal distribution and then to the upper body engorgement. As described above facial plethora[swelling] is a common occurrence in astronauts during their first few days in space. This is thought to be due to these fluid shifts. This change in gravitational forces felt

by the astronauts is not the same as atmospheric pressure (or ambient pressure) changes. Astronauts are exposed to close to one atmosphere of pressure (14.7 psi) throughout most of their time in space. During space walks [EVAs] their space suits have a lower pressure — between 4.3 and 5.7 psi — depending which suit they use. All of these ambient pressures are applied equally to the whole body so they do not impact on blood flow.

Q: ***What are your interests, sports to play, hobbies?***

A: I enjoy hockey and tennis, SCUBA diving and sailing. As well I enjoy wood working and deconstructing and creating things in the shop.

Q: ***What are your future plans?***

A: To enjoy life.

We wish Dr. Mark Lipsett continued success.

Footnotes

1 Telemedicine is the use of electronic communication devices (telecommunication) to enable enhanced medical care in regions in which medical care would otherwise be limited. For example, radiographic images (X-ray, CT scan) can be taken at one location and then transmitted to another where they could be interpreted by a radiologist. That information can then be transmitted back to the original centre to allow for appropriate care.

2 Pathopsychology is the branch of science that deals with mental processes, particularly as manifested by abnormal cognitive, perceptual, and intellectual functioning, during the course of mental disorders.