YOUNG UROLOGY MEETING

REVIEW

in association with GETTY SCIENCE

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In the fast paced world we live in, news about scientific research can be easily missed. Yet we all are beneficients of the progress made in any field of science. That is why it is so important to be aware of the current trends, possibilities and whenever possible give feedback by joining the discussion. To make the first step, science communication should become a part of a research routine. Young Urology Meeting Review is the perfect example of how representants of a very narrow field can with a little effort present a summary of their work to everyone else. Hopefully more organisations and individuals will take this path in the future. As Getty Science we will give you the tools and support to do it. Finally it is worth to underline what an exceptional editorial work has been done by Dominika Bijos who is also an organiser of the YUM. Great job for science!

The Getty Science Team

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Young Urology Meeting Review

a wee bit about who we are
and what we do

Science needs to be discussed to bring new answers. I organise the Young Urology Meeting for early career researchers to share their scientific findings focused on the lower urinary tract. I shared my research in a Getty Science article entitled "To pee or not to pee?" But urology isn't just the bladder I described; it is a whole system of cells, tissues and organs connected together in the ways we do not fully understand yet.

Why do we wee when we want? Jon presents here what little is known on the matter, while Lisa describes the reasons for ageing in a hope to turn back the clock for the bladder. Organ function is often down to single molecules, as Stephen explains the case in the urethra, an organ going against the tide.

From a brain signal to the bladder and the urethra, weeing is complete, but there is more to urology than just that. The bladder shares nerves with the gut and when this relationship goes wrong, that is literally pain in the butt, as Nipa shows. Gentlemen have an additional organ in this area – a walnut size prostate, which becomes problematic when enlarged. Vanessa tackles how to best monitor the prostate for any cancer signs. But with ageing and disease all tissues can fail and so regenerative medicine studied by Giulia can help refurbish body parts if need be.

This publication aims to bring urology research closer to the public domain, present our work and field as relevant to everybody and promote the early career researchers involved in it. Here, we communicate science and create urology outreach. I am very excited to bring this Getty Science Young Urology Meeting Review to life, with 6 great stories from young researchers who care about what they do so much, they wanted to tell us all about it.

Dominika Bijos
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Why We Wee When We Want – How The Brain Controls The Bladder

by Jonathan Crook

The Lord of the Rings: The Two Towers is a long film. I remember seriously regretting my decision to wash down my popcorn with a litre of diet coke when the film decided to taunt my aching bladder with a protracted scene of a dam breaking. When you feel such an urge to go to the toilet, it can be hard to focus on anything else, even the movie!

The bladder is unusual amongst internal organs in that it can be consciously controlled. While one cannot will the heart to beat faster or slower, or the pancreas to secrete more or less insulin, most people are able to defer the emptying of their bladder until a safe and socially acceptable time, even if this may cause great discomfort.

The sensation of 'needing a wee' occurs when the walls of the bladder are stretched. Nerve endings in the bladder wall detect this stretch, and send electrical messages to the brain. If this occurs at a time or place in which it is not socially acceptable to urinate (which is most of the time!), a 'voiding circuit' in the brainstem is consciously kept under control by higher brain regions.

If you decide that this is indeed a good time to empty the bladder, the 'voiding circuit' sends messages to allow passage of urine: first to the bladder to tell it to contract, and second to the urethral sphincter muscle to tell it to simultaneously relax. With a permission from the higher brain centre, a contracted bladder and relaxed urethra, we wee when we want.

It is unclear how exactly the brain controls urinary voiding. Which neurons in the brain 'switch' the bladder from storage mode into urination mode? How do they communicate with the rest of the voiding circuit? These questions are the focus of my research - finding the answers may point towards ways of helping people with an 'overactive' bladder.

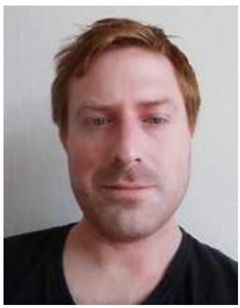
Overactive bladder patients suffer from frequent intense urges to urinate and often, without prior warning, involuntarily leak urine (incontinence). These symptoms not only greatly impact the sufferer's quality of life, but also come attached with a social stigma, leading to feelings of shame and embarrassment. Around 10% of the UK population are estimated to suffer from overactive bladder, and this number is likely to increase due to our aging population. With the management of incontinence currently estimated to consume over 1p out of every £1 spent on the NHS, we literally cannot afford to neglect this problem.

Researchers are beginning to understand the brain regions that are involved in bladder control. Animal experiments have shown that a brainstem region known as the Periaqueductal Grey (PAG) is essential to the control of voiding - it may be where the crucial 'switch' between bladder filling and voiding happens. Human studies confirm that PAG has a role in voiding control. Using fMRI scanners researchers have shown more activity in the PAG region in the human brain when the bladder becomes full. Some recent experiments indicate that electrical deep brain stimulation of the PAG may help with continence.

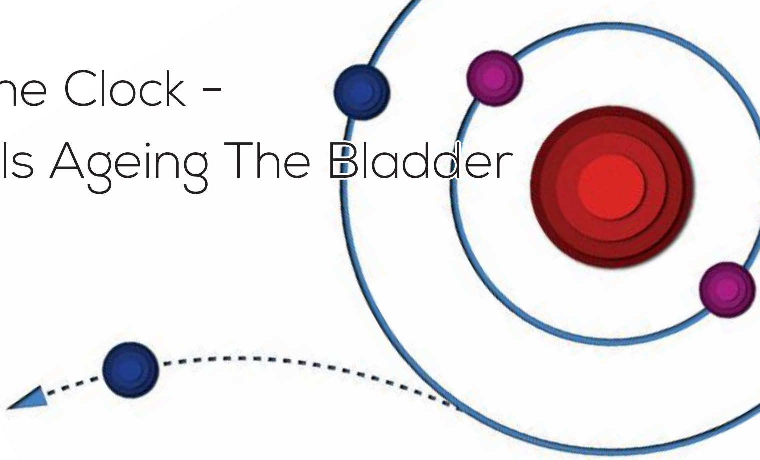
With a better understanding of how the brain controls the bladder, and how these mechanisms malfunction, we may be able to develop more targeted and effective treatments for people with incontinence. I hope that my research will one day help more people to wee when they want.

Author's Bio:

Jon Crook is a postdoctoral research assistant in the School of Physiology and Pharmacology at the University of Bristol. His current research project concerns the role of periaqueductal grey matter neurons in micturition control. He completed his PhD in neuroscience at the University of Bristol in 2014, and previously studied Biomedical Sciences at the University of Leeds. His interests include reading, running and rock music.



Turn Back The Clock - Free Radicals Ageing The Bladder



by Lisa Adjei

The anti-ageing industry in the UK brings in, on average, a whopping 8.3 billion each year! The large revenues reflect how much it affects us as a society. With new eye creams and anti-wrinkle formulas being released each year - ageing definitely matters to us! Have you ever paused to think about what is actually causing you to age? Is it that yummy chocolate-covered birthday cake each year, which is giving gravity the upper hand on your skin?

Well, in 1956, a scientist named Denham Harman proposed a new revolutionary idea. He suggested we age because we are constantly producing unstable molecules called 'Free Radicals'. His 'Free radical theory of ageing' has proved true over the many years. It's thought these free radicals, bind to proteins and DNA in your body and cause them to be broken down or worn away. Over time, the organs and tissues in your body do not work as well as they used to.

This theory has been put to test in many parts of the body, and shown to be involved in areas such as: the heart – when cells are starved of oxygen, regions of the brain in Alzheimer's and Parkinson's patients and blood vessels - linked with plaque formation leading to atherosclerosis. However, little research has been done to shine a light on its role in the bladder.

The bladder is a balloon shaped organ found in your lower abdomen. Its main function is urine storage and release. Just like a balloon being filled with air, the muscles relax and the bladder wall expands as it's filled with urine. Once the volume of urine passes a certain threshold, the body senses that the bladder is full and sends signals to the bladder muscles to contract in order to expel the urine via urethra (the exit tunnel).

The aim of my PhD research project was to discover the role of free radicals in bladder function. My research proposes the idea that, over time, free radicals accumulate in our bladder. Too many free radicals cause damage to essential pathways, thus resulting in increased incontinence with age.

I set out to test my theory, by looking at one of the sources of free radicals in our body –

an enzyme Nicotinamide Adenine Dinucleotide Phosphate Oxidase (NADPH Oxidase). So far I found some interesting results. I hope to investigate further which specific type of NADPH Oxidase is responsible for bladder activity and to move onto its drug potential. Would blocking this enzyme help turn back the clock on bladder function in the elderly? Can we reverse the damage done? What can we do now to slow down the ageing process effects in the bladder?

Maybe one day, there will be a new cosmetic product on the market - this time it'll be for your bladder! ;-)

Author's Bio:

Lisa Adjei is currently a final year PhD student in Bladder physiology at the University of Surrey, UK. Her passions include teaching, science outreach and public engagement. So far, she's worked with numerous undergraduate students, The British Science Festival, summer schools and open days at the University. In her spare time, Lisa loves to work with young people at her church; where she teaches, helps run services and fun activities. She also enjoys travelling and discovering new cultures, both within the UK and around the globe.

Going Against The Tide - An Essay On Urethra Function

by Stephen Fedigan

The phrase "to go against the tide" means to oppose or resist what others are doing or saying. For the urethra this phrase perfectly describes its function – to provide resistance against the urinary bladder.

The urethra provides a resistance that stops any unwanted leakage of urine from the bladder: the contracted urethra is much like the valve in a tap. When the bladder needs to empty, the urethra relaxes, "opens the tap" and acts as a pipe to carry urine from the bladder. The mechanism of urethral resistance is not yet known but understanding it would have a huge impact in medicine for treating diseases such as Urinary Incontinence.

Urinary incontinence is any unintentional loss of urine. Most people associate it with a dysfunctional bladder, which squeezes out urine, but urinary incontinence can also mean a poorly functioning urethra. For example, when the urethra doesn't contract enough to form a tightly sealed tap then an unwanted leakage of urine occurs. This type of incontinence is Stress Urinary Incontinence and can happen when you laugh hard or cough.

Stress urinary incontinence predominately affects women, especially those who have had children. To date there are no drugs available to treat it. Therefore patients are required to 1) manage the condition with absorbent pads 2) try pelvic floor strengthening exercises or 3) undergo surgery as a last resort. This is not a good enough solution for sufferers who have a poor quality of life and for society as a whole. Thus, we need to improve our knowledge of how the urethra works.

Finding out how this system works through experimental research has been the focus of my studies. From the outside the urethra appears to lie almost idle. However, if we delve deeper into the walls of the urethra, there is a whole range of cellular activity that makes this tissue all the more interesting.

One of the layers in the wall - the smooth muscle layer - holds the answer to the cellular origins of the urethral resistance. Within this layer, lie two different groups of cells: smooth muscle cells and Interstitial cells of Cajal. Researchers speculate that Interstitial cells of Cajal relay messages from nerves to smooth muscle cells causing them to contract, thereby generating urethral resistance.

We are able to record electrical activity from each of these cells. We measured the current and voltage of the cells, similar to measuring the electric flow passing through a wire except on a much smaller scale. When we recorded electrical activity we found that smooth muscle cells are electrically quiet while Interstitial cells are electrically active. When we explored Interstitial cells further we found that the origin of this electrical activity comes from an ion channel.

Ion channels are the doormen of cells - they decide what enters and what leaves the cell. Just as a doorman checks for the correct footwear so do ion channels recognise specific characteristics and decide who's in and who's out. The ion channels responsible for generating electrical activity can be activated by calcium ions inside the cell and in turn let chloride ions flow out of the cell. This flow ultimately generates urethral resistance.

Identifying the origin of urethral resistance has given us the big picture, however much work remains to fill in the details. Once we understand the details the race is on to find a drug capable of activating these ion channels. These drugs could be used to treat urinary incontinence, improve patients' quality of life and keep everyone's urethra "going against the tide".

Author's Bio:

Stephen Fedigan is a third year Ph.D student at Dundalk Institute of Technology within the School of Health and Science as part of the Smooth Muscle Research Centre. His current research involves understanding the mechanism responsible for the generation of tone in urethral smooth muscle. Other interests include ion channel physiology and scientific outreach. He has presented findings at various scientific gatherings both nationally and internationally and has published a paper titled "Pharmacological characterization of TMEM16A currents" in the journal Channels.

Pain In The Butt - The Bladder, The Bowel, And Their Relationship

by Nipaporn Konthapakdee

Every morning after we wake up, the first thing everybody needs to do is go to the toilet. We get rid of the digested food we ate yesterday and empty our bladder. Can you imagine what's going on inside our body?

In order to have a normal happy life, we require a very good relationship between 'the Bowel' and 'the Bladder', because when we pee, we can't defecate at the same time and vice versa. This relationship is wisely controlled by the nervous system. However, the Bowel is very sensitive, especially in the condition of 'Irritable bowel syndrome'. The Bowel is easily irritated after we have eaten some spicy curry, coffee, or are under stress, and it becomes more sensitive to any stimulus. In 2014, this condition was reported the most common digestive complaint affecting almost a fifth of the UK's population with more women affected than men. People with irritable bowel syndrome have abdominal pain, discomfort and defecation symptoms (constipation, diarrhea, or both).

Similarly, the Bladder gets inflamed easily. The condition is especially common in women. 400,000 people in the UK have 'Interstitial cystitis' or chronic inflammation in the bladder wall, which is also diagnosed as painful bladder syndrome. Patients with interstitial cystitis urinate very frequently and have unpleasant urgency and pain during urination or sex. Unfortunately, the causes of these diseases are still unclear.

Our body requires electrical messages from the brain to allow the Bowel and the Bladder to work accurately. The brain sends messages through the network of nerves, which are specific to pelvic organs including the Bowel and the Bladder. 'Command nerves' carry messages from the brain to the organs and 'sensory nerves' send messages from the organs to the brain. When the Bowel and the Bladder are filled with stool or urine, the sensory nerves detect the fullness. Then, they directly communicate it to the brain and the brain sends the command signal back to allow the sphincters - gatekeepers of the Bowel and the Bladder - to relax when we are ready to release stool or urine. We need a good coordination between 'command nerves' and 'sensory nerves' to control contraction or relaxation of muscles in these organs. This coordination ensures that the sphincters remain closed when we are not ready to go to the toilet.

The sensory nerves play a key role in controlling not only fullness of these hollow organs, but also their pain sensation. When one organ is sick or affected by a disease, pain or discomfort is detected in the other. About 3 in 5 of irritable bowel syndrome patients also have painful bladder symptoms and vice versa. Therefore, we still need to find more clues to understand and control unnecessary pain sharing between those two organs.

One of the key signs the Bowel and the Bladder are sick is high activity of their sensory nerves. When sensory nerves become hyperactive to any stimulus, they send more warning signals to the spinal cord and the brain and make patients very sensitive to pain.

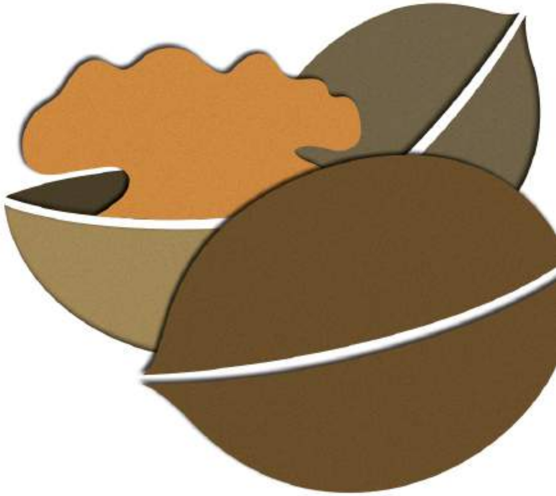
My main focus is how these two organs communicate and share information with each other. Understanding it could lead to the development of potential drugs that would help relieve pain in the butt for everyone.

Author's Bio:

My name is Nipaporn Konthapakdee. I am currently doing PhD in Biomedical Science at the University of Sheffield, United Kingdom. I finished a Master degree in Physiology from Mahidol University, Thailand. I am interested in sensory process and physiology of the urinary bladder. My research is currently focused on cross-talk between the bowel and the bladder. After finishing the degree, I will go back to Thailand, do research, and expand knowledge in bladder physiology. I hope my research help people who suffer from bladder diseases.

Prostate Cancer - In A (Wal)nut Shell

by Vanessa Otti



A walnut best describes the shape and size of the prostate gland. The prostate is a round structure found between the bladder and the urethra, responsible for secreting prostate fluid, a constituent of semen. Interestingly, walnuts have also been associated with health benefits to males and slowing the progression of prostate cancer.

When the prostate gland grows during cancer or in Benign Prostatic Hyperplasia, it tightens the urethra and so greater force is needed to push urine out of the bladder. This causes Lower Urinary Tract Symptoms like poor urine stream, hesitancy or incomplete voiding. These symptoms however, are not always indicative of cancer, as some prostate cancer patients show no symptoms.

Prostate cancer is the most commonly diagnosed malignancy affecting men worldwide and incidence is on the rise, with a 1 in 9 lifetime risk for men in the UK (patient.co.uk). Despite its high incidence, prostate cancer is not the most common cause of cancer deaths among men (lung cancer is). This highlights the importance of early detection and management in improving a patient's prognosis.

Age is an important risk factor for prostate cancer. The majority of new cases present in men over 50 and the incidence steeply rises amongst men over 65. Ethnic background also plays a role. Men of African descent are 56% more likely to develop prostate cancer compared to their white counterparts. Hispanic men also have a higher likelihood of developing prostate cancer, in relation to the general population.

Screening based on the Prostate Specific Antigen (PSA), an enzyme present in prostate fluid, was first introduced 28 years ago and is used to identify potential prostate cancer cases. Generally speaking, the higher the PSA value the higher the likelihood of prostate cancer. Yet it would be nutty to rely on PSA results alone. This assay is controversial; high values don't always indicate prostate cancer, while low values do not necessarily mean no cancer, so it is used together with diagnostic tests such as a biopsy. Ever more sensitive detection techniques are always highly sought after and comparing such techniques is the focus of my research.

Currently the gold standard for prostate cancer detection is the Transrectal Ultrasound (TRUS) guided biopsy, followed by histological analysis. This means that a tissue sample is cut out from the prostate and a pathologist checks if cancer cells are present. Some cancers grow slowly and thus do not require urgent treatment, however these cancers still need regular monitoring through a process known as active surveillance.

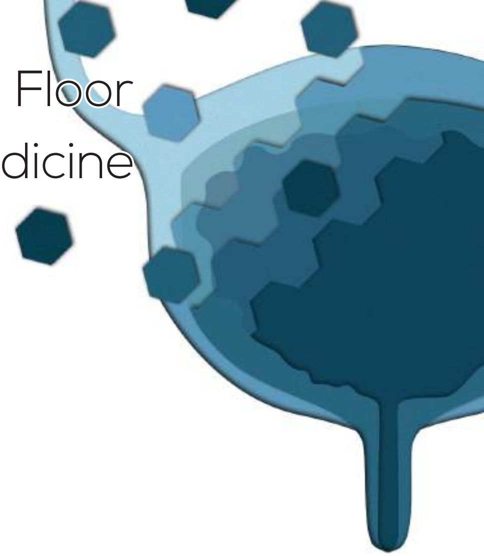
For this purpose, UK National Institute for Health and Care Excellence recommended Multi-Parametric Magnetic Resonance Imaging (MP-MRI). This diagnostic test is ideal as it is less invasive, faster and cheaper than a biopsy. MP-MRI is considered reliable as detection is usually based on 4 different imaging exams that characterise the cancer by appearance, metabolism and aggressiveness. In spite of this, working out whether cancer detection is more sensitive using imaging or biopsies has been a hard nut to crack.

To date, we do not know enough about MP-MRI as a diagnostic tool to warrant a change in existing practice and biopsies remains the golden standard. But the possibility of a non-invasive, fast diagnosis highlights avenues for further research, which could drastically improve the diagnostic methods of numerous types of cancers! Nuts, isn't it?

Author's Bio:

Vanessa Otti has just begun a Professional Training Year as part of her BSc Medical Sciences degree at the University of Exeter, UK. She is currently researching prostate cancer and the characterisation of tumours in this region through the use of multi-parametric MRI scanning. To advance her knowledge of medical science she has organised work placements which include The Harley Street Clinic, London and has carried out voluntary work at Kings College Hospital, London and The Royal Devon and Exeter Hospital. For leisure she enjoys playing netball and basketball and participating in the St John's Ambulance society at university.

Refurbishing The Pelvic Floor Using Regenerative Medicine



by Giulia Gigliobianco

Tissue engineering is like upgrading a building. The building is our body damaged by age or disease. When one or more tissues fail due to an accident or aging, prostheses or other artificial materials are inserted in the body by doctors. These materials act as a scaffold so the builders - our cells - can grow on them, lay the bricks down (the extracellular matrix) and upgrade the degraded building - our damaged body.

Regenerative medicine, the field of tissue engineering, is an increasingly exciting field, where soft tissues, organs or bone are extended or regrown. Regenerative medicine in action includes bone grafting, regeneration of the cornea in the eye, nervous tissue and even the liver. While some regenerative treatments are already in regular medical care, others, such as lab-engineered liver cells, have the potential to change lives if they can be developed further.

It is exciting to know that my research in urological tissue engineering faces the new challenges for regenerative medicine. The majority of urological conditions are due to aging of the human body. Therefore, tissue engineering can help rebuild the old tissue by for example, surgically strengthening the pelvic floor. Urinary tract, bladder, pelvic floor, urethra and vagina are made of soft tissue. Thus, in contrast to most other reconstructions that use solid materials as scaffold, soft materials are needed for urological reconstructions because they resemble the natural tissues. To solve this challenge we use biodegradable polymers to create structures similar to human tissues.

Biodegradable polymers are a preferred choice for tissue scaffolds as they can be degraded by the human body and do not harm the patient once implanted. Biodegradable polymers include lactic acid - the polymer in absorbable sutures and polyurethane, a bouncy cell-friendly polymer. Both polymers are fairly sticky for cells, thus cells like growing on them. They can be manufactured in various ways to produce a wide range of products for urological applications as well as for wound repair like ulcers and burns.

Polymers are a good scaffold material, but can be improved by mixing with active compounds which give them additional functions. For example, when mixed with hormones polymers can induce collagen production in older women, while mixing polymers with heparin induces the production of blood vessels which is very important for the formation of new, healthy tissue.

Our body, the building we are living in, deteriorates with age. Thus, regenerative medicine aimed at renewing ageing tissues can repair a damaged building, thereby improving our quality of life. The discovery of new biodegradable materials creates more possibilities, which are not restricted to urology only. The use of biodegradable materials in regenerative medicine might help when nerves are damaged due to a car accident or when big chunks of tissue are removed due to cancer. Thus, regenerative medicine is growing to be an essential field for a variety of medical applications, building and refurbishing damaged body parts.

Author's Bio:

Giulia Gigliobianco is a final year PhD student at the University Of Sheffield (UK) in the department of material science and engineering. Her research is about novel materials to treat pelvic organ prolapse in women. She organises outreach activities for women in engineering and children within the University of Sheffield. In her spare time, she bakes and she writes a blog about her life as PhD student.

Young Urology Meeting

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