Editorial

Virtual anatomy, histology and embryology in research and education

Dear Colleagues,

Xavier Bichat once wrote “Open up a few corpses: you will dissipate at once the darkness that observation alone could not dissipate” (Bichat, 1801). A new darkness in the form of the coronavirus disease 2019 (COVID-19) disrupted our ability to teach anatomy, histology, and embryology using our tried and tested techniques. It has been estimated that nearly 1.6 billion learners in over 200 countries were affected by the pandemic, with around 94% of schools, universities and learning spaces closing (Pokhrel & Chhetri, 2021). As many universities across the world had to shut their physical doors due to COVID-19, new gateways to research and teaching were quickly opened and a new light was shed on alternative teaching and research methods.

There was little insight into how long we would need to undertake our research, teaching, learning and assessment activities under these new conditions. Once the doors of our homes and institutions had opened again many of us conducted work using hybrid systems and contended with recurring restrictions and periods of isolation. Whether by working alone, as a department, or even collaborating internationally, many advances were made in the fields of anatomy, histology and embryology and this special issue ‘Virtual anatomy, histology and embryology in research and education’ shares some of these techniques and the studies researching their impact.

Histology has seen many advances since the first basic light microscope was invented. These have ranged from differing microscopes and imaging platforms through to advanced imaging and virtual/digital microscopy. The first two papers in this special issue show advances in digital microscopy and the use of virtual/digital microscopy in histological morphometry and quantitative histology and stereology. These papers include ‘Digital histological morphometry of the human pineal gland in a post-mortem study, with endocrine and neurological clinical implications’ and ‘Using virtual microscopy for the development of sampling strategies in quantitative histology and design-based stereology’. The third histology-based paper ‘An international collaborative approach to learning histology using a virtual microscope’ shows the methods used to enhance histology teaching during the pandemic, a technique which will likely continue in a blended form in many universities internationally.

The review ‘Veterinary anatomy teaching from real to virtual reality: An unprecedented shift during COVID-19 in socially distant era’ gives us an insight into many anatomical techniques, including adopting virtual reality aids such as 3D animations, software packages, virtual dissections and E-museums, used to assist anatomical teaching and research during the pandemic. Anatomical based research and teaching often relies on cadavers, which has been used as the principle method by many institutions internationally for centuries, alongside prosected specimens and models. Additional techniques have increasingly been used in conjunction with these methods including books, papers, videos, digital materials and other contemporary innovations. During the COVID-19 pandemic, alterations or alternatives to practical classes were sought to enhance the teaching and research being conducted, especially when access to laboratories was more difficult.

Anna Morandi once explained ‘whatever object presents itself to the hand for examination of its tangible qualities, nature immediately permits the hand, of all the anatomical members the most capable and sincere judge, to evaluate it’ (Messbarger, 2001). The fifth paper in this special issue

brought the specimens to the hand by bringing the laboratory into the home. The authors described how 'Delivery anatomy kits help to keep practical veterinary classes at a distance'. Meanwhile the sixth paper explores 'How virtual animal anatomy facilitated a successful transition to online instruction and supported student learning during the coronavirus pandemic'. Seeking to understand which techniques worked well in educational settings when teaching anatomy. The next two papers sought to understand the impacts of utilising videos to teach anatomy with 'Using videos in active learning: an experience in veterinary anatomy' and 'Dissection videos as a virtual veterinary anatomy peer learning tool: Trialed at the University of Tehran during the Covid-19 pandemic'.

The ninth paper 'New virtual platform for teaching comparative animal neuroanatomy based on metameric slices of the central nervous system' looks specifically at new methods employed to teach neuroanatomy. Meanwhile the tenth paper blended neuroanatomy and embryology to understand 'Student remote and distance research in neuroanatomy: Mapping Dscaml1 expression with a LacZ gene trap in mouse brain'. Embryology classically uses a number of techniques to research and teach this vital subject. Therefore, this special issue contains both a review and original research into embryology pedagogy in 'The use of active methodologies for the teaching of embryology: A systematic review' and 'Implementing a multi-color genetic marker analysis technique for embryology education'.

The final three papers presented in this special issue cover teaching research itself, alongside student attainment and pedagogical needs. Original research into the 'Impact of COVID-19 on student attainment and pedagogical needs when undertaking independent scientific research' studied the differences observed prior to and during the pandemic, giving deeper insights across a five-year period. The next two papers 'Extended reality veterinary medicine case studies for diagnostic veterinary imaging instruction: Assessing student perceptions and examination performance' and 'Students' performance in teaching neuroanatomy using traditional and technology-based methods' delved into neuroanatomy and diagnostic imaging, researching student attainment and perceptions. In addition to the task of learning anatomy, histology and embryology, we should also remember that the differing techniques we use in anatomy, histology and embryology often provide strengths and additional proficiencies in other areas such as ethical qualities, teamwork, and professional and communication skills (Ghosh, 2017; Moore, 1998). Therefore when assessing the effectiveness of newer techniques, we must remember to look at both the core learning achieved and the other competencies provided.

This special issue also contains the sixteen abstracts presented at the Trans-European Pedagogic Anatomical Research Group (TEPARG) symposia 2022. They provide a glimpse into how COVID-19 affected human anatomy activities around the world. General oversight, insights into anatomy spotter exams and comparisons between 3D digital models compared to 2D illustrations are provided in the abstracts 'Blended anatomy education: Challenges and opportunities', 'Adopting a flexible approach to professional anatomy spotter exams during COVID-19', 'Evaluating learner gain and student satisfaction of teaching anatomy online using 3D digital models as compared to 2D illustrations' and 'Drawing alongside digital 3D models: Synchronous versus asynchronous teaching'.

Experiences of teaching anatomy at differing institutions are also offered by the abstracts presented on the 'Experience and learning of COVID-19 in the Department of Anatomy and Embryology at UCM', 'New perspectives in Anatomical Teaching for Sports Science Students: Addressing the COVID-19 pandemic' and 'Anatomy education: A perspective of pre-clinical medicine students on the outcome of utilizing a virtual learning environment.

Anatomy, radiology and the use of online games have been explored in ‘An innovative online resource for learning radiology and anatomy’ and ‘Impact of online game to learn anatomy in medical education’. Despite the speed at which new tools and techniques were developed during the pandemic for our curricula, decolonisation remained an essential aspect and is explored in ‘Considering decolonisation of anatomy curricula in the era of hybrid anatomy education’. The next abstracts explored differing sources and the role of cadaveric dissection in ‘Educational Sources for Distance Teaching in Anatomy during the Covid-19 pandemic’ and ‘The role of cadaveric dissection and hybrid medical education in the post COVID-19 pandemic era’.

The relative strengths and weaknesses of face-to-face, online and hybrid anatomy and imaging have been discussed at length throughout the world in order to provide optimal teaching and research conditions. Therefore, the remaining abstracts in this special issue explored the lessons we have learnt ‘Can anatomy be taught without face-to face teaching? Lessons from the COVID-19 pandemic at Cambridge University’, ‘Online solutions to the delivery and assessment of a clinical anatomy and medical imaging unit’, Medical student experiences of learning anatomy face-to-face versus online: A qualitative study’, and ‘The role of anatomy demonstrators in the future: Lessons from virtual, hybrid and in-person teaching’.

Most of the research in this special issue concentrates on the techniques and resources by which we undertook our teaching and research during the COVI-19 pandemic. In many cases new skills and resources were developed and the effectiveness of each method was assessed. It is also important to highlight that everyone, professors and students, researchers and administrators, were affected by the emotional and practical challenges they faced on a daily basis. Whilst not covered in such detail in this special issue, it is essential to remember these innovations and changes were made against a background of worldwide change, uncertainty, extreme hardship for many, and often little access to resources.

As we start on the pathway to recovery and emerge back into the light, we do not have to leave these innovations and lessons behind us. Looking forward we can continue to understand and develop the skills and resources we have established. Rosalind Franklin said "Science, for me, gives a partial explanation for life. In so far as it goes, it is based on fact, experience and experiment" (Franklin, 1940). The research in this special issue, and the incredible amount of work conducted during the pandemic, ensured scientific research and teaching was able to continue. This included experience and experimentation of course, and the ongoing facts including analysis of the outcomes will continue to be reviewed in the years to come. Science is continually evolving, as are researchers, teachers and learners, we will continue to innovate, make discoveries, and impart our knowledge to the next generations.

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Dr Catrin Sian Rutland

School of Veterinary Medicine and Science, University of Nottingham, United Kingdom.

Professor William Pérez

Facultad de Veterinaria, Universidad de la República, Uruguay.

Correspondence

Catrin Rutland: Catrin.rutland@nottingham.ac.uk

William Pérez: vetanat@gmail.com

ORCID

Catrin Rutland: https://orcid.org/0000-0002-2009-4898

William Pérez: https://orcid.org/0000-0002-9647-4731

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