

Opinion Article

Newly developed practicals for physiology education and research

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For over a decade now, Indian physiologists have been placing emphasis on the important agenda of reinclusion of animal experiments in Physiology and Pharmacology. There have been several rounds of discussions and debates at several for involving groups of experts from different disciplines. Coincidentally, expert group at Medical Council of India (MCI) examined the need for ban of animal experimentation in UG courses. I happened to be the part of such discussions. The recent developments in physiology are encouraging and noteworthy in the country. With this context, finally, the MCI (now National Medical Commission) came out with a bold step of inclusion of an amendment in regulations on animal experimentation, as under:^[1]

'Animal experimentation should continue to be included as an integral part of the competency-based curriculum of postgraduate courses in Physiology and Pharmacology in medical institutions...' (Postgraduate Medical Education (Amendment) Regulations, 2019)

It is understandable that the purpose of PG education is to create specialists who would provide high-quality health care and advance the cause of science through research and training. Further, the purpose of the training in Physiology is to produce experts with necessary knowledge, skills and attitude to impart education and to carry out research in physiology, be able to serve the community as competent physiologists and render appropriate advice/service to the clinicians and society.

Now, it is a great opportunity that MCI has reconsidered this issue and I am convinced that it could result in regaining skill set of animal handling. This would result in substantial building up the body of knowledge in the domain of fundamental research. Research in this domain is a must for the advancement of core physiology and pharmacology and is the very building block of the foundations of Medicine. It will also culminate to the acquisition of lost skill sets required to handle animal experimentation which has dwindled for several decades.^[2] I am optimistic and confident that now Indian Physiologists will wake up and take a call. I know they have lots of potential to contribute to fundamental research in physiology and medicine.

THE ROLE OF AIIMS, NEW DELHI, IN DEVELOPING NEWER REPLACEMENTS

The Department of Physiology of AIIMS, New Delhi, has been performing amphibian experiments for undergraduate students since inception. These practicals included the study of various aspects of cardiac muscles, capillary circulation, nerve-muscle physiology and certain aspects of neural reflexes among others. In the past 3 years, the matter was discussed and

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deliberated in our departmental meeting of teaching staff, to explore alternative options of frog nerve muscle preparation for demonstrating the concepts of nerve muscle physiology. The challenge was actively taken up by all the teaching staff of the department. After concept presentation in the weekly departmental meeting of teaching staff, a systemic brain storming was done to find replacement for each of the lost practical. Then for each replacement suggested, a go ahead signal for pilot study was given. Small teams of faculty led resident-volunteers were made. After obtaining appropriate clearances from the Institute Ethics and Animal Ethics committees, the experiments were performed. I supervised the progress of the individual groups continuously on a regular basis. With persistent efforts, the experimental setup and observations were standardised to be consistent and reproducible. The observations and the graphs were subsequently discussed with me and presented and validated by the faculty and teaching staff of the department. Based on these innovations, a full cycle of undergraduate practical demonstrations was performed. Feedbacks were received and incorporated. As and when I saw an opportunity to innovate, I encouraged the young residents and researchers to file a patent. Our departmental efforts nearly lasting for 2 years yielded fruitful results.

For the benefit of the medical teaching community world over, we have carefully documented and published these innovations in Indian Journal of Physiology and Pharmacology (2019, 1st issue) [Table 1]. These were essentially intended for undergraduate medical education, however, now they find their value in Postgraduate Physiology education as well.

The advantages of these new experiments are manifold. Students can correlate their theoretical knowledge with the findings in practical experiments and discuss among themselves about the conceptual aspects of associated physiology. Assessment of student's learning of this demonstration practical can also be done using objectively structured practical examination with question stations based on the graphs obtained during the demonstrations. These experimental protocols may be used for research as well.^[3]

THE GROWTH OF CLINICAL PHYSIOLOGY AND REVERSE ENGINEERING

The growth in the field of clinical physiology is remarkable during the last many decades. The country has seen the steady growth in the field of Autonomic Physiology for three decades,^[4] emergence of Human Sleep Physiology and Polysomnography over two decades and Clinical Neurophysiology (especially intraoperative neuromonitoring, IONM) during the last decade. The field of Applied Physiology too is expanding. Cognitive neuroscience has made its dent as it was taken as a thrust area in the country. Apart from this, non-invasive interventions of pain and other functional disorders, exercise physiology and wellness clinics are finding their deserved places. The research in yoga remains as low-hanging fruit for physiologists, albeit more fundamental research is needed to explore the basic mechanisms. The Interventional Physiology is, thus, getting the required momentum where physiologists can play a leading role. I am sure the lost fields

Table 1: Newer replacements for frog experiments at AIIMS, New Delhi.

S. No.	Name of the practical	Transition	References
1	Demonstration of Nerve Muscle Preparation in Rats: For Nerve-Muscle Physiology Teaching.	Frog>Rat	Chakraborty <i>et al.</i> , 2019 ^[5]
2	Study of Neuromuscular Transmission Under (i) Phenomenon of Fatigue, (ii) Site of Fatigue, (iii) Neuromuscular Blocking in an <i>in situ</i> Rat Nerve Muscle Preparation: A Novel Approach to Nerve Muscle Physiology Experiment Teaching.	Frog>Rat	Sharma <i>et al.</i> , 2019 ^[6]
3	Effect of Load on <i>in situ</i> Rat Skeletal Muscle Preparation Under Free Loaded and After Loaded Condition.	Frog>Rat	Das <i>et al.</i> , 2019 ^[7]
4	An Innovative Method to Demonstrate Nerve – Muscle Physiology Experiments Using Finger Muscle Twitch Recording in a Human Subject.	Frog>Human or Rat	Muthukrishnan <i>et al.</i> , 2019 ^[8]
5	Practical to Demonstrate Electromyographic Changes Associated With Phenomena of Fatigue Due to Isometric Exercise.	Frog>Human or Rat	Chitturi <i>et al.</i> , 2019 ^[9]
6	A Novel Practical to Demonstrate Systemic and Local Regulation of Circulation in a Human Subject.	Frog>Human	Kaur <i>et al.</i> , 2016 ^[10]
7	Isometric Exercise in Humans at varying Muscle Lengths.	Frog>Human	Patent filed for the device through NRDC ^[11]

These experiments were used as 'Demonstration practicals' for undergraduate teaching and as 'Self-Performance Practical' for postgraduate level to inculcate performance skills (effect date: 2018, except no. 6). Experiment no. 6 is yet to be included in teaching. NRDC: National Research Development Corporation, New Delhi

of clinical physiology such as respiratory function testing, routine clinical neurophysiology and other newer fields such as cognitive function testing, and several other domains of physiology will also witness the headway in the departments of Physiology. Some of these practicals have already been included in physiology teaching and many more may be included.

Now, there is greater need to develop animal models for current practices in Clinical and Applied physiology services. In the absence of such animal models and experimentation, the physiology will reduce to 'services' with least component of research. I would consider this a reverse engineering in Clinical Physiology.

The newer Physiology should be pursued in this direction.

RECENT DEVELOPMENTS IN PHYSIOLOGY

There are several areas where both animal research and human research need to be done hand-in-hand to explore physiological basis such as gastrointestinal physiology, research in the field of special senses, sensory physiology, vascular research and many more.^[2,3] Furthermore, there is a need to create a “physiology skill map” of India, which may serve as roadmap for skill development programme for physiologists.

The recent activities in the field of space exploration have opened the new arena of Space Physiology. There are several analogue experiments that may be pursued on earth at molecular and cellular level, in small organisms, animals and humans. This covers a large number of organ/system areas. Therefore, the field of Space Physiology and Medicine is a new versatile area which has lots of potential to explore.

CONCLUSION

The purpose of physiology practical is to develop research skills and reinforce theoretical construct for physiology education. To reinforce and replace this, the Department of Physiology, AIIMS, New Delhi, has innovated and documented seven new experiments for undergraduate and postgraduate practicals. Since our department has been providing clinical services for over three decades, we have been successful in bringing practical elements of clinical physiology into teaching. Now, we are trying to explore the newer animal experiments for Clinical Physiology research and teaching.

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Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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