Forensic analysis of narcotic drugs – challenges and opportunities

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The exploitation of plants, toxins and certain synthetic chemicals and the collective knowledge of drug production has increased tremendously in this world of information explosion. Everyday new combinations of lethal drugs are being invented; the international drug control system is perplexed at the proliferation of such substances. The drug war is being fought by almost all states and governments across the world. The intelligence of forensic scientists involved in examination of such drugs is being tested and challenged. Embracing new techniques, interdisciplinary research and advanced training are the only weapons with which scientific soldiers can wage a war against this global epidemic.

There is a plethora of literature regarding narcotic drugs and substance abuse, their effect on the mind and body, ill-effects on society, economic strength, capability of destroying generations and also their potential in creating international conflicts. The exploitation of plants, toxins and certain synthetic chemicals and the collective knowledge of drug production has increased tremendously now. Everyday new combinations of lethal drugs are being invented, either in hi-tech laboratories, pharmaceutical units, or some clandestine kitchen laboratories around the world. The problem is hydra-headed and the challenge appears to be unending in the sense that as soon as any government bans a certain drug, manufacturers produce new variants. Further, the use of new psychoactive substances (NPS) not under international control and that pose a health threat, has grown rapidly over the past decade[1], in contrast to the prevalence rates for the use of internationally controlled drugs, which seem generally to have stabilized during the same period[2].

The new potent variants of designer drugs trace their point of origin and synthesis route from ephedrine, cathine, pseudoephedrine, ketamine, methacathinone, synthetic cannabinoids, ephedrones, methamphetamines, mephedrones, methylenedioxypyrovalerone, etc. Such substances are far more dangerous than traditional drugs; they are sold openly and legally, and have been reported to claim several lives. The international drug control system is perplexed at the proliferation of such substances. In case of ketamine, for example, in India the authorities woke up to its abuse potential only when headlines began appearing frequently of its rampant misuse associated with sexual assault cases worldwide. Mephedrone containing bath salts has been reported to be snorted by a person who got such a high that he took his skinning knife and slit his face and stomach repeatedly. The case of an alleged overdose of LSD by a young male in Delhi has been reported, who succumbed to the fatal dose[3]. The target of these narcotic drugs remains the same: our blood, body, brain, genes and economy. A war-like situation is being faced by almost all states and governments across the world, as the problem is not local but global. The problem is now being discussed even between nations sharing conflicting boundaries to mitigate the menace of drug and substance abuse. The traditional approach to drug scheduling tends to be time-consuming. At the same time, decisions made prematurely before a scientific consensus emerges may be counter-productive[4]. This creates a dilemma. A way to overcome this is through 'emergency procedures'[5] which involve introducing an emergency scheduling system. Emergency scheduling permits faster action than permanent scheduling and is used when a substance poses imminent danger to public health[6]. It also helps mitigate the risk of making incorrect decisions by delaying the final scheduling decision. In 2011, the United States temporarily scheduled several synthetic cannabinoids such as JWH-018, JWH-073, JWH-200, CP-47,497, CP-47,497 C8 homologue[7] and some of the problematic synthetic cathinones, such as mephedrone, methylone and MDPV, before putting them under regular control a year later[8]. Emergency scheduling appears to have helped a number of countries to prevent the outbreak of drug epidemics. The appearance of new drugs has changed the entire gamut of scientific examination and investigation strategy for forensic scientists, as fighting the menace of these narcotic drugs and psychoactive substances is not limited only to marijuana, charas, opium, cocaine, morphine, methaqualone, amphetamines and heroin any more. Mildronate (MET88, meldonium), an antiischemic drug was recently banned (1 January 2016) by the World Anti-Doping Agency fearing that it increased oxygen delivery to the muscles and could be abused by athletes trying to increase their endurance[9]. Maria Sharapova and Yulia Efimova have tested positive for the drug[10]. LC-MS/MS technique has been reported to be the adequate test method used for identification of mildronate and is regarded as the most reliable technique at present. The specific physico-chemical properties of the molecule and the fact that the drug is mostly excreted unchanged via renal route makes it an ideal analyte for the 'dilute-and-inject' approach using hydrophilic interaction liquid chromatography–high resolution/high accuracy mass spectrometry[11]. Underequipped and inadequately staffed forensic laboratories are likely to miss the new class of synthetic drugs that are cropping up everyday. Detection of these drugs which are synthesized to mimic existing illegal substances is an achievement in itself. Analysis of exhibits will always remain a learning experience and having a well-equipped laboratory is advantageous. Development is an ongoing process and the proactive measures which are required to keep pace with the emerging trends are to custom synthesize and characterize some of the working reference materials in the laboratory, if possible; build a database of emerging substances; perform continuous research for the next wave of drugs through updated publications; observe additional unknown peaks in the mass spectra of drugs under examination and correlate with new combination of designer drugs; obtain mass

spectral database of designer drugs; partner with custom synthesis companies, though this may be an expensive venture but will help detect the most problematic compounds with confidence. Spectra can be searched with commercially available databases; a database with retention time data can be built; standard material can be characterized in-house using state-of-the-art instrumental techniques like LC/MS TOF for exact mass and NMR for structure elucidation. Modernization of the laboratories by way of creating facility of newer techniques and appointing high-calibre scientific staff is the best and only option. Budget constraints and funds are limiting factors, but a strong technical justification and transparent approach can always convince the government authorities. Forensic science research is, surprisingly to some extent, an unexplored terrain in our country, though it is but natural that various streams can jointly work on new areas, sometimes a niche area like that of narcotic drugs, to develop new forensic analytical techniques and improve knowledge and scientific robustness of forensic science in general. Innovation comes from extending existing technologies and techniques to new areas of application. There is a great deal of research expertise and equipment in analytical sciences that is available which can be customized with a view to suit a specific interdisciplinary approach and utilized in the examination and detection of unknown drugs or related molecules in the forensic examination of biological as well as non-biological exhibits. Novel chromatographic screening methods for substituted methcathinones, development of semi-quantitative field tests for controlled substances, reliability of drug profiling using GCMS, ICPMS and IRMS for methamphetamine and MDMA, investigation of the synthesis of methamphetamine from pharmaceutical precursors, rapid quantitative detection of these drugs and their metabolites in body fluids, tissues and hairs, advanced chemometrics and artificial neural network analysis of complex and multivariate datasets are some of the thrust areas of research. As the examination of contraband drugs is a sensitive issue and with forensic science being a highly dynamic field, the key task for forensic scientists lies not only in the detection of compounds but in the conceptualization of a strategy in order to locate, collate and disseminate the knowledge and expertise to the authorized bodies and institutions in the global network. Training on proper understanding of the legal frameworks and the international reporting pattern is the need of the hour for forensic scientists and chemical examiners working in the core area. The data generated can be interpreted in a logical manner to provide investigating agencies leads to unmask the mushrooming cartels and syndicates involved. Information/intelligence-gathering regarding drug trafficking, its analysis and dissemination capabilities need to be strengthened.

The chemical examiners working in the forensic laboratories need to be well-informed, willing to take up challenges and well-versed in the emerging instrumental methodologies. New science and technology is transforming the capabilities of forensic laboratories all over the world. Forensic science is going through a metamorphosis from playing a supporting role to becoming a playmaker in criminal investigations.

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