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A Case Report

Postmortem Sperm Retrieval in a Case of Paraquat-Induced Death

Raghvendra Kumar Vidua[*] Leena Lokhande[*], Ashwani Tandon[**], Niranjan Sahoo[*], Moirangthem Sangita[***], Sashikanta Sahoo[**]

[*]Department of Forensic Medicine & Toxicology, All India Institute of Medical Sciences (AIIMS),Bhopal(M.P.)
[**]Department of Pathology & Lab Medicine, All India Institute of Medical Sciences (AIIMS), Bhopal (M.P.)
[***]Department of Forensic Medicine and Toxicology, Manipal TATA Medical College, Jamshedpur (Jharkhand), India

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Corresponding author : Dr. Raghvendra Kumar Vidua, Professor, Department of Forensic Medicine & Toxicology, All India Institute of Medical Science, Bhopal (M.P.)-462020
Email: raghvendra.fmt@aiimsbhopal.edu.in

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Abstract :

Postmortem sperm retrieval (PMSR) is an emerging technique in forensic and reproductive medicine, particularly relevant in cases of sudden or premature death. Paraquat poisoning is associated with severe multi-organ toxicity and high mortality; however, its impact on postmortem sperm viability is poorly documented. We report a case of PMSR performed in a 24-year-old male who died due to paraquat poisoning. Epididymal wash was undertaken during a medicolegal autopsy. Semen analysis demonstrated preserved motility and viability despite acute toxic exposure and a postmortem interval of approximately 15 hours. Histopathological examination of the testes revealed intact spermatogenesis. This case demonstratesthe feasibility of PMSR even in acute toxicological deaths and supports the potential utility of PMSR in forensic and assisted reproductive contexts.

Keywords: sperm retrieval; paraquat; autopsy

Introduction

The sudden death of a young individual poses a significant challenge in forensic medicine, confronting families not only with bereavement but also with the abrupt loss of reproductive potential. In recent years, postmortem sperm retrieval (PMSR) has emerged as a clinically relevant, though ethically complex, intervention that offers the possibility of genetic continuity afterdeath.[1,2] As awareness of assisted reproductive technologies increases, PMSR is becoming an integral consideration in medicolegal autopsies rather than a peripheral procedure.[3] The feasibility and outcome of PMSR are governed by multiple interrelated factors, including the postmortem interval, conditions of body preservation, and critically, the cause and mechanism of death.[4]

Although the literature has predominantly focused on PMSR following sudden cardiac death or traumatic injury, fatal poisoning represents a distinct and frightening biological challenge.[5] Paraquat is a highly toxic bipyridylium herbicide and a common agent of self-harm in agricultural regions of the Indian subcontinent.[6] Its toxicity results from continuous redox cycling within cells, which leads to excessive production of reactive oxygen species (ROS), lipid per-oxidation, and damage to cellular membranes.[7] Because human spermatozoa are highly susceptible to oxidative stress due to their high polyunsaturated fatty acid content, lethal paraquat ingestion has traditionally been considered a relative contraindication to successful postmortem sperm retrieval.[8]

The present report examines a landmark

case from Central India that challenges these assumptions. It provides an exhaustive analysis of a 24-year-old male who died of paraquat poisoning, where PMSR was successfully performed during a medicolegal autopsy. The case is relatable to both the clinical community and the families involved, as it highlights the technical triumph of retrieving viable genetic material despite a catastrophic toxicological insult.

Case Details

The body of a 24-year-old male was received by police at the Department of Forensic Medicine and Toxicology with an alleged history of intentional ingestion of *Safaya* poison at around 11:50 pm on June 24, 2024, at his residence. He was initially taken to the nearby hospital at around 12:30 am and then referred to MIMS Bhopal on June 25, 2024, where he died during treatment at 09:00 pm on June 26, 2024. Despite aggressive supportive management, including gastric decontamination and intensive care support, the patient succumbed to progressive respiratory failure and multi-organ dysfunction within 24 hours of admission. Death was declared, and the body was transferred for medicolegal autopsy.

The body was preserved in cold storage at 4°C for 10 hours and 06 minutes in accordance with institutional protocol until autopsy the following day, as the body was received during nighttime hours. The estimated time since death at the time of postmortem sperm retrieval was 14 hours and 48 minutes. The medicolegal autopsy was conducted as per standard institutional protocol. PMSR was undertaken during autopsy as part of the ongoing research protocol.

Sampling and Semen Analysis

Semen was retrieved from the deceased using an *in-house-developed* Vaso-epididymal (VE) wash method. PMSR was performed at the conclusion of the autopsy within a postmortem interval of less than 24 hours. This method involves accessing the epididymis and vas deferens to collect spermatozoa from the site of sperm maturation and storage. The collected semen sample was immediately transferred for laboratory analysis. Semen parameters, including total sperm count and motility, were assessed using a Semen Quality Analyzer (SQA-Vision-MES™). Motility was categorized as rapidly progressive, slow progressive, and non-progressive. Sperm viability was evaluated using the 1% eosin dye exclusion method, and the proportions of immotile and dead spermatozoa were calculated.

Histopathology of Testicular Tissue

Representative testicular tissue was collected during autopsy and fixed in 10% neutral buffered formalin. The tissue was routinely processed, embedded in paraffin, and sectioned at 4–5µm thickness. Sections were stained with hematoxylin and eosin (H&E) and examined at 40x under light microscopy to assess seminiferous tubular architecture, spermatogenesis, Sertoli and Leydig cell morphology, and any evidence of degenerative or pathological changes.

Autopsy Findings

The postmortem examination revealed features consistent with acute paraquat toxicity, including pulmonary congestion and edema, hepatic and renal congestion, and evidence of corrosive injury to the gastrointestinal mucosa. No gross abnormalities of the testes were identified. The cause of death was certified as acute respiratory failure due to paraquat poisoning.

Sperm analysis findings

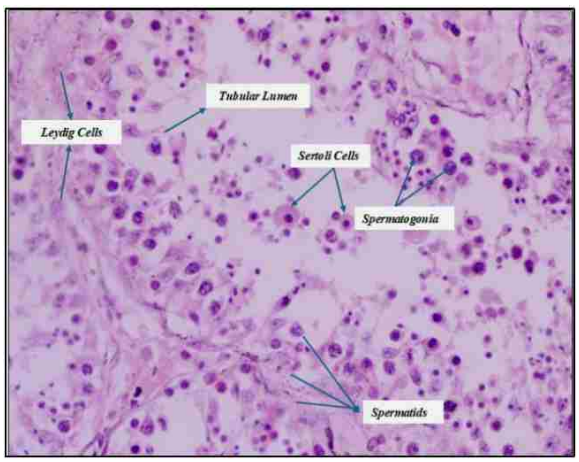
Despite acute toxic exposure and a postmortem interval of approximately 15 hours, the semen analysis demonstrated the presence of viable and motile spermatozoa. Microscopic and automated analysis of the retrieved epididymal sample demonstrated the presence of spermatozoa with preserved viability and motility. The total sperm motility was 28%, with 21% exhibiting rapid progressive motility, 6% slow progressive motility, and 1% non-progressive motility. A substantial proportion of spermatozoa (76%) were immotile. Sperm viability assessment using the 1% eosin dye exclusion method revealed that 45% of spermatozoa were viable, while 55% were non-viable. (Table 1)

Table 1: Semen analysis findings of he retrieved epididymal sample

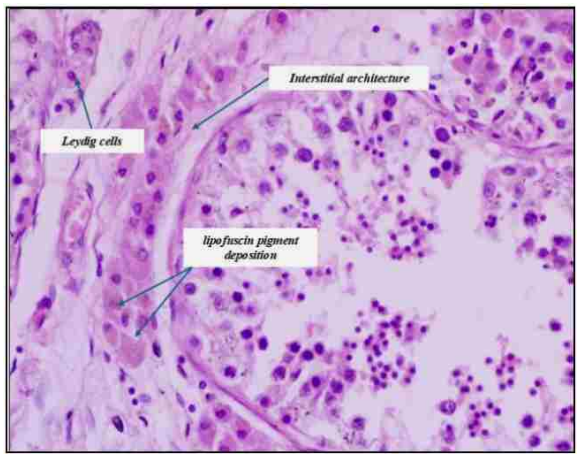
SN	Parameter	Result
1	Total motility (%)	28
2	Rapidly progressive motile spermatozoa (%)	21
3	Slow progressive motile spermatozoa (%)	06
4	Non-progressive motile spermatozoa (%)	01
5	Immotile spermatozoa (%)	76
6	Live spermatozoa (%)	45
7	Dead spermatozoa (%)	55

Histopathology Finding

Histopathological examination of the testicular tissue revealed well-formed seminiferous tubules with intact basement membranes and orderly spermatogenesis. Sertoli cells were preserved, and the interstitium showed scattered Leydig cells with delicate vascular channels. There was no evidence of tubular atrophy, inflammation, fibrosis, or neoplastic change, indicating preserved testicular architecture and active spermatogenesis. (Figure 1 A& B)



(A)



(B)

Figure 1: *Photomicrograph findings of the H&E stain (40x) of Testicular tissue. In Image (A) of well-preserved seminiferous tubules with orderly spermatogenic cells, an intact basement membrane, identifiable Sertoli cells, and a patent tubular lumen. Image (B) demonstrates the Leydig cells with focal lipofuscin pigment deposition and preserved interstitial architecture.*

Discussion:

PMSR is an evolving practice in forensic and reproductive medicine. The majority of reported PMSR cases involve sudden traumatic or cardiac deaths. Toxicological deaths pose unique challenges due to the potential direct gonadotoxic effects of poisons and systemic hypoxia.[8,9] In the present case, an epididymal wash performed approximately 15 hours postmortem yielded spermatozoa with 28% total motility and 45% viability. These values are lower than those typically observed in fresh ejaculated semen but are noteworthy given the acute toxic exposure and postmortem interval. The presence of rapidly progressive spermatozoa (21%) suggests that functionally competent spermatozoa can persist in the epididymis even after systemic poisoning.

Experimental animal studies provide important mechanistic insight into this observation. Chen *et al.*(2017) demonstrated that paraquat exposure in rodent models induces oxidative stress–mediated injury to the male reproductive system, characterized by lipid peroxidation, mitochondrial dysfunction, and impaired spermatogenesis, particularly following repeated or chronic

exposure.[8] Importantly, these and related experimental studies have shown that structural damage to the seminiferous tubules and depletion of germ cells occur in a time-dependent manner, rather than as immediate consequences of acute intoxication. In support of this, Wang *et al*. reported that short-term paraquat exposure in rats resulted in severe systemic toxicity. At the same time, testicular architecture and mature epididymal sperm reserves remained relatively preserved during early exposure phases.[10] This temporal dissociation between systemic lethality and gonadal damage may explain the preserved sperm viability observed in the present case.

A possible protective mechanism underlying this phenomenon is the blood–testis barrier (BTB). Cheng and Mruk (2012) described the BTB as a specialized structure formed by tight junctions between adjacent Sertoli cells, creating a highly regulated micro environment that restricts the entry of toxins, inflammatory mediators, and immune cells into the adluminal compartment of the seminiferous tubules.[11] Expanding on this concept, Mital *et al.*(2011) emphasized that the BTB, together with the blood–epididymis barrier, plays a critical role in preserving germ cell integrity under systemic stress conditions.[12] Through this barrier function, developing germ cells are protected from circulating toxicants, which may delay the onset of toxic or inflammatory injury to spermatogenic cells. In acute poisoning, the BTB may transiently protect developing germ cells and stored epididymal spermatozoa from immediate toxic injury.

Postmortem biological processes also influence sperm survival. Shefi *et al.* (2006) noted that although progressive hypoxia, acidosis, and autolysis ultimately compromise cellular integrity after death, epididymal spermatozoa are metabolically quiescent and demonstrate greater tolerance to hypoxic conditions than somatic cells.[1] Additionally, Gat *et al.*(2022)emphasized that cold storage at 4 °C delays enzymatic degradation and bacterial proliferation, thereby reducing infection-related damage to gonadal tissue.[4] In the present case, the absence of histological inflammation or degenerative changes supports the conclusion that autolytic or infectious processes had not yet significantly affected spermatogenesis at the time of retrieval.

The preservation of seminiferous architecture with orderly spermatogenesis, together with measurable sperm motility and viability at approximately 15 hours postmortem, indicates that acute paraquat poisoning does not cause immediate gonadal failure. Instead, sperm viability appears to decline in a time-dependent manner influenced by toxin kinetics, protective tissue barriers, postmortem interval, and storage conditions. These findings suggest that, in acute toxicological deaths, testicular structure and epididymal sperm reserves may remain preserved for a limited postmortem period, and that toxicological death should not be considered an absolute contraindication to PMSR, provided careful case-by-case evaluation is undertaken.

From a forensic perspective, this case underscores the importance of timely PMSR and appropriate cold storage conditions. From a reproductive medicine standpoint, it raises the possibility that viable sperm may be obtained even in cases of lethal poisoning, although ethical, legal, and consent-related considerations remain paramount.

Conclusion

This case demonstrates that postmortem sperm retrieval (PMSR) yielding viable and motile spermatozoa is achievable even following death due to paraquat poisoning. Notwithstanding severe systemic toxic insult, live and motile spermatozoa were successfully obtained, and histopathological examination demonstrated preserved spermato-genesis. These observations underscore the potential applicability of PMSR in cases of acute toxicological fatalities and emphasize the necessity for further systematic research to delineate the boundaries of sperm viability across varying toxic exposures and postmortem intervals.

Ethical Approval and Consent

This case is a part of an ICMR-funded research, and written informed consent was obtained from the next-of-kin of the deceased. Institutional ethical approval was obtained for the ICMR-approved study.

Ethical Considerations

Postmortem sperm retrieval raises complex ethical and legal issues, including consent, intended use of gametes, and the rights of surviving relatives. In the present case, PMSR was performed as part of a research and feasibility protocol. Any clinical application of retrieved sperm would require appropriate legal authorization and informed consent

from the next of kin, and this case underscores the urgent need for standardized national guidelines addressing consent, legal ownership, timing, technical procedures, and storage

References:

1. Shefi, S., Raviv, G., Eisenberg, M. L., Weissenberg, R., Jalalian, L., Levron, J., ... &Madgar, I. (2006). Posthumous sperm retrieval: analysis of time interval to harvest sperm. *Human Reproduction*, *21*(11), 2890-2893.
2. Simana, S. (2018). Creating life after death: should posthumous reproduction be legally permissible without the deceased's prior consent?. *Journal of Law and the Biosciences*, *5*(2), 329-354.
3. Morgan, L. W., & Morgan, H. G. (2020). The Legal and Medical Ethics of Post-Mortem Sperm Retrieval on Behalf of Grandparents. *J. Am. Acad. Matrimonial Law.*, *33*, 67.
4. Gat, I., Umanski, A., Kaufman, S., Kedem, A., Avraham, S., Youngster, M., ... &Levtzion-Korach, O. (2022). What can we learn about posthumous sperm retrieval after extra long-term follow-up?. *Journal of Assisted Reproduction and Genetics*, *39*(7), 1661-1665.
5. Bahadur, G. (2004, April). Ethical challenges in reproductive medicine: posthumous reproduction. In *International Congress Series* (Vol. 1266, pp. 295-302). Elsevier.
6. Bonvoisin, T., Utyasheva, L., Knipe, D., Gunnell, D., & Eddleston, M. (2020). Suicide by pesticide poisoning in India: a review of pesticide regulations and their impact on suicide trends. *BMC public health*, *20*(1), 251.
7. Dinis-Oliveira, R., Duarte, J. A., Sánchez-Navarro, A., Remião, F., Bastos, M. L., & Carvalho, F. (2008). Paraquat poisonings: mechanisms of lung toxicity, clinical features, and treatment. *Critical reviews in toxicology*, *38*(1), 13-71.
8. Chen, Q., Zhang, X., Zhao, J. Y., Lu, X. N., Zheng, P. S., & Xue, X. (2017). Oxidative damage of the male reproductive system induced by paraquat. *Journal of biochemical and molecular toxicology*, *31*(3), e21870.
9. Md Zain, A. (2007). The Evaluation of the Toxic effect of Paraquat and Its Mechanism of action on reproductive system of Male Rats *[RA1242. P34 A636 2007 f rb]* (Doctoral dissertation, University Sains Malaysia).
10. Wang X, Zhao J, Zhang X, et al. Time-dependent testicular toxicity induced by paraquat in rats: role of oxidative stress and mitochondrial dysfunction. *Toxicology*. 2016;368–369:44–52.
11. Cheng CY, Mruk DD. The blood–testis barrier and its implications for male fertility. *Physiol Rev*. 2012;92(2):825–872.
12. Mital P, Hinton BT, Dufour JM. The blood–testis and blood–epididymis barriers are more than just their tight junctions. *Biol Reprod*. 2011;84(5):851–858.

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