The "Hub and Spoke" model: a pathway for urgent plasma exchange to treat patients with rodenticide ingestion induced acute liver failure in Tamil Nadu, India

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Dear Editor,

Ingestion of phosphorus-containing rodenticide is an important cause of acute liver failure (ALF) in agrarian communities in southern and western India. In Tamil Nadu (TN), it was estimated that among 1584 cases of rodenticide hepatotoxicity (RH), 554 (35%) had died in 2019.[1] As highlighted recently in *The Lancet Gastroenterology and Hepatology*, high mortality in low-resource settings is attributable to lack of access to urgent liver transplantation.[2] Annually, only about 50–75 ALF patients undergo urgent liver transplantation in India.[3] Specific criteria to list RH patients for urgent liver transplantation (model for end-stage liver disease score ≥36 or baseline prothrombin time–international normalized ratio ≥6 with hepatic encephalopathy) were proposed from Kochi in Kerala state. No patient fulfilling these criteria survived with standard medical management alone.[4]

High volume plasma exchange (PLEX) is an alternate treatment in ALF due to paracetamol overdose.[5] We had previously reported, in Vellore, TN, survival in six out of eight (75%) children with RH, meeting Kochi criteria for transplantation and no contraindication to PLEX, treated with low volume (0.5 × estimated plasma volume per session) PLEX.[6] When expanded to include all children and adults with RH who met Kochi criteria for liver transplantation treated with low volume PLEX, from January 2014 to September 2023, 1-month survival rate was 22/32, 68.7% (unpublished data). In Vellore, low volume PLEX is standard of care for ALF due to RH. It was adopted as the Health Department's policy in TN.[7]

The TN Government adopted a set of interventions to manage RH, including timely access to PLEX in case of ALF (Fig. 1). Protocols for non-transplant management of rodenticide ingestion were prepared by the Tamil Nadu Chapter of the Indian Society of Gastroenterology (TN-ISG)[8] and the TN Government.[7] Poisonings constitute one of six thrust areas of the TN Accident and Emergency Care Initiative (TAEI) of the National Health Mission (NHM).

Under the aegis of TAEI-NHM, an expert group (called Working Group) was asked to propose solutions to address rodenticide poisoning. Furthermore, the authors visited Thanjavur (TN district with the highest RH case burden) and interacted with those who survived RH as well as farmers, shop owners selling rodenticides and concerned district regulatory authority personnel. All stakeholders were sensitised about the high number of deaths, especially amongst the youth due to easy access to rodenticide and its use as a poison for suicide, and ways to curb this. The Working Group recommended stringent regulations to restrict rodenticide sale and a model of care for rodenticide poisoning within the patient's own district. Initial assessment and resuscitation is feasible at the nearest primary health centre and monitoring at the nearest secondary level hospital. Those who develop RH would be taken to the district government medical college (GMC) hospital, where those who fulfil defined criteria undergo low volume PLEX. This referral chain is the "Hub and Spoke" model.

Legislation was passed to curb unrestricted access to rodenticide. Online sensitisation and training were periodically imparted to doctors, nurses, and technicians from TAEI centres (*taluk* [sub-district], district and state level). Initially, dedicated teams from GMC hospitals with high case load started PLEX services for RH, after onsite training in the TAEI-NHM management protocol. This subsequently expanded to include more specially trained teams in district government hospitals offering PLEX to treat RH patients. The aim is for each of the 38 districts in TN state to have a similar facility. By repurposing of existing resources, the plasmapheresis machines acquired during the COVID-19 pandemic are now used to treat RH patients.

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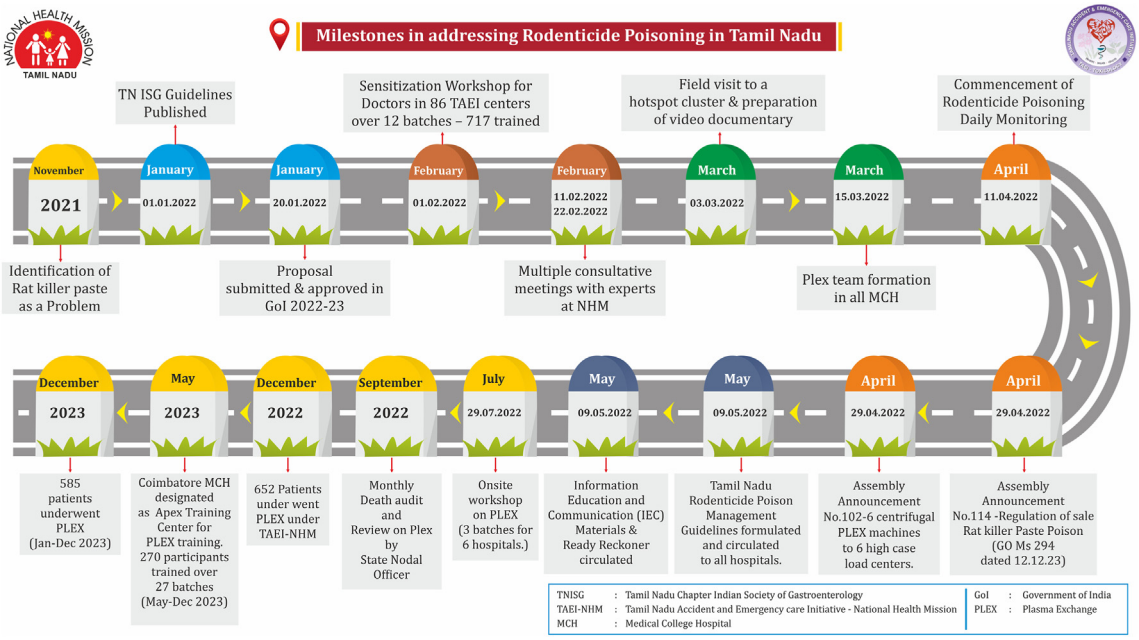

Fig. 1: Milestones in addressing Rodenticide poisoning in Tamil Nadu, India.

In 2 years (2022–23), in the state of Tamil Nadu (population 72 million), only three patients with RH accessed urgent liver transplantation.[9] During the same period, 1237 RH patients underwent PLEX under the TAEI-NHM programme. The effectiveness of this "Hub and Spoke" model needs to be analysed further.

A cost analysis of low volume PLEX as compared to liver transplantation needs to be carried out; it is likely that PLEX will be a fraction of the cost of transplantation. Equally, the donor pool for PLEX (plasma) is more readily available than for transplant (organ).

This "Hub and Spoke" model could be replicable in other resource-constrained settings for saving lives of patients with ALF of diverse aetiologies.

Contributors

CEE, AG, UZ, and KN conceptualized the paper. TAEI Team - SPS, KN, SMT, SR, JJ, AM, CP, NS, SC, and SK were involved in project administration. UD and VJ supervised the project and paper. VA, SKE, CEE, AG, and UZ were involved in data curation, formal analysis and the manuscript preparation. VA, SKE, AG, CEE, UZ, DD, GKC, SV, VD, IA, DRV, SK, KP, EJ, KPPA, DDA, SJ, and SG were involved in the clinical care of patients. All contributors reviewed and approved the final draft of the manuscript.

Declaration of interests

None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lansea.2024.100405.

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