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Commentary

# Design and Evaluation of Transdermal Patches for Controlled Delivery of Antipsychotics

**Mei-Ling Huang***

*Department of Pharmaceutics and Drug Delivery Systems, Taipei Biomedical Research Institute, Taipei, Taiwan*

## ABOUT THE STUDY

The development of Transdermal Drug Delivery Systems (TDDS) has significantly transformed pharmacotherapy by offering sustained drug release, bypassing first-pass metabolism, and improving patient compliance especially in the treatment of chronic disorders such as schizophrenia and bipolar disorder. Antipsychotic medications, while effective, are often associated with challenges including poor patient adherence, variable gastrointestinal absorption, and significant first-pass hepatic metabolism. To address these concerns, transdermal patches present a promising alternative by delivering drugs through the skin in a controlled and consistent manner. This study focuses on the design and evaluation of matrix-type transdermal patches for the controlled delivery of second-generation antipsychotics, with particular attention to risperidone, due to its favorable pharmacokinetics and clinical efficacy.

The formulation development began with the selection of suitable polymers, plasticizers, and permeation enhancers. Polymers such as ethyl cellulose, Hydroxypropyl Methylcellulose (HPMC), and Polyvinyl Alcohol (PVA) were evaluated for their film-forming ability, drug compatibility, and mechanical properties. Dibutyl phthalate and propylene glycol were used as plasticizers to enhance flexibility and patient comfort, while oleic acid and Dimethyl Sulfoxide (DMSO) were incorporated as skin permeation enhancers to facilitate drug passage through the stratum corneum. The drug was incorporated into the polymeric matrix using the solvent casting technique, which provided uniform dispersion and consistent film thickness.

The physical properties of the patches were assessed for thickness, weight variation, tensile strength, folding endurance, moisture content, and drug content uniformity. All formulations demonstrated satisfactory physical integrity and uniformity, with acceptable mechanical properties suitable for skin application. In vitro drug release studies were carried out using Franz diffusion cells with synthetic membranes and excised porcine skin to simulate human skin permeability. The optimized formulation released approximately 85% of the drug over a 24-hour period, indicating a sustained and controlled release profile. The release kinetics followed a Higuchi model, suggesting diffusion-controlled drug release from the matrix system. Skin permeation studies revealed that the formulation containing a combination of oleic acid and DMSO as enhancers achieved the highest flux, demonstrating their synergistic role in improving transdermal permeation. The skin irritation potential of the patches was evaluated using in vitro methods and confirmed to be minimal, with no significant erythema or edema observed in animal studies. Stability studies conducted under ICH guidelines confirmed the physical and chemical stability of the patches over a three-month period, with no major changes in drug content, appearance, or release behavior.

A pilot pharmacokinetic study was conducted in rabbits to compare the bioavailability of the transdermal formulation with that of the conventional oral route. The transdermal patches showed a delayed Tmax and prolonged Mean Residence Time (MRT), consistent with controlled delivery. Importantly, the area under the curve was comparable to oral administration, indicating effective systemic absorption. This suggests that transdermal patches can provide therapeutic drug levels over an extended period, reducing the need for frequent dosing and potentially improving adherence in psychiatric patients.

The potential advantages of transdermal antipsychotic delivery extend beyond pharmacokinetics. Patients with psychiatric disorders often experience challenges in adhering to complex oral medication regimens due to cognitive impairment, side effects, or social stigma. A non-invasive, easy-to-use transdermal patch offers a discreet alternative that could significantly improve compliance, reduce relapse rates, and enhance quality of life. Furthermore, healthcare providers can more easily monitor adherence with patch-based systems, potentially allowing for timely interventions in cases of missed doses.

Another consideration in antipsychotic therapy is the reduction of side effects associated with peak plasma levels, such as sedation, extrapyramidal symptoms, and cardiovascular effects. By maintaining a steady-state drug concentration, transdermal systems can mitigate such adverse effects and improve tolerability. This is particularly relevant for long-term

**Correspondence to**: Mei-Ling Huang, Department of Pharmaceutics and Drug Delivery Systems, Taipei Biomedical Research Institute, Taipei, Taiwan, E-mail: m.huang@tbri-tw.org

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management of schizophrenia, where side effects often lead to discontinuation of therapy.

In conclusion, the design and evaluation of transdermal patches for controlled delivery of antipsychotics, particularly risperidone, demonstrate strong potential as a viable alternative to traditional oral dosing. The formulation developed in this study provides sustained drug release, effective skin permeation, stability, and patient acceptability. From both a pharmacological and clinical perspective, transdermal delivery offers numerous advantages that align with the therapeutic goals of chronic psychiatric care. As mental health continues to be a growing concern worldwide, innovations such as these could play a critical role in enhancing treatment outcomes and patient adherence. Further clinical trials in human subjects will be essential to validate these findings and support regulatory approval for widespread clinical use.