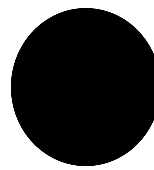
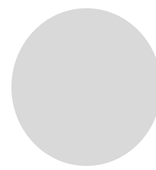
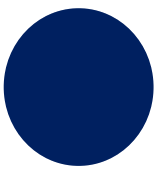
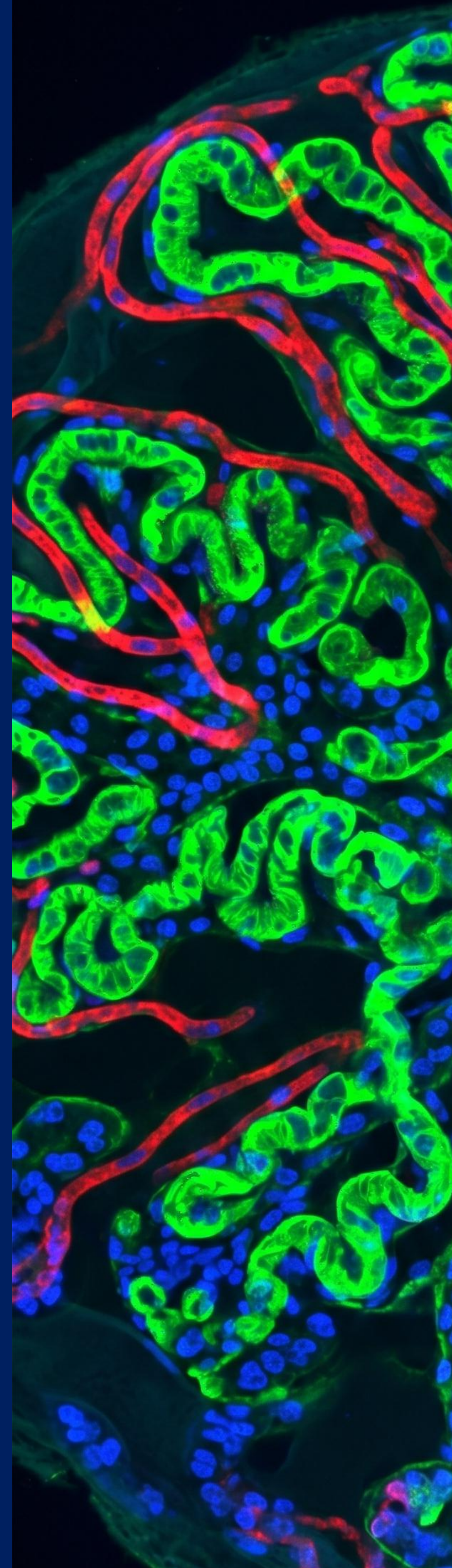
Sbio™

Products related to organoid research

- STEMFULL™ Low Cell Adhesion Tubes
- PrimeSurface™ 3D Culture Plate
- BioStellar™ Multi-Organ MPS



SUMITOMO BAKELITE CO., LTD.

The Hidden Challenges in Organoid Research

Human iPSC-derived organoids have emerged as powerful tools in regenerative medicine and drug discovery. Pioneered at institutions including RIKEN, the serum-free floating embryoid body-like aggregate culture (SFEBq) method enables production of complex, tissue-specific structures including retinal, cerebral, and dopaminergic organoids from ES/iPSCs with high fidelity to native development.

However, current approaches carry a critical and under-recognized challenge: the silent loss of cells and organoids over prolonged culture periods. Insufficient *n*-numbers force costly experiment repeats, while compensating through excess seeding inflates consumable costs and operator workload, ultimately limiting scalability and reproducibility.
Specific loss events remain poorly reported in the literature, including substantial cell loss during large-scale harvest and organoid loss through uncontrolled fusion during extended culture. These are structural inefficiencies embedded in current practice, quietly undermining reproducibility at every stage.

Addressing these hidden losses requires platforms that safeguard aggregate integrity, enable efficient large-scale cell recovery, and prevent fusion-driven attrition, while meeting the throughput demands of personalized medicine. We are committed to surfacing these silent challenges and delivering the solutions that make reliable, cost-efficient organoid research possible.

Our Solution for Organoid Workflow Stage

SUMILON Labware provides purpose-built solutions at organoid workflow stage: STEMFULL™ tubes maximize cell recovery during harvest, PrimeSurface™ plates ensure uniform aggregate formation and long-term organoid survival, and BioStellar™ MPS plates enable clinically relevant drug evaluation across connected organ-on-chip compartments.

STAGE 01
Cell Preparation

STEMFULL™

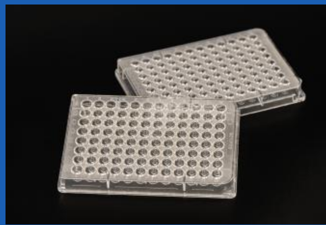
Low Cell Adsorption Conical Centrifuge Tube

- Covalently bonded super-hydrophilic polymer prevents cell adhesion.
- Recovers more cells compare with conventional tubes.
- Supports high-quality scRNA-seq from organoid single-cell suspensions.
- Enables spheroid formation directly in tube.

STAGE 02
3D Culture & Maturation

PrimeSurface™

3D Culture Spheroid Plate 96U · 96S Slit-well



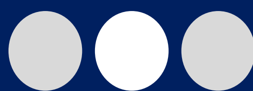
- Super-hydrophilic surface drives uniform spheroid formation
- High pluripotency-related gene expression in slit well before organoid differentiation.
- High organoid survival over long-term culture in slit well plate.
- Supports experiments with high reproducibility and throughput.
- 384-well format enables large-scale parallel drug screening.

STAGE 03
Drug Evaluation

BioStellar™

Multi-Organ MPS Plate

- Connects multiple (up to 4) organ-on-chip compartments for drug response modeling.
- Enables PK/PD modeling, dose-response, and toxicity studies.
- Integrates directly with PrimeSurface™ organoids — true end-to-end workflow
- Data closer to clinical reality than standard 2D assays.



Comparative study on single-cell retrieval of small intestine organoids

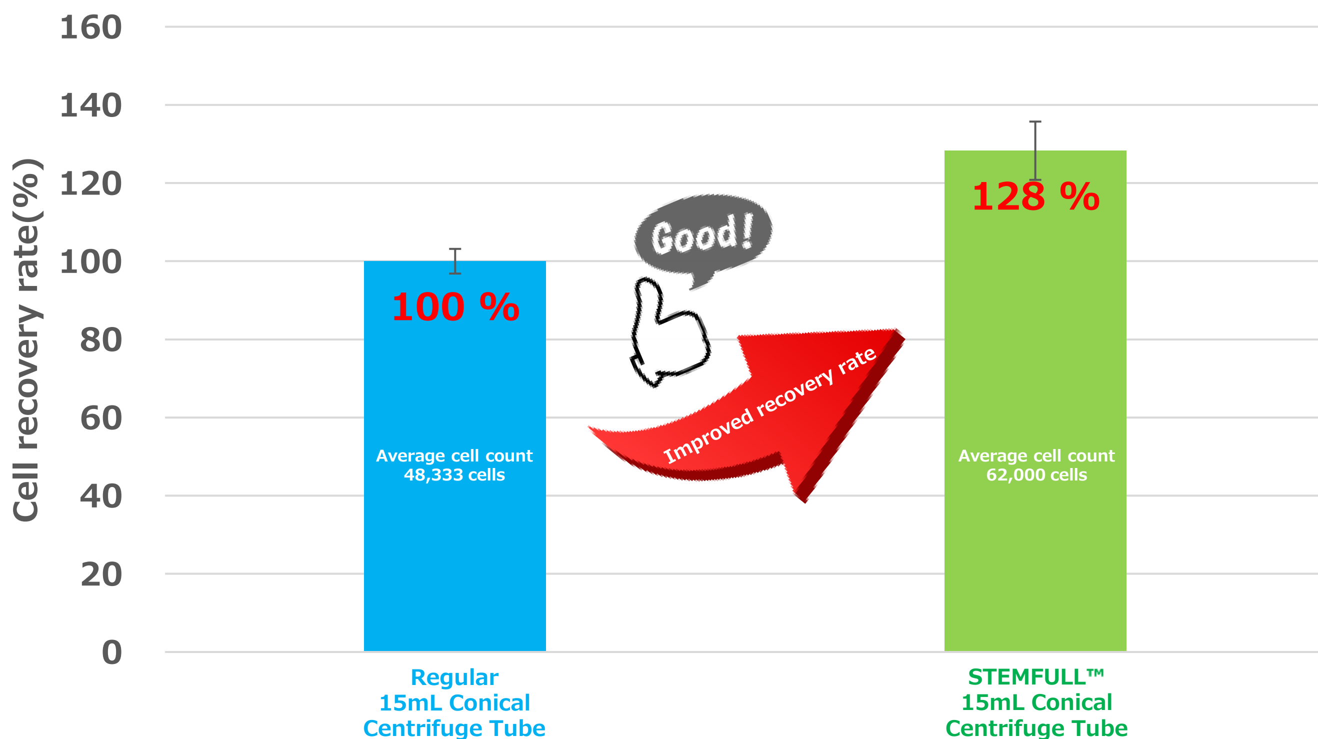
As regenerative medicine research advances, cell transplantation therapy using organoids as an alternative to organ transplantation has gained attention in recent years. By transplanting organoids into the patient's body, it is expected that they can exhibit similar functions to native organs. To regenerate functional organs, a certain number of organoids are required, which need to be expanded through passaging or other methods. Furthermore, by generating single cells from organoids and performing single-cell analysis, there is potential to contribute to the elucidation of disease mechanisms such as cancer and the development of novel treatments. As organoid research progresses, there is a growing demand for efficient retrieval of rare cells through organoid passaging and single-cell analysis.

Data provided by Professor Toshiro Sato,
Department of Medical Chemistry,
Keio University School of Medicine

[Experimental Conditions]

- Sample: Patient-derived small intestine organoids
- Number of samples: n=3
- Container: STEMFULL™ 15mL Conical Centrifuge Tube (Product Code: MS-90150)
  Regular 15mL Conical Centrifuge Tube
- Measurement method:

The small intestine organoids were dissociated into single cells using a cell dissociation enzyme. After washing in serum-free medium, the number of cells was measured. The recovery rate was calculated by comparing it to 100% recovery in a regular 15mL conical centrifuge tube from another company.



STEMFULL™ contributes to improved recovery rate of valuable cells by minimizing cell loss due to reduced cell adhesion compared to regular centrifuge tubes.

Modeling embryo-endometrial interface recapitulating human embryo implantation

Shun Shibata, Shun Endo, Luis A. E. Nagai, Eri H. Kobayashi, Akira Oike, Norio Kobayashi, Akane Kitamura, Takeshi Hori, Yuji Nashimoto, Ryuichiro Nakato, Hirotaka Hamada, Hirokazu Kaji, Chie Kikutake, Mikita Suyama, Masatoshi Saito, Nobuo Yaegashi, Hiroaki Okae, and Takahiro Arima
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【Background】

The early stage of human pregnancy initiation is marked by embryo implantation into the uterine endometrium; however, the underlying mechanisms remain largely elusive due to ethical restrictions and technical challenges. In particular, the 3D architecture of endometrial epithelial, stromal, and endothelial cells and their functional interactions with the embryo remain poorly understood. Traditional 2D culture models and simple coculture systems have failed to replicate in vivo tissue architecture, hormone responsiveness, and intricate cell-cell interactions.

【Research Achievements】

In this study, the authors developed hormone-responsive apical-out endometrial organoids (AO-EMO) that recapitulate the in vivo architecture of endometrial tissue. AO-EMO exhibited an outwardly oriented apical surface, dense stromal cells, and a self-assembled endothelial network with enhanced maturation and secretory functions upon hormonal stimulation. Coculturing AO-EMO with human embryonic stem cell-derived blastoids established a 3D feto-maternal assembloid system which recapitulated crucial implantation stages, including apposition, adhesion, and invasion. Invasion and fusion with syncytial cells and endometrial stromal cells were validated in this model using human blastocysts. Using human blastocysts, they demonstrated their adhesion onto AO-EMO surfaces and invasion into epithelial cells, enabling detailed investigation of cellular fusion and interactions during implantation.

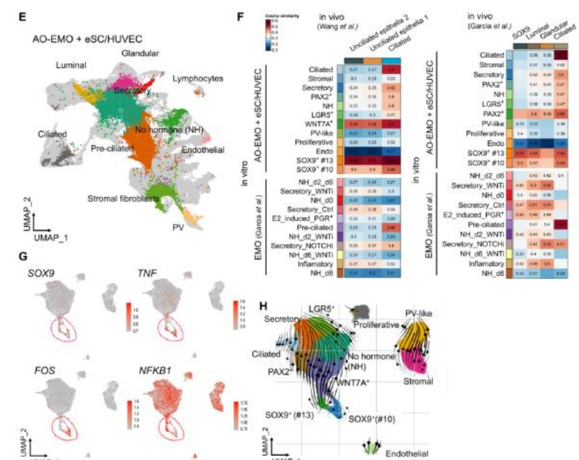


Figure 3 E-H (Multicellular integration into the 3D model and scRNA-seq analysis):
E and F: Fluorescence microscopy images showing fusion of syncytiotrophoblast cells derived from blastoid embryos on AO-EMO, forming multinucleated cells.
G and H: Heatmaps and clustering analyses of gene expression profiles, illustrating the distribution of high-quality cell populations used for analysis.

This model, faithfully recapitulating human embryo implantation processes, This system provides a novel experimental platform to dissect the complex biochemical and physical interactions at the embryo-maternal interface, supplying insights for advancing reproductive medicine.

【Use of STEMFULL™ in This Research】

STEMFULL™ was utilized during single-cell RNA sequencing (scRNA-seq) sample preparation to handle cell suspensions. It minimized cell adhesion and loss, thereby contributing to the acquisition of high-quality scRNA-seq data.

(For details, please refer to the paper)

Generation of Human iPS Cell-Derived Kidney Organoids and Their Application in Drug Discovery Research

【Background】

The technology for generating organoids derived from iPS cells has brought about innovative advancements in regenerative medicine and drug discovery research in recent years. Organoids faithfully replicate the three-dimensional structures and functions of actual tissues and organs, enabling the mimicry of the complex in vivo microenvironment that is difficult to reproduce with traditional two-dimensional cell cultures. As a result, they are attracting attention as novel research models for elucidating disease mechanisms and evaluating drug efficacy and safety.
In this application note, we introduce a technique for the uniform and highly reproducible generation of high-quality human iPS cell-derived kidney organoids using PrimeSurface™. These organoids can be applied to disease modeling, efficacy evaluation, and drug screening, thereby contributing to the efficiency of drug discovery research.

【Methods】

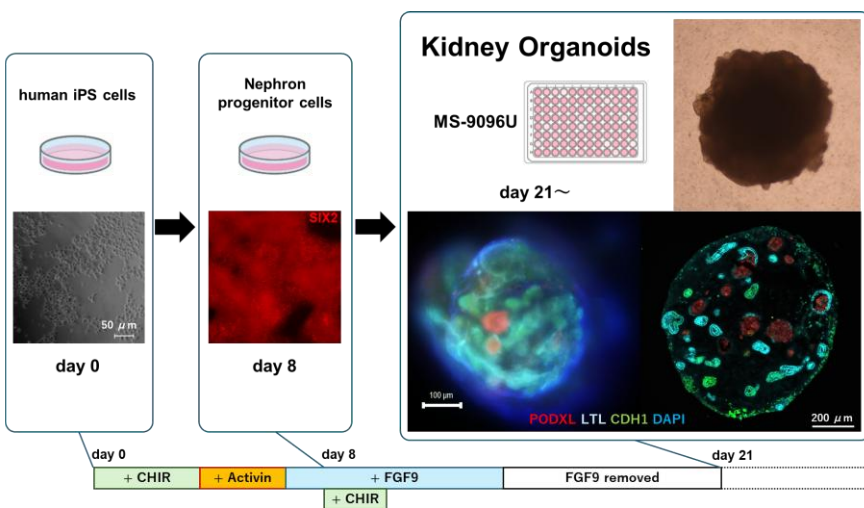
Induction of iPS Cell Differentiation: Human iPS cells were induced to differentiate into nephron progenitor cells through stepwise stimulation conditions, including the addition of CHIR99021, Activin A, and FGF-9.

3D Culture and Organoid Formation: On Day 8 of differentiation induction, cells were seeded onto PrimeSurface™. The special surface treatment promoted cell aggregation and the uniform formation of kidney organoids.

Culture and Evaluation: After approximately 21 days of culture, the formed organoids were harvested and kidney-specific markers were evaluated by immunofluorescence staining. High-quality, functional three-dimensional tissue formation was confirmed.

【Results】

By using PrimeSurface™, human iPS cell-derived kidney organoids were formed with uniform size and high reproducibility. Immunostaining analysis also showed proper expression of key cell markers constituting the nephron structure of the kidney, demonstrating the formation of functional three-dimensional tissue morphology.



Data Provided by: Koichiro Susa, M.D., Ph.D., Junior Associate Professor, Department of Nephrology, Institute of Science Tokyo

【Expressed Markers】

PODXL: A membrane protein expressed in podocytes within the glomerulus of the kidney. It plays key roles in podocyte signal transduction, cell adhesion, and interaction with the glomerular basement membrane, crucial for maintaining the kidney's blood filtration function. Used as a marker for podocytes in organoids.

LTL: Specifically binds to the surface of proximal tubule cells by recognizing sugar residues. It serves as an indicator of tubular function and structure identification. In organoids, it is used to identify proximal tubule regions.

CDH1: An important adhesion molecule involved in epithelial cell-cell adhesion, mainly expressed in distal tubules and collecting ducts in the kidney. It helps maintain tissue structure and integrity by mediating cell-cell interactions.

DAPI : A fluorescent dye that specifically binds to DNA, widely used as a counterstain to visualize cell nuclei. It is a fundamental staining method to observe cell presence and nuclear morphology.

【Organoids generated with PrimeSurface™ as drug discovery tools】

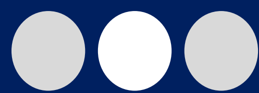
High Uniformity and Reproducibility: PrimeSurface™ provides a uniform cell adhesion substrate through its specialized surface treatment, enabling consistent and highly reproducible organoid formation. This reduces variability in drug responses and enhances the reliability of screening assays.

Stable Long-Term Culture Environment: It offers stability capable of supporting long-term culture, allowing for repeated drug administration and evaluation of chronic effects.

3D Structure Suitable for Functional Evaluation: By mimicking the nephron structure of the kidney and expressing key cell markers, it enables drug efficacy and toxicity assessments that are closer to actual clinical conditions compared to traditional 2D cultures.

Improved Efficiency and Success Rates in Drug Discovery: The stable culture system suppresses variability in evaluation experiments, improving the quality of assessment results. This contributes to the efficient disease modeling, drug efficacy evaluation, and drug screening, ultimately enhancing the success rate of drug discovery.

PrimeSurface™ enables the formation of uniform, highly reproducible, and high-quality organoids, making it a reliable culture system for organoid research. Furthermore, these organoids can be applied to disease modeling, efficacy evaluation, and drug screening, thereby contributing to the efficiency of drug discovery research.



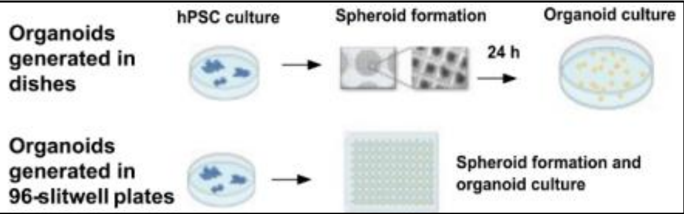
Application of REPRODUCIBLE HUMAN CORTICAL ORGANOIDS

Data provided by Dr. Taylor Bertucci, Principal Investigator, Neural Stem Cell Institute, USA

Human pluripotent stem cell (hPSC)-derived cortical organoids serve as advanced models to study human brain development and neurological disorders. These organoids recapitulate key developmental processes such as neurogenesis and gliogenesis, enabling long-term studies of cortical structure and function. However, existing protocols often suffer from low efficiency and variability across different hPSC lines, limiting reproducibility. This study presents an improved protocol using PrimeSurface™ Slit-well Plate 96S that increases production efficiency and consistency across multiple donor lines. This enhanced platform allows for sensitive detection of disease-related metabolic alterations, facilitating deeper insights into the mechanisms of neurodegenerative diseases.

【Method】

In this application note, cerebral cortical organoids were generated from hPSCs using PrimeSurface™ Slit-well Plate 96S . Cells formed spheroids within the plate wells and were subsequently cultured with specific patterning factors. For the control group, spheroids were first formed in a microwell dish and then transferred to a standard dish 24 hours later for organoid culture. Throughout the culture period, the morphology and size of organoids were regularly monitored. The use of the PrimeSurface™ Slit-well Plate 96S allowed for efficient and consistent large-scale production of organoids.



Day 1 → (5 days)	Day 6 → (19 days)	Day 25 → (18 days)	Day 43 →
E6 medium	Neurobasal medium	Neurobasal medium	Neurobasal medium
+SB431542 + dorsomorphin + XAV939	+ B27 + EGF + FGF2	+ B27 + BDNF + NT3	+ B27

【Results】

- Organoids cultured in the PrimeSurface™ Slit-well Plate 96S exhibited minimal reduction in number, high survival rates, uniform size, and stable growth.

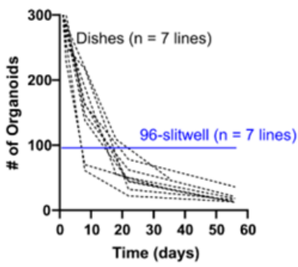


Fig. 1 The number of organoids over time showed less reduction in the 96-slitwell plate (solid blue line) compared to dish controls (dashed line) .

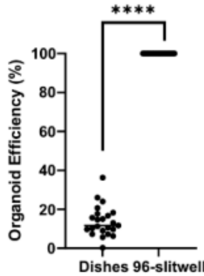


Fig. 2 Organoid production efficiency after 20 days of culture. High organoid production efficiency was maintained in the 96-slitwell plate.

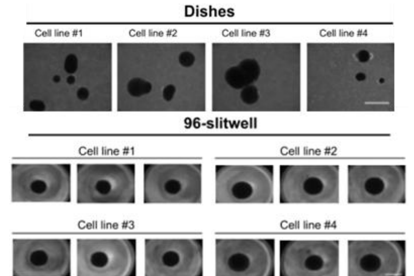


Fig. 3 Organoids generated in dish controls exhibited a range of sizes, while organoids in the 96 Slit-well Plate demonstrated stable growth.

- Spheroids generated in the PrimeSurface™ Slit-well Plate 96S showed significantly higher expression of pluripotency-related genes and demonstrated uniform size distribution across multiple hPSC lines in comparison to the control group.

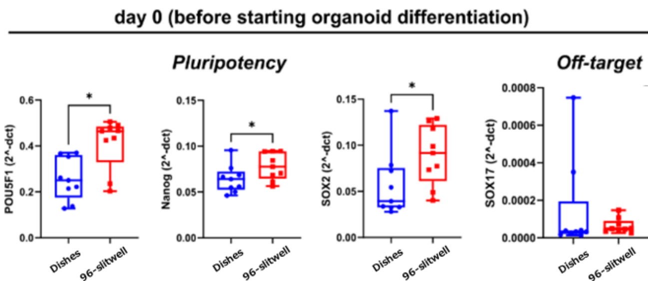
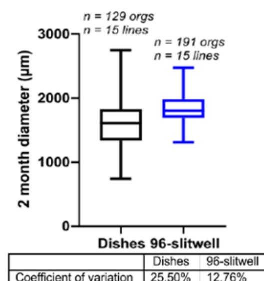


Fig. 4 Gene expression at the spheroid formation stage (day 0). The hPSC spheroids in the 96-slitwell plate showed significantly higher expression of pluripotency-associated genes POU5F1/OCT4, NANOG, and SOX2 compared to spheroids formed in dish controls.



	Dishes	96-slitwell
Coefficient of variation	25.50%	12.76%

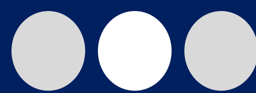
Fig. 5 Diameter variation after culturing 15 hPSC lines for two months. Although organoids generated by both methods reached similar diameters, the reproducibility between organoids and between cell lines was significantly improved with the 96-slit well plate.

【Discussion】

Culturing with the PrimeSurface™ Slit-well Plate 96S significantly improved organoid survival and size uniformity, leading to more stable growth than conventional methods. This reduced variability between cell lines and experiments, enhancing reproducibility and reliability. The consistent formation of uniform initial spheroids also played a crucial role in supporting culture consistency.

PrimeSurface™ Slit-well Plate 96S provides a uniform, stable culture environment that enables large-scale, efficient organoid production. It reduces experimental variability and contributes to the standardization of organoid-based disease models.

PrimeSurface™ Slit-well Plate 96S and BioStellar™ Plate Application



Organoid Generation and Drug Efficacy Evaluation

Data provided by CEO Thomas Mitchell, The Organoid Company BV

Introduction

Cyclophosphamide (CP) is an alkylating agent used extensively in oncology. CP requires hepatic bioactivation via CYP450 to generate its active form. Secondary neurotoxicity and cognitive impairment are recognised clinically, but the mechanisms of inter-organ metabolic communication remain poorly understood in conventional monoculture models.

In this study, stem cell-derived liver and CNS organoids generated by PrimeSurface™ Slit-well Plate 96S were connected via microfluidic channels using the BioStellar™ Plate) to model inter-organ drug metabolism and secondary toxicity. As a result, a dose-dependent reduction in NeuN expression and an increase in γH2AX-positive signal were observed in CNS organoids, consistent with secondary neurotoxicity attributed to CP metabolites generated via hepatic metabolism in liver organoids.

This study demonstrates that the present system, combining organoids with a multi-organ MPS platform, is capable of recapitulating inter-organ metabolic interactions that cannot be captured by single-organ models, and is thereby validated as a highly valuable tool for comprehensive drug toxicity prediction in a physiologically relevant environment.

Methods

Liver organoids (LOs) and CNS organoids (CNSOs) were derived from a proprietary stem cell line using differentiation protocols developed by The Organoid Company BV and an automated culture system utilising PrimeSurface™ Slit-well Plate 96S, and were cultured for 90 days to achieve functional maturation. Following organoid generation, each organoid was loaded onto the BioStellar™ Plate, and three connection configurations were established: (1) LO–CNSO, (2) LO–LO, and (3) CNSO–CNSO. CP was dissolved in sterile water and added at 0, 50, 100, and 200 μM to the designated treatment compartments — the liver compartment in LO-containing configurations, or one side in the CNSO–CNSO configuration — and connected co-culture was performed for 48 hours at 2,500 RPM. After culture, both organoids were fixed with 4% paraformaldehyde. Immunostaining was performed using rabbit anti-NeuN antibody for CNSOs, rabbit anti-Albumin antibody for LOs, mouse anti-γH2AX antibody for DNA damage assessment, and DAPI for nuclear counterstaining. Images were acquired on a Yokogawa CQ1 confocal quantitative image cytometer at 10× magnification across 4 fields of view, with approximately 40 Z-slices collected per well. The acquired images were subsequently analysed and each marker was quantified.

Results

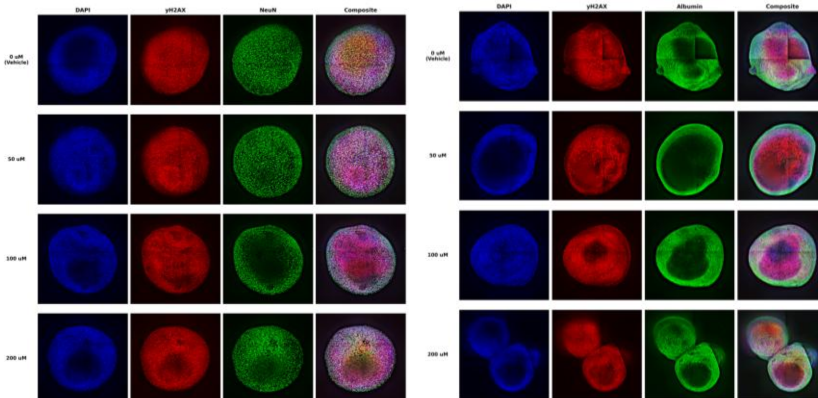


Fig. 1. Representative confocal images of CNS and liver organoids across cyclophosphamide dose-response.

(Left) CNS organoid dose-response grid showing DAPI (nuclei, blue), γH2AX (DNA damage, red), NeuN (neuronal marker, green), and composite overlay for 0, 50, 100, and 200 μM CP. CNS organoids were not directly treated but connected to treated liver organoids via MPS microfluidic channels. (Right) Liver organoid dose-response grid showing DAPI, γH2AX, Albumin (hepatocyte marker, green), and composite for directly treated liver organoids. Scale: each panel approximately 2 mm across.

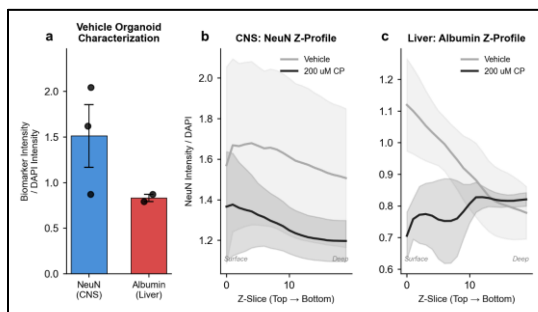


Fig. 2. Organoid characterization and volumetric Z-depth profiling.

a Biomarker Expression in Vehicle-treated Organoids (CNSO:NeuN; LO:Alb)

b Z-depth Profile of NeuN/DAPI in CNSOs (200 μM CP vs. Vehicle)

c Z-depth Profile of Albumin/DAPI in LOs (200 μM CP vs. Vehicle)

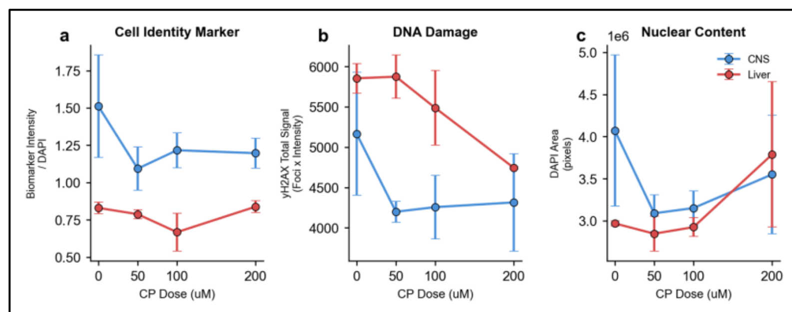


Fig. 3. Dose-dependent effects of cyclophosphamide on connected organoids.

a Organoid Biomarker Expression across CP Doses (Blue: CNSO、Red: LO)

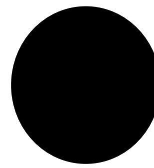
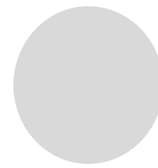
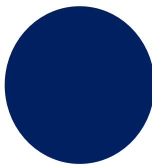
b DNA Damage Assessment across CP Doses (Blue: CNSO、Red: LO)

c Nuclear Content Analysis across CP Doses (Blue: CNSO、Red: LO)

NeuN signal reduction was observed in CNSOs following CP treatment.

With increasing CP concentration, dose-dependent reductions in CNS biomarker expression, DNA damage, and nuclear content were observed.

By combining high-quality organoid generation using PrimeSurface™ 96 Slit-well Plates with the multi-organ connection system of the BioStellar™ Plate, dose-dependent secondary neurotoxicity of cyclophosphamide mediated via hepatic metabolism was successfully recapitulated. These findings demonstrate that inter-organ metabolic interactions can be recapitulated in vitro using this platform. This capability goes beyond what conventional single-organoid systems can achieve, establishing its utility as a next-generation solution for comprehensive drug toxicity prediction.

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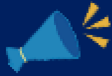

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