NUHS
National University Health System

National University Hospital

MEDIA RELEASE

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STRENGTHENING PATIENT CARE AND SAFETY IN COMPLEX, HIGH-RISK PAEDIATRIC LIVER TRANSPLANT SURGERY

Innovative mixed reality technology enhances pre-surgical planning at NUH's specialised paediatric organ transplant centre in Singapore

SINGAPORE — For the last three decades, the transplant team at the National University Hospital (NUH)'s Department of Paediatric Surgery in the Khoo Teck Puat – National University Children's Medical Institute (KTP-NUCMI) and the National University Centre for Organ Transplantation (NUCOT) has journeyed with countless paediatric warriors who have bravely overcome various challenges on their road to recovery.

One remarkable child is little Avira, who at two years old, has already undergone two major life-saving surgeries.

Diagnosed with a rare illness known as biliary atresia when she was less than a month old, bile was trapped inside Avira's liver, which led to liver damage and scarring. If left untreated, her liver would eventually fail.

Biliary atresia occurs in approximately one in every 20,000 live births, with a slightly higher prevalence in females.

Overcoming the first hurdle with primary treatment

Liver transplantation has proven highly successful in the long-term treatment of children with biliary atresia, with an overall survival of more than 90 per cent. However, the initial treatment is to perform a Kasai procedure because 50 to 60 per cent of children experience significant improvement and may survive well with their own liver until much older.

Hence, Avira first underwent the Kasai procedure at two months old, where her surgeon Adjunct Associate Professor Vidyadhar Mali, a Senior Consultant in the Department of Paediatric Surgery at KTP-NUCMI, NUH, and the Surgical Director of the Paediatric Kidney and Liver Transplantation Programmes at NUCOT, removed the obstructed bile ducts outside the liver and attached a loop of the small intestine directly to the liver, restoring bile flow.

Nonetheless, three in five children may still face progressive liver-related complications following a Kasai procedure.

For Avira, a post-operative follow-up two months later revealed progressive deterioration of her liver function and a liver transplant was deemed necessary. Her mother, Mrs Han, stepped forward as a donor.

Preparing for a complex, high-risk surgery with hybrid mixed reality technology

Preparing Avira for her transplant required overcoming significant challenges.

Liver transplants in a small child (weighing less than 10kg) is relatively rare and considered highly challenging. These cases require specialised surgical expertise and careful planning due to the complexities involved in such small patients.

Factors such as the child's small size, the need for appropriately sized liver donor grafts, and the delicate nature of paediatric patients add significant risks and technical difficulty to the procedure.

Being extremely small, Avira needed to be on a feeding tube to gain weight in two months. Furthermore, her small size meant that her surgeons would have to split her mother's donated liver (known as graft reduction) to ensure that the organ would be a right fit for Avira.

Unlike adults, small children being transplanted with grafts too large or too small for them may present issues following liver transplantation and as the child grows older.

Studies have found that different approaches and graft-size matching strategies that are age- and body weight-appropriate are crucial for better outcomes in paediatric living donor liver transplantations.

In addition to reducing the graft size of the donor liver, the surgical team needed to determine the exact size of the liver graft needed. Incorrectly estimating the size of the graft could lead to a longer time on the operating table for Avira, and could also increase the risk of graft damage.

To ensure the right size of the graft for Avira, the surgical team, led by Adj A/Prof Mali, employed a hybrid technique of utilising mixed reality imaging ("holomedicine") to compare the child's CT scan and the CT scan of the donor liver. This played an important role in accurate pre-operative estimation of the mother's liver size into Avira's body.

"Holomedicine leverages mixed reality to interact with virtual objects superimposed onto the real world, allowing for unparalleled accuracy in pre-surgical planning," explained Dr Gao Yujia, Consultant, Division of Hepatobiliary & Pancreatic Surgery, Department of Surgery, NUH, and the Assistant Group Chief Technology Officer leading the holomedicine programme at NUHS.

"This hybrid technique enhances surgical planning, giving us a solid road map with the potential of greater precision so that patient care and safety can be improved during the surgery itself," said Adj A/Prof Mali.

Little Avira's transplant surgery – which took place in July 2022 – was a success, with both mother and child making a full recovery. Today, Avira is much like other children her age, a playful and energetic toddler, with a bright future ahead.

NUCOT is the only specialist centre in Singapore which has both adult and paediatric liver and kidney transplantation services under one roof, bringing together a comprehensive multidisciplinary suite of medical specialty services required throughout our patients' transplantation journeys.

As we celebrate World Transplant Day, we honour the courage of all transplanted children and their families. Through continuous innovation and compassionate care, NUCOT remains committed to transforming lives and offering hope to families navigating the complexities of organ transplantation.

Chinese Glossary

National University Health System (NUHS)	国立大学医学组织 (国大医学组织)
National University Hospital (NUH)	国立大学医院 (国大医院)
National University Centre for Organ Transplantation (NUCOT)	国大医院器官移植中心
Holomedicine	全息医疗
Adjunct Associate Professor Vidyadhar Mali Surgical Director & Senior Consultant, Paediatric Kidney and Liver Transplantation Programmes, National University Centre for Organ Transplantation (NUCOT), National University Hospital (NUH) Senior Consultant, Department of Paediatric Surgery, Khoo Teck Puat – National University Children's Medical Institute (KTP-NUCMI), National University Hospital (NUH)	Vidyadhar Mali 客座副教授 外科主任兼高级顾问医生 小儿肾脏与肝脏移植计划 国大医院器官移植中心 高级顾问医生 小儿外科 国大医院邱德拔-国立大学儿童医疗中心
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About the National University Health System (NUHS)

The National University Health System (NUHS) aims to transform how illness is prevented and managed by discovering causes of disease, development of more effective treatments through collaborative multidisciplinary research and clinical trials, and creation of better technologies and care delivery systems in partnership with others who share the same values and vision.

Institutions in the NUHS Group include the National University Hospital, Ng Teng Fong General Hospital, Jurong Community Hospital and Alexandra Hospital; three National Specialty Centres - National University Cancer Institute, Singapore (NCIS), National University Heart Centre, Singapore (NUHCS) and National University Centre for Oral Health, Singapore (NUCOHS); the National University Polyclinics (NUP); Jurong Medical Centre; and three NUS health sciences schools – NUS Yong Loo Lin School of Medicine (including the Alice Lee Centre for Nursing Studies), NUS Faculty of Dentistry and NUS Saw Swee Hock School of Public Health.

With member institutions under a common governance structure, NUHS creates synergies for the advancement of health by integrating patient care, health science education and biomedical research.

As a Regional Health System, NUHS works closely with health and social care partners across Singapore to develop and implement programmes that contribute to a healthy and engaged population in the Western part of Singapore.

For more information, please visit www.nuhs.edu.sg.

About the National University Hospital (NUH)

The National University Hospital (NUH) is Singapore's leading university hospital. While the hospital at Kent Ridge first received its patients on 24 June 1985, our legacy started from 1905, the date of the founding of what is today the NUS Yong Loo Lin School of Medicine. NUH is the principal teaching hospital of the medical school.

Our unique identity as a university hospital is a key attraction for healthcare professionals who aspire to do more than practise tertiary medical care. We offer an environment where research and teaching are an integral part of medicine, and continue to shape medicine and transform care for the community we care for.

We are an academic medical centre with over 1,200 beds, serving more than one million patients a year with over 50 medical, surgical and dental specialties. NUH is the only public and not-for-profit hospital in Singapore to provide trusted care for adults,

women and children under one roof, including the only paediatric kidney and liver transplant programme in the country.

The NUH is a key member of the National University Health System (NUHS), one of three public healthcare clusters in Singapore.