Comparing The Outcomes Of A Modified Technique Using A Spatulated Umbilical Cord Patch For A Scarless Primary Repair Of Gastroschisis With Other Techniques For Primary Closure, A Multicenter Experience

A Thesis

Submitted for partial fulfilment of M.D. degree
in Paediatric Surgery

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2019

سورة المؤمنون – آية ٢٩

Acknowledgments

First and foremost, I feel always indebted to **Allah**, *the* **Most Beneficent** *and* **Merciful** *who gave me the strength to accomplish this work.*

My deepest gratitude to my supervisor, **Prof. Dr. Osama El-Naggar,** *Professor of Paediatric Surgery, Faculty of Medicine-Ain Shams University, for his valuable guidance and expert supervision, in addition to his great deal of support and encouragement. I really have the honor to complete this work under his supervision. God blesses him and keeps him a sun lightening the way for the scientific students.*

No words can express my gratitude and appreciation to **Mr. Thomas T. Tsang,** *Consultant of Paediatric Surgery, Norfolk and Norwich University Hospital, for his mentoring and great support. Without his efforts and supervision, I couldn't have finished this work.*

I would like to express my great and deep appreciation and thanks to **Prof. Dr. Mosad Al-Behery,** *Professor of Paediatric Surgery, Faculty of Medicine-Ain Shams University, for his meticulous supervision, and his patience in reviewing and correcting this work.*

I would also like to express my gratitude to **Prof. Dr. Mohamed Al-Debeiky,** *Professor of Paediatric Surgery, Faculty of Medicine-Ain Shams University, for his ongoing support and motivation.*

I must express my deepest thanks to **Dr. Mohamed Al-Sherbeiny,** *Lecturer of Paediatric Surgery, Faculty of Medicine- Ain Shams University for guiding me throughout this work and for granting me much of his time. I greatly appreciate his efforts.*

Special thanks to my Parents and my **Wife,** *and all my* **Family** *members for their continuous encouragement, enduring me and standing by me.*

Last but not least, I would also like to thank my colleagues, my patients and everyone helped me in this study.

✍ *Sherif Mamdouh Abdelhafez Mansour*

Dedication

I dedicate this work with sincere thanks and appreciation to ***my Wife, my Father and Mother, my Father and Mother In-law, my brother, my sister In-law and my two kids*** *for their constant support.*

Sherif Mamdouh Abdelhafez Mansour

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List of Abbreviations

Abbr.	Full-term
AFP	**:** α-fetoprotein
ASUH	**:** Ain Shams University Hospital
CAPNet	**:** Canadian Pediatric Surgery Network
CPAP	**:** Continuous positive airway pressure
DOB	**:** Date of birth
GPS	**:** Gastroschisis Prognostic Score
HAS	**:** Human albumin saline
HICs	**:** High-income countries
HUCMSC	**:** Human Umbilical Cord mesenchymal stem cells
HUCPVC	**:** Human Umbilical Cord Peri-Vascular Cells
IMD	**:** Intramuscular distance
ISUC	**:** Inner surface of the umbilical cord
IUGR	**:** Intrauterine growth retardation
KID	**:** Kids' Inpatient Database
LOS	**:** Length of stay
MIM	**:** Minimal intervention management
MIMG	**:** Minimal Intervention Management of Gastroschisis
MSC	**:** Mesenchymal Stem Cell
NEC	**:** Necrotizing enterocolitis
NICU	**:** Neonatal intensive care
NIS	**:** National Inpatient Sample

NNUH : Norfolk and Norwich University hospital
PHIS **:** Pediatric Health Information System
PFC **:** Primary fascial closure
SC **:** Subcutis
SD **:** Standard deviation
SNAP **:** Score for Neonatal Acute Physiology and
SUC **:** Spatulated Umbilical Cord
TPN **:** Total parenteral nutrition
UCA **:** Umbilical cord attachment
UCC **:** Umbilical cord capping'
UK **:** United Kingdom
US **:** Ultrasound

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Abstract

Background: The goal of the surgical management of gastroschisis is to return the bowel into the abdomen without jeopardizing the viscera. Primary fascial closure (PFC) was historically favored due to improved outcomes.

Aim of the work: To prospectively analyse the outcomes of primary closure of gastroschisis using Spatulated Umbilical Cord (SUC) technique, and compare with the retrospectively-collected outcomes of patients who underwent PFC.

Patients and Methods: this pilot interventional case-control study was conducted at the Departments of Paediatric Surgery at Norfolk and Norwich University Hospital in UK and at Ain-Shams University Hospitals in Egypt during the period from February 2017 to February 2019. The "Study" group was a prospective cohort of patients with gastroschisis; in whom SUC closure technique was used. The control group was a retrospective cohort of patients; who underwent primary fascial closure. Outcome measures were success rates, post-operative ventilation, days of parenteral nutrition, time to full enteral feeds and complications.

Technique: The SUC patch involved the following: the amnion layer is opened from the base at 9 O'clock position, the Wharton's jelly exposed and 'spatulated' using longitudinal incisions and then secured as a patch over the defect.

Results: Whereas PFC was successful in all patients (n=10), SUC patch technique was successful in 77.8% (n=9). The duration of mechanical ventilation was statistically significantly shorter in the control group compared to the study group (1.75vs4.0 days). Time-to-start or achieve goal enteral feeding was longer in patients with SUC patch technique, but not statistically significant. Regarding complications, 2 patients in the study group needed re-laparotomy after development of abdominal hypertension. Intestinal obstruction occurred in one patient, and one patient had a persistent umbilical hernia. One patient in the control group had a laparotomy for bowel obstruction and one patient required the repair of a persistent umbilical hernia.

Conclusion: Primary closure of gastroschisis using SUC is safe, feasible, cost-effective and with comparable outcomes to other well-established techniques.

Keywords

Gastroschisis – SUC patch – outcomes

1. Introduction and Aim of the Work

1.1. Embryology, epidemiology and prenatal diagnosis of Gastroschisis

The abdominal wall forms during the fourth week of gestation from differential growth of the embryo causing in-folding in the craniocaudal and mediolateral directions. The lateral abdominal folds of the embryo meet in the anterior midline and surround the yolk sac, eventually constricting the yolk sac into a yolk stalk that becomes the site of the umbilical cord. During the sixth week of gestation, the rapid growth of the intestine causes herniation of the midgut into the umbilical cord. Elongation and rotation of the midgut occurs over the ensuing 4 weeks. By week 10, the midgut has returned to the abdominal cavity and the first, second, and third portions of the duodenum and the ascending and descending colon assume their fixed, retroperitoneal positions. [(1)]

The etiology of gastroschisis is not very clear. One theory suggests that gastroschisis results from failure of the mesoderm to form in the anterior abdominal wall. A second theory postulates that failure of the lateral folds to fuse in the midline leaves a defect to the right side of the umbilicus. DeVries and associates and Hoyme and colleagues proposed that thrombosis of the right omphalomesenteric vein

(umbilical vein) causes necrosis of the surrounding abdominal wall, leading to the right-sided defect. This theory is supported by the observation that gastroschisis is sometimes associated with intestinal atresia, a condition that is also thought to be associated with an ischemic etiology. In-utero rupture of an omphalocele has also been proposed as a mechanism of gastroschisis formation. [(2)]

Gastroschisis occurs in 1 in 4,000 live births. An increased incidence in mothers younger than 21 years of age has been widely documented. There has also been a significant worldwide increase in the incidence of gastroschisis in all age groups over the past two decades. Preterm delivery is more frequent in infants with gastroschisis, with an incidence of 28% compared with only 6% in babies without an abdominal wall defect. [(3)]

Most pregnancies complicated by gastroschisis are diagnosed sonographically by 20 weeks' gestation. Often an ultrasound (US) evaluation is performed because of an abnormal maternal serum α-fetoprotein (AFP) level, which is universally elevated in the presence of gastroschisis. Detection of bowel loops freely floating in the amniotic fluid and a defect in the abdominal wall to the right of a normal umbilical cord are diagnostic of gastroschisis. Intrauterine growth retardation (IUGR) has been noted in many these fetuses as well. [(4)]

Most patients with congenital abdominal wall defects have some form of rotation abnormality, because the herniated bowel does not undergo the normal process of rotation and is not fixed in the appropriate retroperitoneal position during development. Concomitant bowel atresia is the most common associated anomaly in patients with gastroschisis, with rates ranging from 6.9–28% in several series. A recent literature review noted associated anomalies in the cardiac, pulmonary, nervous, musculoskeletal, genitourinary systems, as well as chromosomal abnormalities in babies with gastroschisis. [5]

1.2. Perinatal Care

The optimal mode of delivery for fetuses with gastroschisis has been debated for many years. Proponents of routine cesarean delivery argue that the process of vaginal birth results in injury to the exposed bowel. However, the literature would suggest that both vaginal delivery and cesarean section are safe. Therefore, the delivery method of a neonate with gastroschisis should be at the discretion of the obstetrician and the mother, with cesarean section reserved for obstetric indications or fetal distress. A recent meta-analysis by Segel et al. failed to demonstrate a difference in outcomes for infants delivered by cesarean section or vaginally. [6]

Early delivery of the fetus with gastroschisis has been advocated to limit exposure of the bowel to amniotic fluid to