

# Neonatal Surgery Intensive Care Unit: Hacettepe University Experience

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## ABSTRACT

**OBJECTIVES:** Surgical treatment in the neonatal period is very significant. The neonatal surgery intensive care model has been applied in our hospital for about six years. This study aims to examine the data gathered from the neonatal intensive care unit of our hospital and to understand how this model contributed to the health improvement of newborns with surgical problems.

**STUDY DESIGN:** The file records of newborns admitted to the neonatal intensive care unit were retrospectively analyzed from January 2014 to December 2019. The protocol was registered with Clinical Trials.gov identifier NCT04734002.

**RESULTS:** The total number of newborns admitted to the neonatal intensive care unit was 5442. Surgery was performed on 546 of these patients. Two hundred and four patients were hospitalized due to congenital heart disease. Two hundred patients were operated on by pediatric surgeons whereas 142 were operated on by other surgery specialists. In the last six years, the mortality rate was 5.25% in babies without surgical diseases and 18.3% in those with surgical diseases ( $p < 0.05$ ). The hospitalization periods of the babies followed up in our neonatal intensive care unit in the last two years were evaluated. Thereupon, premature babies with other diseases were hospitalized for an average of 9.6 days; however, those patients who require surgery were hospitalized for 33.0 days ( $p < 0.05$ ). The term babies, who did not have any surgical diseases were hospitalized for an average of 4.8 days and those with surgical indications for 16.5 days ( $p < 0.05$ ).

**CONCLUSION:** We believe that the neonatal surgery intensive care unit model should become widespread in Türkiye. We intend to draw attention to this matter through our study, sharing our own experience.

**Keywords:** Neonatal surgery intensive care unit, Newborn, Surgical diseases

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## Introduction

Surgical diseases of newborns differ from those affecting other pediatric age groups mainly because of congenital anomalies and the difference in the level and kind of care required for newborns. The care provided to newborns before,

during, and after surgery is different, owing to discrete anatomical, physiological, metabolic, and immunological features. In particular, the maintenance of hemodynamic status and fluid-electrolyte balance, optimum enteral and parenteral nutrition, surgical wound care, pain treatment, and infection control is important. Therefore, there is a tendency to begin caring for newborns in the neonatal intensive care unit (NICU), where they are taken care of by relevant surgical specialists not only in our country but also worldwide. According to overseas studies where the neonatal surgery intensive care unit (NSICU) model was applied, newborns requiring surgical treatment may be followed up in NSICUs, thereby decreasing mortality and associated morbidity rates (1,2).

Although neonatal specialists manage the NICUs throughout Türkiye in most cases, sometimes pediatricians also work in these intensive care units. Since 2013, one of the neonatal intensive care units located on two different floors in our hospital has been used as a neonatal surgery intensive care unit. All newborns with surgical problems are admitted to NSICU, and their pre-, peri-, and postoperative care and treatment are carried out in consultation with neonatologists, as well as relevant surgical specialists.

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There are few comparative publications on the care and treatment provided to babies with surgical diseases in the NICU. However, no comprehensive study compares newborns with and without surgical problems in NICUs and surgical services in terms of neonatal care burden, morbidities, and mortality rates. The NSICU is a very new concept in Türkiye.

This study aims to examine the data gathered from the NICU of our hospital and to understand how this model contributed to the health improvement of newborns with surgical problems.

## Material and Method

In this study, after ethical approval (2020/03-16), the file records of newborns admitted to NICU and NSICUs were retrospectively analyzed from January 2014 to December 2019. The demographic, neonatal, and clinical information of the patients, including medical and surgical diseases and mortality rates, was recorded retrospectively for the study period with the information obtained from the hospital database. We presented additional data such as a gestational week, birth weight, gender, and hospitalization duration of the patients operated on within the past two years due to the available data and the retrospective design of our study. In addition, when exploration due to necrotizing enterocolitis or ligation for patent ductus arteriosus is to be performed on the babies, routinely followed by the same neonatologists in the premature NICU, they were transferred to the NSICU on the other floor with regard to the protocols of our unit. Data were analyzed using "Statistical Package for Social Sciences for Windows 27.0." Data were expressed as mean  $\pm$  standard deviation, median (lowest-highest value), percentage, and ratio. Normal distribution analysis was performed for the variables with the Shapiro-Wilk test. A nonparametric Mann-Whitney U test was used for the comparison of the two groups. A p-value less than 0.05 was considered significant in the results obtained. The protocol was registered with ClinicalTrials.gov identifier NCT04734002.

## Results

Between January 2014 and December 2019, the total num-

ber of newborns admitted to the NICU and NSICUs of our hospital was 5442.

Surgery was performed on 546 (10.2%) of these patients. Two hundred and four patients were hospitalized and operated on due to congenital heart disease (mainly hypoplastic left heart syndrome, aortic coarctation, pulmonary atresia, great artery transposition, and patent ductus arteriosus) during the study period. Sixty-five (31.8%) of them died.

Two hundred patients (mainly with esophageal atresia, congenital diaphragmatic hernia, duodenal atresia, pyloric atresia, anal atresia, meconium ileus, and incarcerated inguinal hernia) were operated on by pediatric surgeons. Thirty-five (17.5%) of the patients who were attended by pediatric surgeons died. Seventy patients were operated on by neurosurgeons for meningomyelocele, hydrocephalus, ventriculoperitoneal shunting, brain tumor, etc.; 23 by otorhinolaryngologists for tracheostomy opening, tracheal stenosis/atresia, airway tumor, etc.; 21 by ophthalmologists for laser photocoagulation (Retinopathy of Prematurity- ROP) and 12 by plastic and reconstructive surgery specialists for mandibular distraction osteotomy due to Pierre Robin sequence. Nine patients were operated on by urologists and seven by orthopedists (Table I).

Before and after all surgeries, the treatment and follow-up of the patients were performed in the NSICU by neonatal specialists and neonatal surgery nurses, along with relevant surgical specialists.

In the last six years, the mortality rate was 5.25% in babies without surgical diseases and 18.3% in those with surgical diseases ( $p < 0.05$ ; Table II).

In our hospital, the mortality rate in newborns with surgical diseases was 22.16% on average between 2014 and 2017, which decreased to 13.9% in 2018 and further to 8.24% in 2019.

Demographic data such as gestational age, birth weight, and gender are listed in table III for the years 2018- 2019. The distribution of these patients according to surgical problems in 2018- 2019 is listed in figure 1.

**Table I:** Features of infants who required surgery in the neonatal surgery intensive care unit between 2014-2019 (n=546)

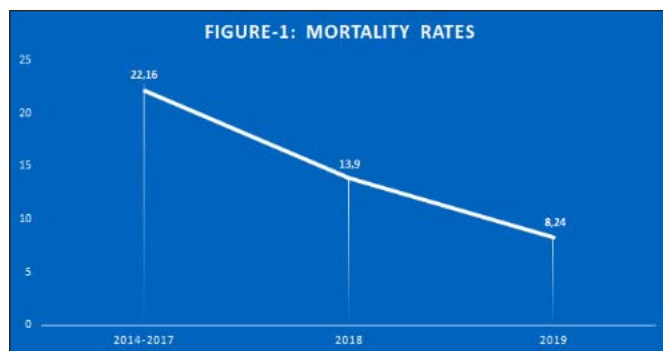
Department of Surgery	The number of patients n (%)	Mortality n (%)
Pediatric Surgery	200 (36.6)	35 (17.5)
Cardiovascular Surgery	204 (37.4)	65 (31.86)
Neurosurgery	70 (12.8)	0
Otorhinolaryngology	23 (4.21)	0
Ophthalmology	21 (3.84)	0
Plastic and Reconstructive Surgery	12 (2.19)	0
Urology	9 (1.65)	0
Orthopedics	7 (1.28)	0

**Table II:** Mortality rates between 2014-2019

Total patients (n=5442)	Mortality rates (%)	
Patients hospitalized for non-surgical reasons (n=4896)	5.25	<b>p&lt;0.05</b>
Patients hospitalized for surgical reasons (n=546)	18.3	

**Table III:** Demographic data of the newborns with surgical diseases between 2018-2019

Surgical patients (n=227)	
Birth weight	2750 ± 708 gr (520- 4400)
Gestational Age	37±3 week (25-41)
Gender n (%)	Female: 103 (45.3) Male: 124 (54.3)
Surgical patients (n=227) / Total patients (n=1605) %	14.4%

**Figure 1:** Mortality Rates

The hospitalization periods of the babies followed up in our NICU in the last two years were evaluated. Thereupon, premature babies with other diseases were hospitalized for an average of 9.6 days; however, those patients who require surgery were hospitalized for 33.0 days ( $p<0.05$ ). As regards the term babies, those who did not have any surgical diseases were hospitalized for an average of 4.8 days, and those with surgical indications for 16.5 days ( $p<0.05$ ). The number of patients who died because of surgical problems in the last two years was 25 (11.01%); 13 of these patients underwent surgery for congenital heart disease, and 10 of them had surgical problems related to pediatric surgery. Two of the patients died in the intensive care unit a few weeks after cardiovascular surgery. In our hospital, the mortality rate in newborns with surgical diseases was 22.16% on average between 2014 and 2017, which decreased to 13.9% in 2018 and further to 8.24% in 2019.

## Discussion

The NSICU model is a new concept in Türkiye and the number of centers having these intensive care units is quite low. This led NICU and NSICUs during the last six years, as we want to contribute to the literature thereby providing our data. According to a study neonatal surgical diseases remain a significant health problem, especially congenital anomalies

(3). All treatments and interventions in the neonatal period can have permanent effects on the life of newborns. Therefore, it is necessary to be very careful in all treatments, interventions, and medical decisions made in the neonatal period.

As the anatomical, physiological, metabolic, and immunological features in the neonatal period are different from those in other pediatric age groups, internal and surgical diseases must be managed in units with neonatal specialists and experienced neonatal nurses. With the consultation service provided in the inpatient ward of the surgical specialty, it is not possible to follow up on a newborn under optimal conditions. Good pre-, peri-, and postoperative medical care and cooperation with the surgical team increase the success of treatments in newborns hospitalized with surgical indications, thereby decreasing the complications, morbidity, and mortality rates associated with surgical diseases (4). During the transportation of newborns, it is necessary to maintain the body temperature and hemodynamic balance to ensure good vital sign monitoring, continue critical treatments without interruption for babies who are seriously ill, and carry out neonatal transportation using appropriate medical devices. In premature and critically ill babies in particular, there are difficulties experienced in maintaining body temperature and hemodynamic balance during transportation and even during surgery. Therefore, some surgical procedures such as patent ductus arteriosus (PDA) ligation of newborns are performed in the NICU without even moving the baby (5). In some large centers in Türkiye, PDA ligation is performed at the baby incubator itself. Before any surgical interventions are planned to be performed at the incubator, all necessary preparations must be in place for any possibility that may arise during the procedure, including the availability of access to medicines, materials, medical devices, and health care supplements. We are unable to do surgical procedures on babies in their incubators in our unit, therefore we transfer them from NICU to NSICU. In the NSICU, the newborns have been cared for by the same neonatologist and experienced nurses in surgical care, to decrease mortality rates while improving the quality of care and patient comfort.

When the last six years' results were evaluated, 10.18% of the inpatients were found to be those who underwent surgical procedures. Similarly, in a study conducted in Africa, it was found that 11% of the patients hospitalized in the NICU in a center where gastrointestinal system surgery was performed included those requiring surgery, and the mortality rate of these patients needing urgent surgical intervention or intestinal obstruction was approximately 17% (4). In our unit, the mortality rate of the patients who underwent neonatal surgery was found to be about three times higher than that of those hospitalized in the NICU for other reasons. For this reason, the mortality and morbidity rates of newborns who underwent surgery were found to be higher than those with internal diseases, which necessarily require monitoring in NICUs. We anticipate that mortality and morbidity rates would decrease with the increase in follow-up opportunities in NICUs in parallel with the development of technology.

It is significant to be attentive to receive appropriate fluid–electrolyte nutritional support, respiratory and circulatory support, and infection control before surgery. Neonatologists accompany patients during transportation to the operating room and the procedure, providing that the microenvironment and the required treatment continue as seamlessly as possible. In addition, continuous communication and cooperation with the surgical and anesthesia team are ensured, and postoperative follow-up is planned. For example, during transportation and surgery, babies with congenital diaphragmatic hernia are ventilated with a high-frequency oscillation method in our unit, and the respiratory and hemodynamic balances are also maintained during the procedure.

After the surgery, it is crucial to maintain the body temperature of the baby, evaluate the side effects of anesthetic drugs on their respiratory and circulatory systems, provide fluid–electrolyte nutritional support, maintain hemodynamic balance, eliminate the effects of anesthetic drugs, and regulate the respiratory, circulatory, pain, and stress responses of the baby. The evaluation, initiation, and maintenance of analgesic treatment, infection control, and antibiotic treatment are performed by the doctors and experienced nurses of the NSICU. In addition, special care and follow-up for surgical wounds, drains, and catheters are provided by experienced neonatal nurses under the guidance of relevant surgical specialists.

Most of the diseases that require surgical treatment in the neonatal period include congenital anomalies. A multidisciplinary approach and teamwork are required for the diagnosis, treatment, and follow-up of many of these anomalies. Therefore, the NSICU also contributes to the effective communication and cooperation between neonatal specialists and surgical specialists, thereby creating a basis for multidisciplinary teamwork. The quality of communication and collaboration of this team ensures that the health indicators of newborns with surgical problems gradually improve. The follow-

up of newborns with surgical problems in terms of growth and development after discharge is of great importance for the long-term prognosis because these babies are faced with long-term morbidities related to their diseases and neurodevelopmental risks partially due to treatment interventions. For this reason, as in almost all developed countries, babies made interventions for surgical problems are followed up by a long-term multidisciplinary team, and guidance–rehabilitation–support treatment services are provided in terms of possible risks and sequelae. Babies with congenital anomalies, in particular, may have different problems during the neonatal period, childhood, and adulthood. Therefore, these patients should be followed up for a long time by a follow-up team consisting of experienced doctors and other healthcare personnel.

Short- and long-term results may also differ depending on whether or not these babies are premature and term. In the last two years, the hospitalization duration of premature babies who underwent surgery was approximately three times longer than that of those hospitalized for nonsurgical reasons. Severe surgical stress and stress-induced problems in premature babies, which require a long period of recovery and hospitalization duration, accompanying problems related to premature birth such as immunological status and underdeveloped physiological processes that maintain hemodynamic balance, and morbidity due to surgical stress are the main reasons behind why the process takes a long time. The mean hospitalization duration of term babies with nonsurgical indications was shorter than that of those with surgical diseases (4.8 and 16.5 days, respectively). In term babies, hospital stays were three to four times longer, although not as much as in premature babies, because of surgical stress-induced problems and the recovery process.

In a 2-year retrospective study conducted by Badawi et al. with 990 patients in Australia, 29 (3%) patients were lost, 13 (1.31%) were reported to have undergone cardiovascular surgery, and 9 (0.90%) had gastrointestinal surgery (6). In the current study, the mortality rate in the last two years was 11.01%. In our study out of 25 patients who died, 13 had cardiovascular surgery and 10 had gastrointestinal surgery. Two of the patients died in the intensive care unit a few weeks after cardiovascular surgery. Higher mortality rates in our hospital compared to the results in our study and developed countries are derived from the high frequency of even major congenital anomalies and consanguineous marriages in Türkiye. In our hospital, the mortality rate in newborns with surgical diseases was 22.16% on average between 2014 and 2017, which decreased to 13.9% in 2018 and further to 8.24% in 2019 (Figure 1). This is of course because the quality of care has improved over the years and the number of experienced staff at NSICU has increased.

The most important limitation of this study is that it is ret-

rospective and therefore some data are not available. Future studies will be planned prospectively and data will be easier to obtain.

## Conclusion

The widespread use of NSICUs is a new concept and a new model in our country. In these units, the treatment and follow-up of newborns with surgical problems under the consultation of neonatologists along with an experienced nurse team and related surgical specialties would reduce the morbidity and mortality rates of newborns. This would make a positive contribution to long-term results. Therefore, we believe that the NSICU model should become widespread in Türkiye. As there is a paucity of information concerning this subject in the literature worldwide and in our country. We intend to draw attention to this matter through our study, sharing our own experience.

### Declarations

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*Ethics approval and consent to participate: We have a statement about consent for using data. The study was reviewed and approved by the ethics committee of the Hacettepe University Non-Interventional Ethics Committee. Ethics approval reference number: 2020/03-16. All procedures were performed according to the Declaration of Helsinki.*

*Availability of data and materials: The data supporting this study is available through the corresponding author upon reasonable request. / The datasets and code used and/or analyzed during the current study are available from the corresponding author upon reasonable request.*

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