NAVA in the post-operative treatment of congenital heart disease infants

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The Shanghai Children’s Medical Center, affiliated to Shanghai Jiao Tong University School of Medicine, was jointly constructed and established ten years ago by the U.S. based Project Hope, the Shanghai Municipal People’s Government and the Xin Hua Hospital. Ever since the inauguration ceremony with U.S. First Lady Hillary Clinton in June, 1998, the Shanghai Children’s Medical Center has made rapid progress in the areas of pediatric cardiology and surgery, improving the lives of Chinese children with congenital heart disease, as well as establishing comprehensive cooperation and training collaboration with over ten well-known medical institutions around the world.

The Department of Cardiovascular Thoracic Surgery of Shanghai Children’s Medical Center is the key program of the Shanghai Bureau of Higher Learning, and the first clinical medical center for pediatric cardiology and cardio-thoracic surgery. In addition to becoming a clinical educational and research center, it is the national top-ranking diagnostic and treatment center for congenital heart disease.

The latest advancement within the Department of Cardiovascular Thoracic Surgery is the implementation of NAVA – Neurally Adjusted Ventilatory Assist in the post-operative treatment of infants undergoing congenital heart surgery. Critical Care News met with the staff of the CICU, who shared their recent and expanding experience of Edi monitoring and NAVA as a treatment modality.
Can you give us a description of the operations of the Department of Cardiovascular Thoracic Surgery and the CICU?

ICU Chief Dr Shi Zhenying: Our department, cardiovascular thoracic surgery and the CICU here at Shanghai Children’s Medical Center have been in existence for 10 years, ever since the hospital was constructed.

We have 9 physicians on staff in the CICU. I have been chief of this unit for the past 10 years, ever since the beginning. Prior to that I was surgeon at the Xin Hua hospital, and thereafter I was an intensive care physician for 10 years, before my current position as chief of this unit.

How many children are treated in the department on an annual basis?

Dr Shi Zhenying: At the present time, we conduct surgeries for nearly 3,000 infant cases on an annual basis. We receive patients from Shanghai, as well as other cities and the countryside. They are born with congenital heart defects and sent here for surgery.

Diagnosis and treatment of congenital heart disease is one of the primary specialization areas at this center. How many patients in this category do you treat on an annual basis, and what other types of patients do you treat in addition to these?

Dr Shi Zhenying: We treat infant patients with acute and complex congenital heart disease, pulmonary artery atresia and infants with single ventricles. About 90% of our caseload consists of babies born with congenital heart disease. The other 10% of patient categories are here due to many different factors, such as lung disease and various types of congenital tumors. We have achieved an overall success rate of 97%.

Which ventilation therapies do you most frequently use in these patient categories?

Dr Shi Zhenying: Primarily we use synchronized intermittent mandatory ventilation - SIMV. We also use PRVC – Pressure Regulated Volume Control as well as Pressure Support ventilation. The mode of mechanical ventilation we choose is always dependent upon the patient condition and sedation levels.

Can you describe the primary factors and process leading to the decision to implement NAVA in this CICU?

Dr Zhu Limin: The first time we heard about NAVA was two years ago, when our chief Dr Shi Zhenying attended a symposium at the ESICM meeting in Barcelona, and she heard the
Dr Zhu Limin: For patients that have had diaphragmatic paralysis, we want to leave the Edi catheter in for 2-3 days to monitor the status of the diaphragm. Our surgeons need verification; so now we can give all this information to them, ultrasounds, Edi signals and X-rays, so that they see the actual condition of the diaphragm. It is very interesting and very useful for the surgeons. For our NAVA patients at post-extubation, we leave the Edi catheter in for another 24 hours just to monitor the Edi, if we suspect the patient may re-develop something, or just to confirm that their spontaneous breathing is doing well on their own. We have been doing this as a routine for our NAVA patients. We have also monitored the Edi signals in other modes, such as Pressure Support.

**When did you have your first patient experience with NAVA, and how many infants have been treated with NAVA so far?**

Dr Zhu Limin: We had our first patient experience with NAVA only two months ago. We have placed the Edi catheter in about 16 patients, and treated about twelve patients with NAVA. The other four cases were babies with diaphragmatic paralysis, and since the babies were not spontaneously breathing, we could not use NAVA in those patients. However, in using the Edi catheter, we were able to monitor the Edi and detect the paralysis in these four cases. Some patients develop a bilateral diaphragmatic paralysis after surgery, so the Edi monitoring will confirm this by indicating no Edi signal.

**How routinely is NAVA used in the ICU?**

Dr Zhu Limin: We have been gaining a lot of experience since we just started using NAVA only two months ago, so now we are selecting more difficult cases to gain even more experience with Edi monitoring and with NAVA. For the patients we have treated with NAVA, they have been on NAVA for a range of times, between a few hours up to three days, depending on their condition.

**Is monitoring of the Edi signal used in conventional ventilatory modes, or in stand-by post-op after extubation?**

Dr Zhu Limin: For patients that have had diaphragmatic paralysis, we want to leave the Edi catheter in for 2-3 days to monitor the status of the diaphragm. Our surgeons need verification; so now we can give all this information to them, ultrasounds, Edi signals and X-rays, so that they see the actual condition of the diaphragm. It is very interesting and very useful for the surgeons. For our NAVA patients at post-extubation, we leave the Edi catheter in for another 24 hours just to monitor the Edi, if we suspect the patient may re-develop something, or just to confirm that their spontaneous breathing is doing well on their own. We have been doing this as a routine for our NAVA patients. We have also monitored the Edi signals in other modes, such as Pressure Support,
to monitor diaphragmatic status.

**What in your opinion is the advantage or benefit of Edi monitoring as a bedside parameter?**

Dr Zhu Limin: I think it is very useful. For example, just in the past two days, right after surgery we had a patient with a low Edi signal and very labored breathing, but after 12 hours the Edi signal became much stronger. We switched the patient to NAVA and yesterday we successfully extubated him, and now we are just monitoring the Edi signal. I think the Edi signal is very helpful and useful; you can get answers to all kinds of questions during the treatment process. It is a new bedside parameter for us. I think that maybe the Edi signal can tell us about sedation levels and the wash-out process and behavior patterns of the patient coming out of sedation that we were not able to see before.

**How do you perceive NAVA from a therapeutic perspective?**

Dr Zhu Limin: From our CICU department, I think we have two patient perspectives. On the one hand, for the simple cases after cardiac surgery, you want to extubate them as safely and as quickly as possible. If you place the Edi catheter and use NAVA, and find the Edi signal returning after surgery, the patient can be extubated as early as possible. On the other hand, in complex cases, the patient needs mechanical ventilation for some longer lengths of time. If we use NAVA, the patient and ventilator are in synchrony, which means that the baby is more comfortable, and the dosage of sedation can be reduced. The Edi monitoring gives the opportunity to extubate earlier as well as monitor the sedation process.

**Do you think esophageal ECG is valuable as a diagnostic tool in this patient category?**

Dr Zhu Limin: Esophageal ECG is very important for us, as our open heart surgery patients sometimes have post-operative arrhythmia. From the normal ECG, we cannot always see a clear diagnosis, such as SVT, or sometimes atrial tachycardia. If we have an esophageal ECG, we can see the correct diagnosis of the arrhythmia, which is very useful for our treatment.
Have you had any infant patient cases with NAVA of particular interest you would like to share?

Dr Zhu Limin: We had a baby which came to the hospital at two months of age, who was suffering from transposition of the great arteries. An emergency operation was necessary, and it was very difficult to extubate him. We had three failed extubation attempts, with breathing difficulties and bronchospasm. We performed a bronchoscopy contrast CT, which revealed another problem, a vascular ring that compromised the trachea. Another surgery was performed to resect the vascular ring. The patient had been in the CICU for about one month. After the second surgery, we placed the Edi catheter and treated the child with NAVA. He was spontaneously breathing with NAVA for about three days, followed by a successful extubation. One week later, we were able to finally discharge him. (Editors note: details of this patient case report may be found at www.criticalcarenews.com).

Are there specific staff members using NAVA, or has the general ICU staff received training?

Dr Zhu Limin: All of the CICU staff has received training, doctors and nurses. We have also trained our RT group for special cases, so everyone has been educated. Our respiratory therapists place the Edi catheter and verify the positioning.

How do the respiratory therapists experience the Edi catheter placement and positioning process?

Ji Gang, RT: It is not very difficult to place and position the Edi catheter, and we just monitor placement by means of the ECG signals. We use the Edi catheter as a normal feeding tube as well.

As a team, we have a follow-up after each NAVA treatment for every case, so that we can all continue to learn about NAVA together.

What role do you think NAVA will have in the future in this patient population of congenital heart defects and disease?

Dr Zhu Limin: I think that NAVA will be used increasingly in cardiac surgery, especially for pediatric patients, because of the opportunity of earlier extubation for simple cases post-op, and for complex cases, the opportunity to monitor Edi and diaphragmatic status, in order to monitor and decrease dosage of sedation. Also, I think that the NAVA technique is easy to learn for any ICU staff member.

Do you think that your institution will be researching and expanding the use of NAVA in future?

Dr Zhu Limin: I think that the research is very important, and we are planning to do some research in three areas. First, we would like to compare NAVA with traditional Pressure Support ventilation in terms of patient-ventilator synchrony as well as if we determine reduction of sedation dosages. Secondly, we are interested in research with NAVA to confirm the safety of hemodynamics in cardiac surgery patients. One other area of research we are interested in is to measure the Edi signal after extubation and chart and track to establish the normal range for children.
The Shanghai Children's Medical Center was established 10 years ago, and has become an internationally known center for treatment and research.

**Biography**

Dr. Shi Zhenying, MD, received her medical degree in 1975. She worked in Xinhua Hospital from 1975 to 1999, and was employed as physician of the cardiac intensive care unit there from 1989.

Dr. Shi Zhenying has been the chief of the cardiac intensive care unit of Shanghai Children's Medical Center, China since 2000. She was versed in the clinical and research work in perioperative treatment for congenital heart disease in children, especially in the prevention of low cardiac output syndrome and the treatment of multiple organ dysfunction syndrome.

Dr. Zhu Limin, MD, obtained her medical degree in 1999. Thereafter she was employed as a physician of the cardiac intensive care unit at Shanghai Children's Medical Center, China. She received the fellowship of respiratory therapy and pediatric intensive care in Schneider Children's Medical Center of Israel in 2006.

She has been the manager of the team for respiratory management in the Cardiac Intensive Care Unit since 2006. She specializes in treatment of pulmonary hypertension and post-operative lung protective mechanical ventilation. From 2008, she has conducted clinical research of NAVA in neonates and pediatrics following cardiac surgery.

**References**


