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Neurally Adjusted Ventilatory Assist: The first annual NAVA Nordic Summit Meeting

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Some of the many NAVA Nordic Summit meeting participants

Neurally Adjusted Ventilatory Assist: The first annual NAVA Nordic Summit Meeting

Twenty-six intensive care clinicians from over eight hospitals in three countries participated in the first NAVA Nordic Summit meeting in Solna, Sweden, in April. The purpose of the meeting was to provide an opportunity to share NAVA clinical experiences and cases, and to build bridges for ideas for future cooperation with NAVA, as presented by Claes Goderlöv of Maquet Nordic.

There was a range of experience with NAVA, from ICU departments that are just starting out, and units that have been using and gaining experience with NAVA as treatment methodology since the product became available in November, 2007. Experience in patient categories ranged from neonates to elderly patients. Participants were also updated about ongoing NAVA clinical studies and future developments. The one day summit meeting is intended to be held for NAVA users on an annual basis.

The twenty-six participants were welcomed by Thomas Lindström, MD of Maquet Nordic, who gave a brief presentation about the history of the SERVO ventilator, from the early 1970's to recent developments, such as the MR and NAVA applications in the SERVO-i ventilator.

The agenda for the meeting consisted of presentation of NAVA patient case experience from various Scandinavian hospitals. Dr Ninna Gullberg of the Astrid Lindgren Children's Hospital in Stockholm presented, from her unit with experience of 20 patients. Dr Amela Khorassani of Ryhov Hospital in Jönköping, Sweden presented the experience of NAVA in her adult patient ICU from an 8 month perspective, and Dr Lisa Seest Nielsen of Kölding Hospital, Denmark, where NAVA has been recently implemented, shared a few cases from their 10 patient collective experiences.

The meeting was moderated by Sylvia Göthberg, MD, PhD, pediatric intensive care physician from Queen Sylvia Hospital in Gothenburg, Sweden, and Arne Lindy of Maquet Critical Care.

ICU physician Dr Lisa Seest Nielsen from Kölding, Denmark

Recent NAVA experience from Denmark in adult patients

Intensive care physician Lisa Seest Nielsen from Kölding in Denmark, described her ICU as an 8-10 bed medical unit for adult patients, who are often lightly sedated. NAVA had been implemented in the ICU a few months prior to the meeting, and she described two patient cases of interest that they have observed.

Moderators Sylvia Göthberg, MD, PhD and Arne Lindy

Case 1

The first patient was a 78 year old woman, admitted for pneumococcal-based pneumonia. The patient had been in hospital for over 2.5 months, and NAVA was utilized to wean this patient. Since the patient was ventilated conventionally for 2.5 months, there was a condition of hyperventilation and diaphragmatic atrophy. Initial settings included a NAVA level of 1.4 cm H_20/µv, with tidal volumes of 750-800 ml. The Edi peak value was about 20 µv. The NAVA level was adjusted down to 0.4 cm H_20/µv to obtain tidal volumes of 350-400 ml, and an Edi peak of 75-80 µv.

The patient was also being treated with hemodyalisis as a complicated case with acidosis. The NAVA level was increased to 1.5 cm H_20/µv with Edi max of 20-25 µv and tidal volumes of 350-400 µv. Dr Nielsen said that the strategy was to decrease the NAVA level in increments of 0.2 cm H_20/µv, as the diaphragmatic muscle regained strength. The strategy also succeeded by maintaining a very low PEEP of about 4, in order to titrate in relation to the acidosis.

Case 2

The second patient case reported by Dr Nielsen was a 55 year old woman with difficult respiratory patterns, who had been ventilated for a period of time with Pressure Control and Pressure Support ventilation, with significant hyperventilation. The Edi catheter was placed, and the Edi signals and irregular respiratory pattern were observed in switching from controlled ventilation to Pressure Support. NAVA was implemented, and as the sedation levels started to decrease, NAVA worked very well and the patient was able to be extubated without any difficulties at all. Dr Nielsen commented: "The patient weaned herself with no difficulties on NAVA, it was us physicians at bedside that disturbed the order of the process by switching between controlled and supportive modes, prior to NAVA."

Experience of NAVA at Ryhov Hospital, Jönköping, Sweden in 22 patients

The Ryhov Hospital of Jönköping is a regional hospital with 7 intensive care beds. Dr Armela Khorassani has been working with NAVA since it was implemented in September 2008. Together with Chief ICU Physician Peter Nordlund, she has collected data from 22 NAVA patients, between the ages of 10 and 89 years. These patients have had diagnoses such as pneumonia, pulmonary fibrosis, sepsis, peritonitis, diabetes, COPD and muscle hypotrophy. She presented the preliminary results of the data collection so far:

Total days in NAVA:	1-10
Average days in NAVA:	4-7
Total days of MV:	2-23
Average days of MV:	< 10 days

Benefits with NAVA:
- Tracheotomy was avoided in 5 patients.
- Probable shorter hospitalization in 7 patients.
- Edi led to diagnosis in 1 patient.

Difficulties with NAVA:
- Asynchrony alarms in 6 patients due to earlier software versions, but also deep sedation and high PEEP.
- No or little Edi signals in 3 patients, who had sedation difficulties due to cramping and anxiety, and required higher levels of sedation.
- NAVA did not work in 2 patients, Dr Khorassani observed that in patients with large hiatus hernia it is difficult to place the Edi catheter and get signals.

Complications due to NAVA:
- No complications have been observed to date.

Dr Armela Khorassani, of Ryhov Hospital in Jönköping, Sweden

Dr Khorassani went on to describe two NAVA patient cases, one of the early experiences and a more recent patient case that had been treated.

Case 1

The first NAVA case was an 80 year old woman, with respiratory difficulties, an ex-smoker who had fatigue and difficulty to breathe in the past 6 months. In the two weeks prior to emergency admittance, she had increasing symptoms of an upper airway infection. When admitted she had saturation of 85%, respiratory rate of 33, pulse of 110 with sounds of secretions when auscultated. She was given oxygen by mask and antibiotics. However, she rapidly became worse, with an atypical pneumonia. A CT scan of her thorax showed findings of tree-in-bud which were interpreted as an airway infection and bronchiolitis. The lung x-ray showed different areas of infection.

As she had more difficulty to breathe, she was intubated, and the staff believed she would be difficult to ventilate, with a long period of mechanical ventilation. Her antibiotics were changed and increased. NAVA was implemented directly. Initially the patient was difficult to ventilate, followed by steady improvement. Dr Khorassani presented the following results:

- NAVA for total of 7 days, of total of 8 days of MV
- Initial Edi 11 µv, end Edi 24 µv. Initial PEEP 16, end PEEP 4.
- Initial PIP 30, end PIP 11. Initial NAVA level 1.5 cm H_2O/µv, end NAVA level 0.2 cm H_2O/µv
- FiO_2 initially 45%, end FiO_2 30%. Initial PaO_2 14, end PaO_2 9.96.
- Initial PaO_2/FiO_2 ratio was 32, end PaO_2/FiO_2 ratio was 33.

There were some difficulties with asynchrony alarms, with very high Edi values on two occasions, bronchoscopy indicated stagnating secretion in the tube, which was switched to a larger tube.

The final result was summarized by Dr Khorassani as a diffuse pneumonia and pulmonary hypertension. The patient could be extubated without need for tracheotomy. The Edi was monitored after extubation, and the patient needed intermittent NIV for 2 days.

Case 2
The second NAVA patient case presented by Dr Khorassani was a 89 year old man, diabetic, with a recent history of orthopedic surgery in the hip and pelvis after an accidental fall. He was admitted into the emergency room with a rapid onset of loss of strength and motor function in his entire body, and a limited consciousness. He could not neurologically lift his legs. Upon CT examination of the brain there was no finding, however an X-ray of the neck revealed a fracture through the C7 area.

The patient was moved to the orthopedic clinic. An MR showed a degenerative tumor behind C1-C2 level which compromised bone marrow and caused edema in the area. This was judged to be the cause of the recent rapid onset of degradation.

The patient was then transferred to the neurosurgical unit for cervical surgery with fixation from C6-Th1. Post-operatively, the patient had worsened neurologically with a complete tetraplegia. The patient was tracheotomized, after unsuccessful attempts to extubate, no respiratory drive and complete dependency upon mechanical ventilation.

The patient was moved to the ICU for continued mechanical ventilation and to observe for signs of neurological restitution. He was awake and communicating with miming and blinking upon admittance to the ICU. Initial ventilator settings were Pressure Control, PEEP 10, PIP 29, RR 15, with no sedation. NAVA was attempted in this patient as a means to determine if the diaphragm was functioning. NAVA was only used for 2 days, since, due to a weak diaphragmatic signal and function, the ventilator switched back to back-up modes.

Dr Khorassani presented the final result as meddular damage with no phrenic activity, and little accessory muscle activity, the diagnosis was provided by NAVA and the Edi signal. The patient became vasoplegic and died. Utilizing NAVA and Edi in this case probably meant that this patient had a shorter period of hospitalization and suffering, according to Dr Khorassani, since receiving the diagnosis by another means, for example MR of the neck may have required more time on the unit.

Dr Armela Khorassani and colleagues

Dr Ninna Gullberg, of the PICU of Astrid Lindgren Children's Hospital, Stockholm, Sweden

Experience of NAVA at Astrid Lindgren Children's Hospital, Stockholm, Sweden

Dr Ninna Gullberg began her presentation by summarizing the experience with NAVA within her unit. NAVA was implemented in the autumn of 2008, and has since been used in 15 to 20 patient treatments. The case she presented was one of the first infants to be treated with NAVA during the autumn of 2008.

Infant NAVA case

A six week old infant was transferred to the ICU, ventilated and sedated, and treated with Sildenafil, Bosentan and Iloprost inhalations. The baby was treated with Pressure Control ventilation with settings PIP 25, PEEP 7, RR 50-60 and FiO_2 0.35-1.0. The baby was triggering but needed intermittent heavy sedation as the child did not tolerate to be awake. Since the child did not seem to be tolerating the ventilator, he was switched to NAVA and immediately seemed much more settled. For this particular infant, Dr Gullberg stated that NAVA offered the possibility to be awake and more stable, with less problems of "near death episodes", but with higher pressures, high tidal volume and high Edi signals.

The initial settings with NAVA were the same volumes installed with Edi signals, a NAVA level of 0.8 cm H_20/µv, while the child was still under sedation. As the child awoke, pressure was limited and with a low respiratory rate, the NAVA level was adjusted to 1.4 cm H_20/µv and the Edi signal decreased but the alarm limits were a limitation, due to an older version of NAVA software. Despite the alarms, the child was awake, seemed to be improved and the blood gases looked good.

As the child was improving it was decided to make an extubation trial, which resulted in immediate failure. There was high airway obstruction, and a tracheotomy was made, and CPR given in connection with bronchoscopy. Postoperatively the child was returned to Pressure Control ventilation, although with frequent recurring "episodes". After switching back to NAVA, the child seemed more stable again. Cause and effect were discussed, a general worsening situation perhaps due to sepsis, according to Dr Gullberg, with a vicious cycle of Pressure Control and episodes. The child seemed to do much better when switched to NAVA, however with the older software version alarms it became a bit of a department joke; "The baby had a hard time to live without NAVA, but the staff had a hard time to live with it!" said Dr Gullberg.

The staff determined that more investigation was needed to determine the cause of the high pressures, the high Edi signals, if this was due to the long period of ventilatory treatment or diaphragmatic function.

Screen values of infant treated with NAVA at Astrid Lindgren Children's Hospital

Upon a new failure to wean, an MRI angio was made and found no perfusion of the right lung. Thereafter, bronchoscopy indicated intermittent obstruction of the main lung bronchus which was compressed by the right atrium. A V/Q scint confirmed that the right lung was better ventilated while the left lung was being perfused but intermittently not ventilated.

After these investigations, there were extensive national and international discussions regarding possible treatment for this severe situation. Thorax surgeons from the University Hospital of Lund, and specialists from Stockholm and Great Ormond Street Hospital in London were consulted. It was determined that there would be no chance to win any significant time by any means, and that no treatment was available for this case. Palliative care was initiated until the infant passed away.

Dr Gullberg summarized the experience of NAVA in this patient situation:

- NAVA provided time to explore options
- NAVA provided comfort and:
  - A relationship between the infant and the parents
  - Some joy in a short life; between crises, NAVA allowed the infant to be awake and to laugh and smile when trying mango puree for the first time.
  - Knowledge for the future

Dr Gullberg ended her presentation by saying that this patient had been on NAVA for an extended period of time with no symptom of thoracic involvement, and the limitation of NAVA was not the NAVA level but the alarm settings in the older software versions.

A final presentation was made showing milestones in development since the NAVA application for invasive use was released for sale in November 2007. A number of clinical studies were summarized that are currently ongoing with NAVA:

- Patient-ventilator synchrony
- Comparing NAVA and Pressure Support
- Sleep studies
- Sedation studies
- Studies of NAVA and hemodynamics
- Local and regional NAVA studies that are currently generating scientific abstracts.

Educational resources currently available for NAVA were reviewed, consisting of an e-learning package, a study guide, tutorials, a pocket guide, and NAVA interviews, lectures and patient case reports located in www.criticalcarenews.com. ■