At Karlstad Sweden Hospital, Proportional Pressure Support (PPS) is an appreciated mode of ventilation used in the Intensive Care Unit. It mimics a more “natural” form of breathing and gives patients a great deal of control.
INTENSIVE CARE AT KARLSTAD

The central hospital in Karlstad is a 500-bed hospital in the county of Värmland serving an area of 270,000 inhabitants. The hospital itself was built around 1920. It offers Medical and Surgical Care Units, as well as Obstetrics and NICU, and is responsible for medical training and a residency program for medical students.

When the hospital moved to part of a new building in 1965/66, the new general ICU was established with 14 beds in total. The ICU admits all types of patients, but the majority come from infection and surgery. In general, it is a very mixed group of both surgical and medical patients. The hospital admits 800 intensive care patients per year, and approximately 350 patients are ventilated during their hospital stay.
In your ICU you use the Evita Infinity® V500 ventilator. What type of ventilation do you employ in daily clinical routine?

Jon: Normally we use Volume Control with Mandatory Minute Volume (VC-MMV) for initial ventilation of patients; some doctors use Pressure Control with Biphasic Positive Airway (PC-BiPAP/PC-SIMV+) instead, but MMV is the most common ventilation mode. A few years ago we started to use PC-APRV (Airway Pressure Release Ventilation) regularly, we like it a lot and have had some really good results. And we use SPN-PPS (Spontaneous – Proportional Pressure Support) for spontaneously breathing patients.

Could you please explain PPS in your own words?

Jon: Well according to Google PPS is “flexible”, but I’m not really happy with that. My impression is more along the lines of: The patient has a great amount of control, and if you set the parameters right to meet the patient’s demand, you get a patient who is very comfortable. We’re happy that PPS is part of our ventilatory strategy.

Hans: I tried to explain it to one patient’s relative, and he said, I’m a car mechanic, what you are describing sounds like how servo steering functions work: You want more help, you get it, if not, then you don’t get help. I think that’s a pretty good way of describing it; we give a fair amount of control to the patient.

Which types of patients can benefit from using PPS?

Jon: We use PPS for invasive and for non-invasive ventilated patients. I would say that most patients who are awake and able to communicate prefer PPS. PPS will also work for more sedated or otherwise neurologically affected patients. Once a complete assessment is done, you have effectively restored a more natural way to breathe.

For the non-invasive patients, in what cases is PPS routine, when is it used first line or second line?

Jon: I think it’s about 50:50. Personally, I always start with it. I change settings and ask the patients how they feel.

Hans: 70 to 80 % of patients feel good with this. PPS is very comfortable if you’re awake. If the patient is still able to communicate, and you can ask them how they feel, many will say: This is good.

What about sedation?

Jon: We use PPS in sedated patients, without issues; we monitor blood gases and look at the patient. We try to keep patients – with a few exceptions – lightly sedated, try to use spontaneous breathing in some form even early in the course of disease.

Jon Rosell
is an anesthesiologist and intensive care doctor. He is the Medical Director / Head Physician of the Intensive Care Unit, and occasionally works in the operating room. Jon Rosell has been at Karlstad Hospital for 18 years.

Hans Renberg
is an intensive care nurse who started work in 1982. As medical technical coordinator, it is his job to work with personnel from varying disciplines involved in patient care, and to assist in their training.
“For the patient, it’s comfort. For treating physicians it means offering the patient the opportunity of better care by spontaneous breathing.”

Jon Rosell
Could you give us some examples of patients who received PPS?

Hans: We had a patient, a very fit builder of 35 to 40 years old who received extensive thoracic damage in a workplace accident. He had traditional CPAP/PS (Continuous Positive Airway Pressure / Pressure Support) and didn’t like it. The problem was that he wanted to take big breaths, which did not work with his CPAP/PS setting – he may have been injured but in general he was a fit man, and could take big breaths. We asked the patient, do you want to try PPS? He said yes, and he was free to take his breath with PPS. PPS is more natural, it is more like how we normally breathe. He felt very comfortable and after a few days the need for respiratory aid was gone.

Jon: We had another patient who was on some kind of support at home and came to us in the middle of the night. He said that non-invasive CPAP was ok when he was asleep, but in the morning, when he woke, the fear came: The support doesn’t work, I can’t get air! We put him on PPS and he noticed the difference immediately. It is a massive improvement from the older days - patients don’t need to struggle against the ventilator anymore. Today it is much, much easier.

HOW TO START?
Proportional Pressure Support is a flexible, patient friendly support mode which can be used in both intubated and non-invasively supported patients.

For **intubated patients** the experts suggest start settings with a Volume Assist of 8 and a Flow Assist of 4. They always use automatic tube compensation (ATC) when intubating patients and then use lower Flow Assist, since ATC functions, generally speaking, in much the same way as Flow Assist.

For **non-invasive patients** the settings are often different because it is possible to have a dialogue with the patient and then often less support is needed. Staff at Karlstad Hospital recommend lower support levels to start like values for Volume and Flow Assist of 2 to 4.

Initially it is important to frequently evaluate the patients bedside, then perform increases and decreases of 20% to 25% of the two parameters to find the most optimal ventilation support. Then wait, watch the patient, check respiratory rates, tidal volume and blood gases - and evaluate.

**Exemplary start setting SPN-PPS for NIV treatment**
- FiO₂ and PEEP according to the patient’s needs
- Volume Assist 2-4 mbar/L
- Flow Assist 2-4 mbar/L/s

**Exemplary start setting SPN-PPS for invasive ventilator treatment**
- FiO₂ and PEEP according to the patient’s needs
- ATC on as default
- Volume Assist 8 mbar/L
- Flow Assist 4 mbar/L/s
How did you start to establish PPS?

**Hans:** We initially began using it on patients who are awake and can verbalize their level of comfort, to help to control their breathing. We really believed and believe in it.

**Jon:** In the beginning there were only few doctors who supported it, but after introducing special training sessions and after our first positive experiences, they understood how it works. PPS grew on us and now it is established as standard.

What does the PPS training look like?

**Hans:** The main factor that got people interested was doing breathing exercises on ourselves as part of the PPS training. It helped us “feel” the benefits of PPS.

**Jon:** The training needs three stages. Firstly, an introduction: We have this mode, this is how it works and this will be the positive outcome. Secondly and probably most importantly, the bedside training with experienced doctors and nurses. I think I can teach CPAP by talking about it, but for PPS, it is much better to experience it yourself.

So, the three stages of training are: 1, introduction, 2, breathing exercises, try it yourself and 3, do the actual training on patients with knowledgeable staff. We give our new staff a lot of time to feel comfortable.

What is your personal outlook regarding respiratory care as a whole? Are there any hot topics?

**Jon:** In the last five to ten years, there has been more focus on spontaneous breathing and early mobilization, we have definitely not reached the pinnacle yet, there is still a lot of work to do. If you look at mobilization, the aim is to work as early as possible as much as possible, in order to spend less time in rehabilitation!

The same goes for ventilators, patients should work as much as possible.

What is important is the big picture: the integrated workplace, the whole surrounding. For me, the focus should definitely be on patient-driven ventilation, which is comfortable and offers patients a great deal of control. I would like to see technologies that do not need intubations at all.