"Advertorial"

MAKING 'NERVE MAPPING' ACTUALLY USEFUL & HELPFUL

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'Nerve Mapping' refers to the technique of using a nerve stimulator to locate and identify nerves beneath the skin, through the intact skin, without using a needle. Using this technique the course of a nerve can be plotted from the surface – hence the term 'mapping'. The concept of nerve mapping is essentially a South African initiative.

Early equipment used for this technique was simply a nerve stimulator modified to attach to a ball-tipped diathermy probe – a rather 'Heath-Robinson' set-up. Then nerve stimulator manufacturers started making mapping probes for their nerve stimulators and there are now three machines available in South Africa with inbuilt mapping probes as an option. They are the NMS 300 and the Stimpod NMS400 - both by Xavant Technologies and the HNS12 by BBraun.

Nerve mapping has not become as popular around the world as one would imagine for various reasons:

1. In certain countries the feeling is that it is superfluous because if one knows the anatomy well, mapping is not necessary.
2. The equipment has not always lived up to expectations due to differences in philosophy between the manufacturers, leading to difficulty in the current penetrating the skin to stimulate the nerve, often requiring electrode jelly with certain machines. This makes the technique cumbersome and difficult to perform in a sterile fashion.
3. The technique has not been all that easy. Mapping the nerve on the surface and even drawing it on the skin does not always imply that the nerve is or stays directly beneath the drawn line. This problem has now been solved by the Stimpod NMS400 manufactured by Xavant Technologies.

Firstly what is the main philosophy difference between manufacturers?

When using nerve stimulators the nerve is stimulated and depolarised by the **charge (in Coulombs)** that is delivered to the nerve, close to the nerve. In VERY simplistic terms the charge is a product of the current delivered and the time it is delivered to the nerve:

Charge (coulomb) = Current (milli-amperes) X Time (microseconds)

So, to deliver sufficient charge to depolarise the nerve one can either increase the Current Strength OR the Time the current is delivered. BOTH of these parameters can be set on all the newer stimulators.

One manufacturer believes in using a lower current but applying it for a longer time. This approach is limited though by the typical chronaxie threshold of the targeted nerves which is in the order of 0.1ms. For any current applied for a period longer than 0.1ms the resultant charge/ energy cost increases exponentially. Because of this it is more desirable to keep the pulse width at the ideal chronaxie pulse width ie: 0.1ms to 0.2ms and increase the current.

This means that the neuromuscular response to a nerve mapping probe at a specific distance from a nerve stimulating at 5mA and 1ms (5 micro Coulomb) and the same probe stimulating at 50mA and 0.1ms (5 micro Coulomb) will be completely different. The latter will cause a much bigger response, as it is the charge delivered in the first 0.1ms that causes most of the neuromuscular response, because of the chronaxie threshold of the nerve.

Using a higher current for a shorter time is the approach followed by the Xavant devices. These devices have special safety features implemented through their intelligent cable system which will allow the user to use the higher current ranges only when the nerve mapping probe is in use. Due to the fact that the HNS12 BBraun device does not discriminate between the use of the Nerve Mapping Probe and the needle it cannot facilitate currents of more than 5mA. At these lower currents percutaneous stimulation is very ineffective, often requiring electrode gel and other efforts to reduce skin resistance in an effort to transfer more charge.

A major problem with the ball-tipped cautery probes and the earlier mapping probes was that the ball was too big. This reduced the current density – making it more difficult to accurately isolate nerves as well as stimulating omni-directionally. This meant that you could stimulate the nerve when next to it, off to one side of the nerve and not directly above it. This happens when the probe is pushed hard to make an indentation in the skin in an effort to get the probe 'closer to the nerve' to stimulate the nerve. This would lead the operator to make a skin mark directly under the ball of the probe and when the needle was inserted on the mark, the nerve could not be found as the needle would then be passing the nerve.

The Xavant Stimpod NMS400 and the BBraun HNS12 now have a small ball tip which keeps the current density higher with less current dispersion. This alone is not sufficient to improve nerve mapping - other factors mentioned above are involved - but it helps to improve accuracy.

The Xavant Stimpod goes one step further in that the ball tip of the probe is insulated to the equator of the ball Figure 1. This gives the probe greater directional accuracy, making stimulating the nerve from the side as described above almost impossible, meaning greater accuracy as the nerve can only be stimulated from directly above.

Up to now the technique of using mapping to perform regional anaesthesia was cumbersome. It requires plugging the mapping probe into the socket of the nerve stimulators. The required nerve is then located and mapped and marked out on the skim=n with a skin marker. This is usually an unsterile part of the procedure. Then, the probe has to be unplugged from the machine and replaced with the cable which attaches to the stimulating needle. Using a sterile technique the needle is then inserted on the line hoping to find the nerve directly below the line. For reasons described above this is not always so. This process has many steps and is not always accurate.

Figure 1. Interscalene Brachial Plexus being identified at level of $C_{5,6}$

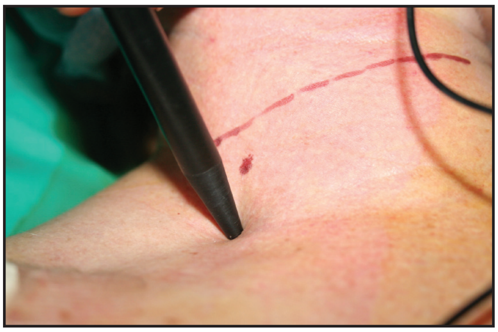

Figure 2. Interscalene Brachial Plexus being identified immediately above the clavicle

Figure 3. Course of Interscalene Brachial Plexus marked on the skin

The Xavant Stimpod now has the mapping probe and the needle cable on one plug Figure 1 so there is no changing plugging out of one cable and in with another during the technique. What makes the technique with the Stimpod unique is the following.

The mapping probe is placed on the skin where, anatomically, the nerve is expected to lie. In cases where the course of the nerve is important for direction of insertion of the needle, the course of the nerve can still be marked out on the skin first Figures 1,2,3. The current strength is gradually increased until the nerve is stimulated through the skin. The mapping probe is pushed hard enough to indent the skin and to fix the nerve in position below the probe Figure 4,5.

Then, without lifting or moving the mapping probe, the tip of the stimulating needle is placed on the skin directly next to the tip of the mapping probe Figure 4,5 without ANY cable swapping as both are plugged into the machine at the same time via one plug. Now, once the needle tip touches the skin, the Stimpod **automatically** switches from stimulating via the mapping probe to stimulating via the needle. As a safety precaution the current drops to zero at this point - also automatically. The needle can now be advanced to just below the skin and the current increased from zero to 1 mA, or wherever the operator wishes to start locating the nerve. It is the advanced in the same direction that the mapping probe is being held in until he nerve is stimulated and then the current reduced as the operator usually does.

The whole time the mapping probe is not moved and is used to stabilise the nerve until the stimulating needle is finally placed. Then the mapping probe is removed, the needle given any final small adjustments and the local anaesthetic injected Figure 4,5 .

This technique makes using nerve mapping as an aid to nerve blocks an actually useful aid and not just a gimmick as it has been accused of being:

1. The mapping probe is effective and accurate, stimulating with a small, insulated ball and often with a quite low current implying proximity to the nerve.
2. The mapping probe is used to fix the nerve below it.
3. The machine switches from probe to needle automatically once the needle touches the skin AND there is no cable swapping.

The Stimpod has other features which make it a very useful machine – like displaying the shape of the stimulating impulse on the screen and a proximity indicator. It can be customised to each user and can be set up in a variety of languages. It also has a very audible disconnect alarm and alarm message on the readout - a feature very essential to preventing nerve damage especially if the peripheral block is performed in an anaesthetised patient or a heavily sedated patient.

Figures 4 & 5 Mapping probe 'fixing' the nerve and without moving it, the needle advanced to the nerve