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- a Health Technology Assessment

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Monitoring Depth of Anaesthesia
– a Health Technology Assessment - Summary

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Monitoring depth of anaesthesia – a health technology assessment

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Summary

In this medical technology assessment based on scientific literature it is evaluated whether the use of anaesthetic depth monitors during anaesthesia shall be recommended in order to reduce the incidence of awareness and/or to shorten and improve the quality of recovery from anaesthesia – taking economy into consideration as well. The methods for search of the literature are given in section 15.

In section 1 the components of general anaesthesia are described, and the consequences of either too little or too much anaesthetic are mentioned (awareness and increased risk of haemodynamic and respiratory complications, respectively). The incidence of awareness is 0.1-0.2% in the general population, but 0.4-0.95% in high risk patients. A study from New Zealand indicates that awareness may be reduced by 50% with the use of anaesthetic depth monitoring. The consequence of awareness varies from no adverse effect to serious posttraumatic stress disorder.

In section 2 an ideal monitor of anaesthetic depth is described, and in section 3 the questions to be answered in this medical technology assessment are outlined: Does the use of anaesthetic depth monitoring decrease awareness, reduce consumption of anaesthetics and by this lead to a faster and better recovery from anaesthesia? Is the use economically effective? Are monitors based on the spontaneous EEG and on stimulus evoked potentials equally effective? Do they increase patient satisfaction with anaesthesia?

In section 4 the different monitors are described. The Bis-monitor is the best documented (we retrieved 474 papers about Bis), and many regard it "the gold standard" with which to compare other monitors. It uses the spontaneous EEG. Other monitors based on spontaneous EEG are Patient State Index Monitor (81 papers, 10 of which on the commercially available monitor), Spectral Entropy Monitor (40 papers, 15 of which on the commercially available monitor), Narcotrend Monitor (28 papers), SNAP Monitor (14 papers, 5 of which on the commercially available monitor), and Cerebral State Monitor (7 papers). Two monitors rely on stimulus evoked potentials (auditory evoked potentials): AEP-II Monitor (which now also incorporates analysis of the spontaneous EEG at low index values; 56 papers were retrieved, of which 19 relate to the commercially available monitor), and A-AEP Monitor with 56 papers (same as above) of which 6 relate to the commercially available monitor.

In section 5 utility studies are discussed for Bis-, CS-, Entropy- and AEP-II monitors. PSI and SNAP are not commercially available in Denmark at present, and it was not possible to obtain a valid price in Denmark for the Narcotrend Monitor. It is well documented that use of the Bis-monitor may reduce the incidence of awareness: Both in a Swedish prospective study on 4,945 consecutive patients compared with a historic control group, and in a controlled study from Australia in high risk patients. The absolute risk reduction was remarkably similar, 78% and 74%, respectively. A condition for such results is the correct application of the Bis-monitor! Such studies have not been undertaken with the other monitors. The use of the monitors to reduce consumption of anaesthetics indicates a significant reduction, but this does not result in a decrease of recovery time or a decrease in immediate postoperative complications.

In section 6 the efficiency of the individual monitors is described by the parameters prediction probability (P_K) as well as sensitivity and specificity. Generally, all the monitors have a high efficiency when used during propofol anaesthesia, whereas variability of results is greater with potent inhalational anaesthetics, and none of the monitors are of value during ketamine or N_2O anaesthesia.

None of the monitors can predict response to a painful stimulus. However, if sleep index remains stable following start of surgery the index may be used to titrate the depth of anaesthesia during

the procedure. None of the monitors thus indicate the true level of sleep, and for this reason the results of monitoring must be compared with the clinical signs traditionally used to evaluate depth of anaesthesia.

In section 7 any risk involved in the use of the monitors is discussed. Artefacts must be looked for and EMG observed, because these influence results. Otherwise no risk exists. In section 8 clinical examples from use of the Bis-monitor are shown.

In section 9 patient related factors of concern are discussed. Many patients (up to 50%) are anxious about being awake during anaesthesia. For these patients the use of anaesthetic depth monitors may decrease anxiety. In section 10 ethical questions are dealt with. Ethical concerns may result from using the monitors solely to reduce consumption of anaesthetics, if the patient is kept on a relatively high sleep index, because this will increase risk of awareness since the monitors do not have a sensitivity of 100%.

In section 11 the organisation is discussed. This will hardly be affected except for the necessary education in the use of the monitors which the anaesthesia staff will need.

In section 12 the economy is reviewed. Data from Department of Anaesthesiology, Vejle Hospital, Denmark are used for this analysis together with the results of a metaanalysis showing a reduction in consumption of anaesthetics of 19%. However, it is emphasized that such a reduction may not be obtained due to different case mix or different routines. Our example indicates that Bis- and Entropy monitoring will cost approximately 80 DKK per case if a 19% reduction in medicine consumption is obtained, whereas CS- and AEP-II monitoring will result in a net saving of 17 and 9 DKK per case, respectively, under similar conditions. Hence, even if a reduction in medicine consumption of 19% is not obtained it is likely that use of the two cheaper monitors will be cost-neutral.

The overall conclusion in sections 13 and 14 are that it is well documented that Bis-monitoring may reduce the incidence of awareness. It is likely but not documented that the other monitors will be similarly efficient in this feature. On the other hand, use of anaesthesia depth monitors will not reduce recovery time or complications in the immediate postoperative period. Both the CS- and AEP-II monitors are cost-effective, whereas the Bis-and Entropy monitor cost approximately 80 DKK per case. Monitors based on the spontaneous EEG and evoked response seem to be similarly effective. Because of the documented efficiency of these monitors we recommend that they shall be used as a minimum for anaesthesia of all high risk cases, and that it should be considered to use them for all cases of general anaesthesia. This will reduce the incidence of awareness and likely increase patient satisfaction with anaesthesia.