CORRESPONDENCE

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Is the EEG a Useful Monitor during Cardiac Surgery?

To the Editor:—I would like to draw the attention of Drs. El-Fiki and Fish[1] to an article describing the changes seen in the EEG pattern of patients suffering neurological damage during cardiopulmonary bypass. Using the Cerebral Function Analysing Monitor (CFAM),[2] which displays relative activity in each of the classical EEG wavebands, the criteria for predicting postoperative neurological deficit were described.[3] These are complete loss of beta activity for more than 3 min and loss of or marked (greater than 50%) reduction of alpha activity for more than 3 min, both associated with increases in theta and delta activity and occurring at temperatures above 30° C. These changes cannot easily be assessed using a density-modulated spectral array, as demonstrated in this case report.[1]

However the Brompton Hospital Study answers the question posed in the title of the case report, and clarifies the statements that "the role of EEG monitoring during open cardiac surgery has not been defined" and "the relationship of intraoperative EEG changes to post-operative neurological function after CPB has not been clearly defined."

S. N. C. BOLSIN, B.Sc., M.B., B.S., F.F.A.R.C.S.
Queen Mary's Hospital
Roehampton Lane
London, SW15 5PN, England

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In Reply:—Thank you for the opportunity to comment upon Dr. Bolsin's observations on our case report.[1] I regret that our literature search missed his article.[2] His letter and article raise several important issues that need to be addressed.

The majority of the EEG monitors available for intraoperative EEG recordings perform a power/frequency/time analysis, which is then displayed in a format that varies among different monitors. While not necessarily the best format, the Cerebro Trac 2500® we used presents the analyzed EEG as a density spectral array. This presentation does not conceal events, as might be obscured behind the "hidden line" features of a compressed spectral array. The density spectral array is combined with a spectral edge analysis, which allows the observer to identify changes in the higher frequencies of the EEG, such as are produced by cerebral ischemia,[3] many anesthetic drugs,[4] and changes in body temperature during cardiac surgery.[5]

It must also be remembered that the EEG signal, measured in microvolts, is recorded in a very hostile electrical environment. The EEG analysis is only as good as the signal recorded, and the original EEG should be examined to assure that the resultant analyzed output is not artefactual in nature. The Cerebro Trac 2500® allows the recorded signal to be viewed continuously prior to automated analysis, a feature that is very useful in interpreting the EEG when one has some experience in recognizing the normal changes seen during anesthesia and cardiac surgery. Although the Cerebral Function Analyzing Monitor has the ability to print out the EEG signal, this feature was not utilized in Dr. Bolsin's study.

Dr. Bolsin described three patients who had transient changes of less than 4 min in the EEG, and who also had focal neurologic injury evident in the postoperative period, suggestive of major embolic injury. The EEG changes seen in his cases (and also in our case report) were particularly apparent in the higher frequencies of the EEG, and, I suspect, would have been identified by all the automated EEG monitors that are available. If Dr. Bolsin's hypotheses are correct, then the prolonged deleterious EEG changes we observed should have been followed by a severe neurological injury. Clearly, this was not the case.

To enable the reader to interpret our observations accurately and properly, we reported the relation of the EEG changes to specific operative events, anesthetic

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drug management, body temperature, and blood pressure. The possibility of artefact was eliminated by direct observation of the EEG signal during the case. Detailed information, such as we supplied in our case report, is necessary to interpret adequately the EEG changes and to answer the question asked in our title. For these reasons, I do not feel that the question has been answered by the Brompton Hospital study. The question can only be answered by a well-designed study to validate the prospective value of their observations.

During the last 8 yr, I have used many different automated EEG analyzers as cerebral monitors during cardiopulmonary bypass. Like Dr. Bolsin, I believe that they can be useful monitors of drug effect and cerebral function. However, I do not believe that significant neurologic damage will be seen unless the observed ischemic changes in the EEG are more prolonged than 4 min. Even when prolonged changes occur, in my experience, significant neurologic damage is not always evident. In addition, such EEG changes are generally associated with a time of high risk, such as the placement or removal of the aortic crossclamp, or the commencement of ejection of blood from the heart. I do not believe that they occur randomly throughout cardiopulmonary bypass. Irrespective of this, the purpose of our case report was to illustrate the uncertainty of the EEG as a neurological monitor, and, in this, I think we succeeded.

KEVIN J. FISH, M.SC., M.B., CH.B., F.F.A.R.C.S., F.R.C.P.(C.)
Associate Professor of Anesthesia (Clinical)
Anesthesiology Service (112A)
Veterans Administration Medical Center
3801 Miranda Avenue
Palo Alto, California 94304

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A New Agent-specific Filling Device for Anesthetic Vaporizers

To the Editor:—To avoid accidental filling of vaporizers with wrong agents, the Cyprane patented keyed filling system* has been widely used. The system uses two agent-specific connections at both ends of the flexible tube adaptor, but one connection should be enough to establish such agent-specificity between the correct bottle and the appropriate filling ports of the corresponding vaporizer.

We invented a new filling and emptying system that utilizes the same agent-specific configurations and dimensions of screw-threaded caps and the bottle-necks, allowing direct connection between the bottle and the corresponding vaporizers. Also, this adapts the same keyed collar on the bottle neck as the conventional Cyprane's one to the keyed receptacle on the filling port of the vaporizers to assure the agent-specificity.

The bottle-neck is directly screwed upward to the filling port with the keyed receptacle, when faced downward, of the appropriate vaporizer (Fig. 1). Then, the bottle is turned around 180° manually with the protecting handle, in conjunction with the rotary housing, to the upside-down position. The rotary housing has two passages in it, the upper one for air and the lower one for liquid, both of which can be shut off ("Closed") or connected together ("Open") by a rotary valve, which is manually operated 90° between the "Open" position and "Closed" position with a knob. When the valve is "Open," the passages are connected through the valve, and the liquid in the upside-down bottle flows down into the vaporizer as air bubbles up to the bottle from the vaporizer (Fig. 2). The liquid level in the vaporizer comes up to the maximum level where the opening of the air-passage is situated to be automatically shut off by the rising liquid level to avoid overfilling. The rotary valve should be "Closed" before the vaporizer is turned on, and the bottle can be left there, either in the upside-down position or in the upright position, or should be unscrewed during the use of the

* Canadian Standards Association (CSA): Z 168.4, Keyed filling devices applied to anaesthetic equipment, Rexdale, Ontario, 1975

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