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NASA TECH BRIEF

Post-Operative Cranial Pressure Monitoring System

A system has been devised for post-operative monitoring of fluidic pressures within the cranial cavity at or near the site of neurosurgical operations. Provision is made for both meter-indication, and short-term chart recording of such pressures. High and low limits can be present, utilizing opto-electric limit-detection devices, adjustable in accordance with the physicians's requirements; if these limits are exceeded, subsidiary alerting signals may be activated.

During initial recovery periods following extensive neurosurgical operations, the body's normal recovery pattern results in increased cranial fluidic pressures at the site of the trauma. One of the major problems encountered in monitoring the patient's condition is the similarity of response of immediately available indicators, such as physical responses and body temperatures, and their trends due to increased cranial pressures, the formation of haematoma, and/or infection. The actions required by the physician to enhance recovery differ widely, depending upon the causative factors involved.

This monitoring system utilizes a miniaturized pressure-sensing transducer, combined with suitable stable amplification means, a meter provided with a scale calibrated in terms of pressures between −100 and +900 millimeters of water, and a miniaturized chart recorder covering a similar range of pressures. The transducer can be sterilized in accordance with normal operating room chemical procedures.

This system could also be used in those cases involving reduction of aneurisms associated with major branches of either carotid artery, within the cranium. It is common practice, following such an operation, to temporarily clamp off the associated carotid artery to promote healing and reduce blood pressures at the site of the operation. Arterial blood flow to that hemisphere of the brain is maintained through the "circle of Willis", permitting the unclamped carotid artery as the prime source of blood supply. A commonly encountered problem is the sympathetic reduction of blood flow through this carotid artery which could result in dangerously low levels of blood flow to the brain. On the other hand, excessive blood pressures at the site of the operation frequently necessitate further operative procedures.

For this application, the pressure transducer could be sutured in the carotid artery, between the site of the operation and the arterial clamp, and the monitoring pressure range of the instrument changed to approximately −10 to 300 millimeters of mercury. A range shifting switch, modifying the forward-current transfer ratio of the amplification means, is provided for this purpose. The low-pressure limiting feature would be employed to provide an alerting indication, and to automatically open up the arterial clamp. The high pressure limiting feature would be used to provide an alerting indication only. Since it is possible for a decrease in cranial blood pressure to lag blood flow loss to the brain by a period of time measurable in minutes, and considerable variation among patients exists in what might be considered normal, it may be desirable to use an additional monitoring transducer to reduce this time lag. The additional transducer could take the following forms: (1) a means of monitoring actual blood flow through the unclamped carotid artery; the transducer output reflecting volume flow; (2) a means of monitoring the blood pulse amplitude of the unclamped carotid artery; or (3) an EEG probe whose output provides an indication of brain activity in the region of the elec-

(continued overleaf)

trode contacting area. If the peak EEG amplitude decreases by some appreciable proportion (10-20%), this information would serve as an energizing input.

If either or any of the additional transducer outputs noted above were made available, a suitable logic-combining OR function could be introduced at the input of the system to energize the low-limit feature.

A modified carotid arterial clamp has been designed which provides fail-safe operation in the event of power failures. The clamp retains the pressure "reset" feature, and incorporates a quick-release solenoid normally held "ON" to apply pressure to the artery. If the power fails, or the low-level indication point is exceeded, the solenoid releases the clamp, without applying any torquing force. An auxiliary battery provides an audible alarm in the event of local or general power failures.

For patient convenience, all hard-wired interconnections between patient and monitoring equipment could be replaced by existing telemetry equipment and systems.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
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and Space Administration
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No patent action is contemplated by NASA.

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