Stroke Unit Design: Intensive Monitoring Should Be a Routine Procedure

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“That deaf dumb and blind kid sure plays a mean pinball.”

“Pinball Wizard” from “Tommy,” The Who, 1969

Tommy, the protagonist of The Who’s first rock opera, became pinball champion although he was deaf and blind (a psychogenic disorder, as we all know). He plays the pinball machine by “intuition,” doesn’t see the ball or hear the whistles and sounds, and doesn’t see the lights and the flippers; nevertheless, he always wins.

However, only few are so gifted that they can champion demanding tasks by intuition, by intent neglecting helpful information that is easily available. In acute stroke management on a stroke unit, general patient management can be handled in several ways: (1) by intuition, (2) on the basis of results of repeated physical examinations and daily assessment of physiological parameters twice or 3 times daily, or (3) with the assistance of continuous monitoring of physiological variables such as blood pressure (BP), heart rate, respiration rate, fever, or oxygen saturation, also known as physiological continuous monitoring. Using the pinball machine example, option 1 would be Tommy’s approach, option 2 would mean playing the machine occasionally, and option 3 would represent a concentrated attempt to score high points.

What do we mean by “monitoring?” There are at least 2 aspects: first, physiological monitoring may serve as a surrogate for frequent clinical examinations that cannot be performed as often as desired because of a shortage of personnel; and second, monitoring may detect changes in physiological variables that cannot be assessed directly by clinical means. An explanation is also needed for “intensive” monitoring and what is meant by “routine.” The EUSI (European Stroke Initiative) recommendations for general stroke management comprise monitoring of clinical status (using validated neurological scales) and vital functions (pulse rate, respiration rate, BP, oxygenation, and temperature) continuously or discontinuously.1 The extent of monitoring depends on acuteness, severity, and the underlying cause of stroke: the risk of missing a critical episode may just be too high if only serial clinical monitoring is performed, eg, every 4 hours. For example, in a young patient with an unstable dissection of the left internal carotid artery, no one would want to overlook a hypotensive period, which would require actively elevating BP and maybe emergency stenting. If an ischemic episode (leading to aphasia and hemiparesis) occurs just after the last clinical examination, although the next is routinely planned 4 hours later, it will certainly be missed. Clearly, this is a rare example and does not describe a standard patient on a stroke unit, but there are certainly more examples of subtypes of stroke for which “continuous” monitoring is needed. And there are even more examples if patients are included who suffer from intracranial bleeding or subarachnoid hemorrhage, who are prone to a variety of complications, particularly in the acute phase.

Obviously, clinical monitoring cannot be performed continuously, considering shortages of personnel and cost. However, technical monitoring with feedback and warning systems can. Basic physiological monitoring as recommended by EUSI may provide important information about the patient, because many clinical changes may be accompanied or even preceded by changes in physiological parameters. This is especially important when treatment options are available. For example, aphasic patients cannot complain about pain. However, pain leads to an increase in pulse rate and blood pressure, which may be followed by an increase in intracranial pressure (ICP). In other cases, the increase in blood pressure may be due to increasing ICP (referred to as Cushing-Kocher response) in patients who have had large strokes. Many stroke patients suffer from elevated blood pressure during the acute phase of stroke and some may need antihypertensive treatment.2 On the other hand, hypertensive treatment may be needed in some patients with unstable blood pressure.3 Patients with suspected cardioembolic stroke require continuous ECG monitoring to detect arrhythmia in order to start anticoagulation as early as possible. Acute stroke at the brain stem or large supratentorial strokes may cause insufficient
Intensive Monitoring Should Not Be the Routine

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The main objective of acute stroke care should be to reduce death and disability, and the objective of monitoring should be the same. Treatment in stroke units (without intensive monitoring) is the only treatment option proven to reduce death in acute stroke patients, and also the only treatment that has shown beneficial long-term effects on survival and disability. All acute stroke patients seem to benefit from stroke unit treatment.

Among the different stroke unit models, the (nonintensive) comprehensive model, which combines acute treatment and rehabilitation, has been most extensively tested in randomized trials and has achieved the most favorable results. The characteristic features of care provided by such units are: (1) a standardized protocol for acute evaluation, monitoring, and medical treatment; (2) a strategy for early mobilization; (3) a strong focus on rehabilitation with an average duration of at least 1 week; (4) a multidisciplinary team; and (5) integration of medical care, nursing, and rehabilitation.

According to our current knowledge, all these aspects are necessary for evidence-based stroke unit care.

During recent years the importance of one aspect, monitoring and control of physiological factors, has received increased attention. As some data from the randomized stroke unit trials indicate, control of physiological factors might be important for recovery. Today most stroke units have a systematic approach to maintenance of physiological homeostasis during the first few days. Hence, the question is not whether acute stroke patients should have monitoring or not, but rather how intensive (continuous or intermittent) and how extensive (how long? for all or only selected patients?) this should be.

From the history of acute cardiac care we know that monitoring, if too intensive or too invasive, might be harmful. From the history of the first stroke units, we know that stroke units where the main focus was on

References


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breathing that can be detected by continuous monitoring of the respiration rate or arterial oxygen saturation. Pneumonia due to silent aspiration is frequently heralded by a temperature increase, which may be missed for hours without continuous monitoring. In all these examples, continuous monitoring will detect changes and will have direct therapeutic consequences.

Some argue that monitoring interferes with early mobilization. This is not necessarily true. Monitoring is mostly used in the very early course of the disease when, in most patients, extensive mobilization is not prescribed. Even so, the devices are not that bulky and can be removed during physiotherapy when the therapist is present and provides clinical monitoring. This is also true if prolonged monitoring is required. Monitoring can also be used in patients sitting in a chair.

In conclusion, stroke patients are monitored both clinically and technically. Because clinical monitoring cannot be performed continuously and stroke patients are prone to risk during the acute phase, continuous physiological monitoring is helpful in patient management. This is especially important in all patients with unknown but suspected cardioembolic cause of stroke; patients with labile blood pressure; patients who are prone to develop a second stroke, increasing ICP, or dysphagia; or patients at risk of breathing insufficiency, because monitoring may have therapeutic consequences. Basic technical monitoring comprises continuous ECG, blood pressure, respiration, oxygenation, and temperature. Stroke units have proven their positive effect on mortality, clinical outcome, and social re-integration, but the extent of clinical and physiological monitoring was not specified. The influence of intensive monitoring on clinical outcome has not formally been established either. Those of us using it, however, feel more comfortable in making decisions about patient management. Basic intensive monitoring may be costly. Therefore, it is time to study the effect of continuous intensive monitoring.
intensive monitoring did not improve outcome. \(^6\) Only one of the stroke units tested in the randomized trials employed continuous monitoring, and this stroke unit showed no beneficial effect. \(^1\) \(^7\)

Monitoring must be balanced against the other important aspects of stroke unit care (see above, points 2 through 5) and particularly early mobilization and rehabilitation. Early mobilization has been shown to reduce complications and to enhance recovery. \(^4\) It might have important effects on circulation, respiratory function, and oxygenation, as well as a positive psychological influence on the patient. \(^4\) We need more research to elucidate all the mechanisms behind this intervention; however, early mobilization and rehabilitation appear to be very important aspects of effective stroke unit care. \(^1\) \(^4\)

Intensive continuous monitoring for several days may lead to a delay in mobilization and may also create a psychological dependence on the monitoring equipment with the resultant fear of unmonitored movement/activities. Hence, the use of continuous monitoring is not an indifferent intervention and may have consequences, which could lead to possibly harmful changes in stroke unit care. Convincing evidence should be present before we change the main recommendations for stroke unit care, which is proven to be beneficial. \(^1\) \(^4\)

Do we today have enough evidence to recommend intensive monitoring for all acute stroke patients? A small randomized pilot trial and a controlled (not randomized) trial have shown promising results of monitoring. \(^8\) \(^9\) However, the authors of both studies conclude that we need larger randomized trials before definitive conclusions can be drawn. Additionally, the fact that we do not have trials evaluating the benefit of intervention on the specific physiological variables supports the view that it is very premature to recommend intensive monitoring as a routine for all patients.

In our comprehensive stroke unit we employ the systematic assessment of neurological status and vital functions 4 to 6 times a day during the first 2 to 3 days, during bed rest as well as activity, to all patients, and according to the protocol we have shown to be beneficial. \(^4\) Candidates for intensive continuous monitoring in our unit are patients with reduced consciousness, patients with progressing neurological deficits, patients with respiratory or circulatory problems (low oxygen saturation, unstable blood pressure, arrhythmia, or other unstable cardiac conditions), as well as some other high-risk patients. These patients are, from our experience, likely to benefit from intensive monitoring, but we do not know. Hence, we (and several other stroke units) have an ongoing research program in order to try to evaluate the consequences of intensive monitoring, identify the patients who seem to need such monitoring, and identify the patients who will likely be treated and trained more quickly and better without. Such research is paramount in the development of better stroke unit care.

In addition to its medical consequences, a general recommendation of continuous monitoring will also have economic consequences. Traditionally “high-tech” medicine has more prestige than rehabilitation and demands great resources. Expensive equipment and monitoring in the early phase may, therefore, drain resources both from the evidence-based rehabilitation in the stroke unit and from the further chain of care, which also seems to be very important for stroke patients’ outcome. \(^10\)

In summary, through systematic research based on 23 randomized trials, the Stroke Unit Trialists have developed well-defined management strategies for stroke care in stroke units, which reduce death and disability for stroke patients. \(^1\) \(^4\)

From this evidence base, further research is necessary to improve the management of acute stroke. We should not change our practice before we know other approaches to be definitively superior. More intensive monitoring might lead to improved care for some subgroups of acute stroke patients. However, whether intensive monitoring is beneficial, indifferent, or harmful for the great majority of stroke patients is a yet unanswered question. At this time, we have to conclude that stroke unit care with early intensive mobilization is important, whereas intensive monitoring might be important. Today, the recommendation of intensive continuous monitoring as a routine is far from evidence based, while non-intensive stroke unit care is. It is hoped that further research will give us the answers about the most effective combination of these 2 approaches and allow us to achieve a greater standard of evidence-based stroke care.

References


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Stroke Unit Design: High Tech Versus Low Tech

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There are compelling parallels between the management of patients with acute stroke and acute myocardial infarction. Common themes include the importance of organized expert care, the value of acute reperfusion strategies in selected patients, and the application of similar early secondary prevention therapies. In both conditions, physiological parameters such as blood pressure, oxygenation, and glycemic status are thought to be important. However, coronary care units (CCUs) were high-technology monitoring units from the outset in the late 1960s, while stroke care units (SCUs) have in most cases consisted of low-technology care, where stroke patients are treated by a multidisciplinary team in a geographically specific location. Interestingly, CCUs became “high tech” early with no real evidence that this improved clinical outcomes. Both of our protagonists have emphasized the benefits of SCUs and the uncertainties about the precise components of care, which are relevant to improved outcomes. However, Steiner emphasizes the benefits of monitoring in the rapid diagnosis of physiological changes that might require intervention and would be missed by less frequent clinical monitoring. Conversely, Indredavik points out the relative lack of evidence in favor of intensive monitoring in SCUs and recommends more trials to evaluate this management approach. In this debate, it is also important to realize that there are regional differences in the design of SCUs around the world. For example, high-technology monitoring is common in Germany but rare in Scandinavia and the United Kingdom. In our own stroke care units, we monitor selected patients for the first 48 to 72 hours.

Some evidence has been recently presented to suggest that monitoring may identify changes in physiological and neurological status requiring intervention and possibly lead to improved outcomes. Since our protagonists submitted their opinions, a further publication has indicated that admission of acute stroke patients to a monitored SCU may positively influence their outcome at discharge. While this information may suggest that a higher-tech approach is appropriate to stroke patient management, there is a need to replicate these findings in larger studies, particularly using a randomized controlled design. Furthermore, cost-effectiveness needs to be evaluated generally and within specific stroke subtypes and severities.

What in the interim? In patients with acute myocardial infarction, it would not be considered appropriate or indeed ethical to admit a patient to a nonmonitored bed in most parts of the world. Should acute stroke patients remain the “poor relation” of their cardiac cousins, purely because of historical precedents and while we await a high level of evidence from randomized trials? We are of the view that, while possible, a higher-tech approach should be taken in the hyperacute phase in many patients. However, we recognize that in many parts of the world the establishment of at least some form of SCU is the more urgent priority. Indeed, improving the relatively low access levels of patients with stroke to SCUs remains one of the major global challenges facing stroke clinicians.

References

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