Use and abuse of stat EEG

“Clinical judgment is always necessary, and ... is superior to any test or technological advance.”

Stat testing is unquestionably inherent to medicine, and the issue of stat EEG is a thorny one for every EEG laboratory. Most EEG laboratories acknowledge this as a problem, but there is no consensus on how to address it. How to deal with it is typically the responsibility of the laboratory director, who tries to reconcile the duty and obligation to provide a necessary service on the one hand, and the necessity of avoiding abuse that would make the laboratory unable to function on the other hand. Recognizing the problem, most centers have developed some sort of guidelines to avoid abuse.

The issue of stat testing and turnaround time (TAT) is frequently discussed in the laboratory medicine literature [1–9], but there is no such information on EEG. There is certainly abundant literature that discusses indications and usefulness of EEG in various clinical settings, but there is little literature, much less any guidelines, that helps delineate appropriate uses of stat EEGs [10–14]. Many facilities, including most Veterans Hospitals, do not have stat EEGs available. Referral tertiary centers should (and do) offer EEGs 24 h/day and stat, but this can only work with certain rules and limitations.

Generally, approximately 10% of EEGs are ordered stat [11,14]. A review at our 900-bed tertiary referral hospital indicates that approximately 6% of EEGs are ordered stat. With some 1900 inpatient EEG requests performed annually, this translates to over 100 stat EEG requests per year. The vast majority of requests for stat EEGs are for convenience rather than a medical indication. Of the ones with an alleged legitimate medical indication, further scrutiny reveals that about half are not reasonable, need not be performed stat, and can be downgraded to as soon as possible (ASAP) or even routine.

Definition of stat

Whether it is for a test, procedure or a consultation, 'stat' (from the Latin word 'statim', meaning immediately) typically means that it is a medical emergency (i.e., the result is of critical importance, and will affect immediate management and eventual outcome). Stat is the highest degree of medical priority, and in order to be executed, the staff or physician involved should and must interrupt what he/she is doing in order to perform the procedure immediately. Thus, stat procedures are of such medical importance that they should be performed immediately regardless of the time and day. This of course includes after hours (nights and weekends), and if requested during regular hours, they will be done immediately, bumping other procedures that are not stat.

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Stat is in contrast to routine, which is the next opening on the schedule and during office hours. The status of ASAP falls somewhere in between (see definitions below). In practice, however, the term stat is easily (and often) abused to obtain tests or procedures rapidly for convenience (rather than for medical reasons). Stat requests can be divided into two clearly different categories: medically warranted (real stat) and others (pseudostats), which include logistic needs, convenience and no reason at all.
The problem
As aforementioned, the issue of stat testing and its abuse is discussed almost only in the laboratory medicine literature [1–9]. In general terms, the abuse of stat tests has several undesirable consequences, including:

- Poor use of time and resources to the detriment of patients
- Staffing difficulties, requiring more personnel in order to be able to respond rapidly to stat requests
- Increasing the use of overtime, resulting in economic burden
- Frustration and strain of staff and physicians

Stat EEG is not like stat CBC
In addition to these general side effects, there are additional issues specific to EEGs.

For some procedure, the stat attribute makes little difference because the personnel are available in house 24 h/day and the procedure available within minutes (e.g., blood count, EKG, chest x-ray or endotracheal intubation). For others like EEG, however, stat means that personnel or medical staff has to make the trip to the hospital, and realistically the test is available within a few hours at best. Therefore, the stat qualifier is relative rather than absolute.

In regards to EEG, stat means that the EEG is to be performed and interpreted emergently (i.e., the technologist comes in to perform the study and the neurologist comes in to render an interpretation). It is inappropriate for stat EEGs to be performed if no neurologist is available to give an interpretation. If the situation is acute enough to require a stat EEG, a neurologist should be available to give an interpretation. When the ordering neurologist reads EEGs, this is relatively simple. However, this can give rise to logistical difficulties if the ordering physician is a non-neurologist or a neurologist who does not read EEGs. While all internists read chest x-rays, not all neurologists read EEGs.

Indications & non-indications for stat EEG

Status epilepticus
The only legitimate and universally accepted indication for a stat EEG is to evaluate the possibility of non-obvious status epilepticus or nonconvulsive status epilepticus (NCSE), because this type may in itself be harmful to the brain and affects prognosis. To justify a stat EEG, there should be a reasonable suspicion for NCSE, that is, not every patient with coma or unresponsiveness should be suspected of being in nonconvulsive status. A reasonable suspicion is of course a matter of clinical judgment, which is a rare commodity and can be highly variable. While NCSE may be found in approximately 10% of coma or unresponsiveness [15,16], this seemingly high number has much to do with the definition of what constitutes EEG status, as pointed out elsewhere [17,18]. In the particularly common scenario of anoxic encephalopathy, the EEG often shows a generalized periodic pattern that does not, in itself, reliably distinguish between anoxia and status [17,18]. A recent retrospective series of 102 patients with intracerebral hemorrhage who had continuous EEG monitoring found that seizures occurred in one third of patients, and over half were purely electrographic [19]. This is important, but it argues for systematic EEG monitoring/screening in intracerebral hemorrhage, not for indiscriminately ordering stat EEGs.

Another common scenario is the patient who has a clear cause for mental status changes, whether structural (e.g., subarachnoid or intracerebral hemorrhage) or metabolic/toxic (e.g., illicit drugs or hyponatremia). In this setting, the underlying cause is much more likely than NCSE, and a stat EEG ‘just to make sure’ is not justified; ASAP yes, stat no.

By contrast, here are some situations where there is a reasonable suspicion of NCSE that may justify a stat EEG:

- After treatment for seizure or status epilepticus, when the patient fails to wake up in the expected amount of time, provided that it is not explained by sedative medications (e.g., high dose benzodiazepines). This is a relatively common reason for a stat EEG [12,13], and a justified one.
- There is no clear underlying process (e.g., anoxic or metabolic encephalopathy, stroke or subarachnoid hemorrhage) that explains the coma or mental status changes. In this situation, there are often clinical clues, such as abnormal movements suggestive of seizure activity (muscle twitches or clonic jerking) [16,20].
- For patients who are pharmaco logically paralyzed.

Unless such circumstances exist, the chances of uncovering NCSE are sufficiently low that the EEG can be deferred a few hours. While we recognize that no rule is absolute, we as clinicians exercise this type of probabilistic clinical judgment on a daily basis.

Continuous bedside EEG for monitoring of drug-induced burst suppression is part of the treatment protocol for refractory status epilepticus, and an EEGer/epileptologist is usually involved at this stage. This requires a stat hook up, and may be read by anyone comfortable at identifying burst suppression, which most neurologists are.

The following are not indications for a stat EEG.

- The patient has a seizure and is recovering
- The patient is obviously seizing
- Abnormal mental status or coma that is readily explained (e.g., stroke, subarachnoid hemorrhage, intracerebral hemorrhage or traumatic brain injury)
- Confirmation of brain death
- “We are waiting on the EEG to discharge the patient”
Seizure

There is no need for a stat EEG following a single seizure that has stopped. The fact that the yield is higher when the recording is obtained shortly after the seizure does not justify a stat. Overt (convulsive) status epilepticus is not an indication for stat EEG. What it needs is stat treatment. An EEG may well be warranted at a later point, but not stat.

Brain death

In general, EEG for the confirmation of brain death should not be an emergency. There may be exceptional situations where families may want confirmation of a diagnosis of brain death (such as organ donation), and there may also be compelling compassionate or social reasons to obtain this. However, these do not constitute medical emergencies. Interestingly and unfortunately, the assessment of brain death is frequently the most common reason for stat EEGs [12,13]. It is often necessary to educate non-neurologists about the diagnosis of brain death, and specifically the fact that EEG is not necessary (or sufficient) for the determination of brain death. Brain death is a clinical diagnosis that requires the presence of three cardinal findings: coma (absence of cortical function), absence of any brainstem reflexes and apnea. In addition, time and etiology are important to make a diagnosis of brain death, so waiting an extra 24–48 h is not only acceptable but may add a degree of certainty.

“We are waiting on the EEG to discharge the patient”

This is a frequent request and one of the most absurd and irritating ones. There is basically no clinical situation where discharging a patient should depend on the result of a routine EEG. This erroneous belief denotes a serious lack of clinical judgment. And by the way this type of attitude is probably applied ritually to other tests and unnecessarily prolongs lengths of stay. If someone is waiting for a routine EEG to send a patient home, what they need is clinical judgment, not an EEG.

Conclusions & recommendations

As described above, the major problems with stat EEGs are:

- Stats are often requested for convenience rather than for medical necessity, in order to obtain results more rapidly. The stat abuse prolongs regular TAT, thus perpetuating the problem. By properly managing stat requests, the vicious cycle can be avoided;
- As is true for other tests, EEGs (and stat EEGs) are ordered the most by people who know the least about them. In fact, it can be said that the number of tests ordered is inversely proportional to clinical acumen. Education on the proper indications for stat EEG and EEG in general is critical. In fact there is a serious need for mandatory minimum of EEG training during neurology residency [21].

Based on our experience and an informal survey of other large referral epilepsy centers and EEG laboratories, the following observations and recommendations can be implemented and allow the service of stat EEGs to be offered (which is useful when used properly), while making it workable. EEG orders should be divided into three categories:

- Routine: next available on schedule;
- Stat: available anytime any day. Should be performed within 2–4 h and interpreted 2–4 h after that;
- ASAP: this intermediary status is useful and highly recommended, because many EEGs that are not stat should also not wait 1–2 days. For example, a request for a stat on Friday evening, if it does not meet criteria for stat, should probably not wait until Monday (as a routine would). It should be downgraded to ASAP and performed the next day. Our definition of ASAP is performed and interpreted within 24 h. With this, many pseudo-stats can be downgraded to ASAP without upsetting the referring physician.

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Stat EEGs should only be ordered by neurologists. This is a necessity. In general, any situation requiring a stat EEG should require a neurology consultation. Occasionally, neurosurgery services may also be appropriate, but neurosurgeons often have unrealistic expectations about what information EEG can provide. In a teaching institution, senior neurology residents are also acceptable.

If an EEG is performed stat, it should be interpreted stat. While technologists often give a preliminary or ‘technical’ interpretation, it is inappropriate for stat EEGs to be performed if no neurologist will be available to give an interpretation. If the ordering neurologist is not the reader, the stat EEG should be approved by the neurologist who will read it.

When an EEG is requested stat during office hours, but is not medically indicated as stat, the requesting physician should be educated about the criteria for stat, even if the EEG can be performed immediately because the schedule allows it.

Since the only real indication for a stat EEG is a reasonable clinical suspicion for NCSE, clearly the keyword here is reasonable. Approving such requests will at times border on questioning other physicians’ clinical judgment. This is unfortunately necessary. Suspecting NCSE in a quietly comatose patient with a huge subarachnoid hemorrhage, a sodium level of 120, sepsis, hypotension and who is on a midazolam drip is not reasonable. Ordering every test on every patient ‘just to make sure’ is not good care. Clinical judgment is always necessary, and contrary to a common fallacy, is superior to any test or technological advance.

Financial & competing interests disclosure

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No writing assistance was utilized in the production of this manuscript.
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