

dietary supplements, antiemetic drugs, antimigraine medications, CNS stimulants and herbal products (Boyer & Shannon, 2005) (Table 1). Several medications, including meperidine, tramadol, ecstasy, dextromethorphan, SSRIs, imipramine, and MAOIs, have been observed to cause extreme cases of SS (Isbister et al., 2003; Demirkiran et al., 1996). With respect to drug overdose, it has been estimated that nearly 16% of all SSRI overdose cases result in SS (Mackay, Dunn, & Mann, 1999).

use, physical examination, and ruling out other neurologic disorders such as neuroleptic malignant syndrome, malignant hyperthermia, sympathomimetic toxicity, anticholinergic poisoning, meningoencephalitis, severe sepsis, delirium tremens and heat stroke (Garside & Rosebush, 2003; Adnet et al., 2000).

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The most common symptoms of SS are widespread myoclonus, tremor, hyperreflexia, diaphoresis, flushing and clonus (Gelender et al., 2011; Hall, 2003). Physical examination should include assessment of deep-tendon reflexes, muscle rigidity, oral mucosa, size and reactivity of pupils, intensity of bowel sounds, skin color and the presence or absence of sweating.

MANAGEMENT AND PREVENTION OF SEROTONIN

Typical SS management involves agitation control, autonomic and neuromuscular stabilization, and hyperthermia control (Sporer, 1995). Ingestion of large doses of serotonergic agents can be treated

Patients presenting with severe SS should be admitted immediately to intensive care where neuromuscular complications may be treated with pharmacotherapy and artificial ventilation (Boyer & Shannon, 2005; Isbister et al., 2007; Mir & Taylor, 1999).

SS is highly preventable (Boyer & Shannon, 2005) and prevention practices should start with increased education for both physicians and patients. Since there is currently no laboratory test to confirm a diagnosis, physicians should carefully monitor patients for symptoms of SS when administering drugs that have the possibility to trigger excess serotonergic activity (Isbister, Buckley, & Whyte, 2007). The interplay between serotonergic drugs is complex, and the risk of serotonin toxicity increases with the use of multiple agents (Zagaria, 2007). Thus it is imperative that physicians are aware of their patient's current medications, as well as previous medication history.

Physicians must also be knowledgeable of what drugs, and combinations of drugs, may result in serotonin toxicity. This will prevent physicians from administering drugs that have a high possibility of inducing SS, as well as encouraging the use of alternate drug options. Furthermore, patients should be forthcoming regarding their health, diet, and lifestyle habits to avoid drug treatments that may augment proper serotonin activity.

The current trends in increased use of offending agents like SSRIs, and the associated life threatening complications of SS is a major concern for clinicians. The failure to quickly recognize symptoms of hyper serotonergic activity, and the subsequent continuation of the offending agents, may result in progression towards a very severe state of SS. Since serotonin toxicity arises from combinations or high doses of serotonergic medications, it is highly preventable. Both physicians and patients need to be aware of the potential for SS, its preventability, symptoms, and treatment.

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