High-dose Parenteral Thiamine in Treatment of Wernicke’s Encephalopathy: Case Series and Review of the Literature

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Abstract. Background: Thiamine deficiency can lead to Wernicke’s encephalopathy (WE), an acute and potentially life-threatening neurological disorder. Even though the main treatment modality for WE consists of thiamine replacement, evidence supporting an optimal dosing strategy and duration is unclear. Patients and Methods: We present a single-center case series of eleven patients that were admitted with possible WE and treated with high-dose parenteral thiamine. Results: Patients with suspected WE were treated with ≥500 mg intravenous thiamine for a median of 3 days with 73% of patients (eight out of eleven) displaying symptom resolution or improvement after treatment. No significant correlation between symptom resolution and timing of high-dose thiamine initiation (median=92 h) was identified. In patients whose symptoms resolved compared to those whose symptoms did not, there were no differences in patient variables nor adverse effects related to thiamine treatment. Conclusion: High-dose thiamine (≥500 mg) appears safe and efficacious for use in patients with suspected WE.

Wernicke’s encephalopathy is an acute neuropsychiatric disorder that occurs as a result of thiamine (vitamin B1) deficiency. First characterized by Carl Wernicke in 1881, traditional signs and symptoms of the disorder include altered mental status, ataxia, and ocular signs, including nystagmus and ophthalmoplegia (1). These classical symptoms may be present in only about 16-38% of Wernicke’s patients, though Wernicke’s encephalopathy can be further characterized by distinct patterns of alterations seen by magnetic resonance imaging (MRI) (2-4).

Wernicke’s encephalopathy is associated with significant morbidity and mortality, with death reported in up to 17-20% of patients (5, 6). About 80-85% of patients who survive develop a chronic disorder of severe memory deficits with amnestic states that include learning defects and short term memory loss. This condition, known as Korsakoff’s psychosis, often follows Wernicke’s encephalopathy, which collectively is known as Wernicke-Korsakoff Syndrome (WKS).

Treatment for WKS involves administration of thiamine, even though firm consensus on the optimal dose, frequency, route and duration has not yet been established. Typical suggested regimens include high-dose thiamine (≥500 mg) prescribed intravenously three times a day for two to three days initially with additional treatment doses based on clinical response (7). These doses are several-times greater than the recommend daily thiamine allowance of 1.1 mg in adult females and 1.2 mg in adult males (8). In this case series, we retrospectively review eleven patients treated with high-dose IV thiamine for suspected Wernicke’s encephalopathy to provide additional information on the management as well as clinical correlation and risk factors associated with WKS.

Patients and Methods

An electronic report searching for intravenous thiamine use in patients with ICD-9 codes for thiamine deficiency (265.1) and/or alcohol amnestic disorder (291.1) was reviewed. The report provided a list of patients from which we identified and retrospectively analyzed the electronic charts of their past admission during which high-dose thiamine was administered. Demographic information, thiamine regimen, relevant past medical history, pertinent laboratory values, hospital course, and treatment outcome was collected for each patient in this case series. Excluded from our analysis were patients that did not receive high-dose thiamine therapy or they had confounding comorbidities which obfuscated the diagnosis of WKS or resolution of symptoms. In our study, we defined high-dose thiamine therapy as ≥500 mg parenteral thiamine per day. Time of treatment initiation was defined as the time from symptom...
onset until treatment with high-dose thiamine. In patients who were symptomatic prior to being admitted, time of hospital admission was used as time of symptom onset. Resolution of symptoms was interpreted based on chart documentation by the physician and included complete or partial improvement in patients’ initial symptoms.

Results

Among the 32 patients which met our search criteria, 14 received high-dose parenteral thiamine (≥500 mg thiamine/day) initially (see Table I). Wernicke’s encephalopathy was suspected or diagnosed in 12 patients. One patient was excluded from our analysis due to alternative diagnoses confounding symptom resolution, leading to 11 patients included in the case series review. The median age of the patients (five males, six females) was 58 years. Thiamine levels were measured in 8 out of the 11 patients (73%) with an appropriate measurable thiamine level detectable in only one patient (22 nmol/L). Undetectable thiamine levels were present in 5 out of the 11 patients. In two patients, intravenous thiamine had been administered before blood was drawn and the thiamine level returned abnormally high (94 and 507 nmol/L). The median baseline magnesium level was 1.8 mg/dL, and seven patients had magnesium replaced during their hospitalization (median magnesium level was 1.8 in magnesium-treated patients and 1.85 in the untreated group).

In the treatment of Wernicke’s encephalopathy, all patients received 500 mg IV thiamine although the number of doses and duration of treatment varied. Six patients received the high-dose thiamine as the initial therapy for suspected Wernicke’s encephalopathy. In five patients, thiamine was started prior to suspicion of Wernicke’s, and of those patients, all received a standard dose of 100 mg thiamine daily either for thiamine deficiency or prophylaxis for delirium tremens. Overall, patients were treated a median of three days with high-dose thiamine.

Upon discharge, symptoms had resolved in 7 out of 11 (63.4%) patients. Eight (73%) patients were discharged with thiamine, half of which did not have resolution of symptoms. Korsakoff’s psychosis was noted in one patient during their admission. In this patient, whose hospital stay was marked by confabulation in addition to altered mental status, nystagmus, and an undetectable thiamine level, all symptoms were present before thiamine treatment had been started. Two patients did receive glucose before thiamine was given, but both had resolution of their symptoms at discharge. There were no reported adverse effects seen in any of the patients attributed to thiamine.

When comparing the duration of treatment with high-dose thiamine, patients whose symptoms resolved were treated for a median of three days versus two days in those patients with persistent symptoms. Interestingly, patients whose symptoms persisted despite high-dose thiamine treatment started high-dose therapy at a median time of 90 h (range=69-111 h) after symptom onset compared to a median time of 92 h (range=46-186 h) until start of therapy from symptom onset in patients whose symptoms eventually improved.

Discussion

Pathophysiology of WKS. Thiamine plays a key role in several enzyme and metabolic pathways, including involvement with transketolase and glucose metabolism within the CNS (9, 10). Prolonged thiamine deficiency depletes the body stores within 2-3 weeks (11). As thiamine blood levels fall, thiamine-dependent enzyme systems involved in prevention of cellular damage become impaired and metabolic demands increase, which can result in selective brain lesions correlated with Wernicke’s encephalopathy and Korsakoff’s syndrome. Consequently, thiamine deficiency and development of WKS is particularly prevalent in malnourished patients oftentimes due to the shift in diet away from vitamin-rich foods and, as in the case of chronic alcoholism, a shift towards the carbohydrate-heavy consumption of alcohol.

Differential diagnosis. As stated, the classical triad symptoms of ocular signs, ataxia, and altered mental status is neither ubiquitous nor unique to WKS, but rather more diagnostically indicative of WKS when used in conjunction with the clinical picture. MRI signal characteristics (reversible cytotoxic edema typified by symmetric alterations in the thalami, mammillary bodies, tectal plate, and periaqueductal area) are still not definitive for a WKS diagnosis (2, 11, 12). The differential diagnosis may include other encephalopathies, paramedian thalamic infarction, primary cerebral lymphoma, multiple sclerosis, Creutzfeldt-Jakob disease, and Leigh’s disease, among others (11, 13, 14). In 1986, the retrospective analysis of 131 WKS subjects by Harper et al. demonstrated the relatively poor ability to correctly diagnose WKS, as 80% of the patients who had confirmed WKS were diagnosed for the first time posthumously on necropsy (3). Because of its relatively non-specific and oftentimes poorly recognized clinical presentation of WKS, it is important to recognize the “at risk” patient population for developing WKS and to begin empiric treatment appropriately when the disease is suspected.

Acute treatment. It is established that thiamine replacement is the primary treatment for WKS in order to reverse mental status changes and prevent further disease progression. Parenteral thiamine is used in the acute treatment of Wernicke’s since intestinal absorption of thiamine may be impaired, as in the case of alcoholics (1). A 1998 study demonstrated decreased expression of thiamine transporter-1, which is involved in thiamine uptake in the gut and inhibition of carrier-mediated thiamine uptake in murine models fed alcohol chronically, which supports the idea that
Table I. Demographic and clinical characteristics of patients with Wernicke's encephalopathy.

| Case | Age (yrs) | Gender | Race | Thiamine level (nmol/l) | Thiamine dosing regimen | Duration of high-dose therapy (days) | Time to high-dose thiamine treatment (hours) | Resolution of symptoms |
|------|-----------|--------|------|-------------------------|-------------------------|-------------------------------------|---------------------------------------------|----------------------|
| 1    | 43        | F      | AA   | <7                      | 100 mg PO qDay, 500 mg IV qDay | 3                                   | 46.2                                         | Yes                  |
| 2    | 44        |        | AA   | 22                      | 100 mg PO, 500 mg IV q8h, 500 mg IV qDay, 100 mg PO qDay | 7                                   | 61.9                                         | Yes                  |
| 3    | 64        | W      | 94+  | 100 mg PO, 500 mg IV q8h, 500 mg IV qDay | 7                                   | 84.4                                         | No                   |
| 4    | 80        | W      | None | 100 mg PO, 500 mg IV BID, 500 mg IV qDay | 8                                   | 117.4                                         | Yes                  |
| 5    | 57        | AA     | None | 500 mg IV once, 100 mg PO qDay | 1                                   | 117                                          | Yes                  |
| 6    | 48        | AA     | None | 100 mg PO, 500 mg IV q8h | 2                                   | 47.4                                          | Yes                  |
| 7    | 63        | F      | AA   | <7                      | 500 mg IV q8h, 200 mg IV qDay, 100 mg PO qDay | 3                                   | 111.3                                         | No                   |
| 8    | 67        | F      | W    | <7                      | 500 mg IV q8h, 100 mg IV qDay | 2                                   | 186.4                                         | Yes                  |
| 9    | 57        | F      | AA   | <7                      | 500 mg IV q8h, 100 mg PO qDay | 7                                   | 69                                           | No                   |
| 10   | 69        | F      | AA   | <7                      | 500 mg IV TID, 250 mg IV qDay | 3                                   | 92                                           | Yes                  |
| 11   | 58        | F      | AA   | 507+                    | 500 mg IV TID, 500 mg IV qDay | 3                                   | 96                                           | No                   |

*Thiamine levels obtained after thiamine administered. †Defined as time between either admission or start of symptoms and high-dose thiamine therapy initiation. AMS, Altered mental status; IV, intravenous; PO, orally; q8h, every 8 hours; qDay, every day; BID, twice a day; TID, three times a day.
Conclusion

Due to high morbidity and mortality of WKS and limited adverse effects associated with parenteral thiamine, clinicians should start empiric therapy as soon as signs and symptoms are recognized. For the treatment of acute Wernicke’s encephalopathy, our case series demonstrates that IV thiamine appears efficacious and safe for use, even in higher doses relative to traditional delirium tremens prophylactic dosing (100 mg/day thiamine). Within our institution, treatment doses and duration of thiamine used in the subjects were similar, but not uniform. More research is warranted to investigate the dose and duration of thiamine treatment as well as adjunct treatments that optimize therapeutic outcomes in this potentially life-threatening disease state.

Conflicts of Interest

The Authors have no conflicts of interest to disclose.

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