

# Utility of laboratory studies in seizures of children older than one month of age

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## ABSTRACT

**Introduction:** Seizure is the most common paediatric neurological disease which occurs in ten percent of children. In approaching a convulsive patient, finding the causes of seizure is essential, and the patient's history as well as the physical examination are important. The role of routine laboratory tests for children's seizures (except neonates) is undetermined, but checking for serum sodium, glucose, calcium and urea routinely has been advised. The purpose of this study was to determine the diagnostic efficacy of these serum chemistry tests in the seizures of children older than one month of age.

**Methods:** In this descriptive, retrospective study, medical records of 302 hospitalised children with seizure were reviewed. Results of laboratory tests, like sodium, calcium, blood glucose and urea levels, pertinent history and physical examination, and the change in patient management based on serum chemistry test results, were analysed. All the children in the study were classified as having seizure with or without fever.

**Results:** In 302 hospitalised children with seizure, about ten percent of 938 tests were abnormal. 27.7 percent of these abnormal results were seen in 1–12-month-old infants. Only 11 percent of abnormal tests (1.3 percent of total tests) might have caused a seizure. Also, 0.2 percent of the results could not be predicted from the history or physical examination, which was conducted in patients younger than one year of age.

**Conclusion:** Routine determination of serum chemistry values in seizures of children does not contribute to therapy, and are costly and time-consuming. It may not be helpful and informative unless the patient is less than one year of age.

**Keywords:** febrile seizure, seizure, serum chemistry

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## INTRODUCTION

Seizures are common in the paediatric age group and occur in approximately 10% of children.<sup>(1)</sup> Indeed, it is one of the main reasons for presentation in the emergency departments. When confronted with a paediatric patient presenting with seizure, it is vital to stabilise the child and then to determine whether a real seizure has occurred. Moreover, it is critical to find the precipitating factor. A detailed history and medical examination are beneficial in providing adequate information regarding the probable cause of the seizure. Evaluation of a seizure patient is closely related to the clinical status of the patient at the time of presentation. In the case of a febrile seizure (FS), a prompt assessment to exclude infectious aetiologies such as meningitis and encephalitis should be undertaken. In afebrile seizure (AFS) of children (except for neonates aged less than one month), when obtaining the history, one should pay special attention to the changes in behaviour, aura or focal seizure, which could indicate partial seizure.<sup>(2)</sup> Up to 40% of childhood seizures are partial seizures, and aura was seen in one-third of the children with partial seizure.<sup>(1)</sup>

Some authors recommend routine determination of some serum chemistry values, such as glucose, sodium, calcium, magnesium and urea in the evaluation of seizure aetiology.<sup>(3)</sup> However, others believe that these tests do not usually contribute to the seizure therapy and are costly and time-consuming.<sup>(4)</sup> Laboratory testing might be appropriate when the clinical data is suggestive.<sup>(2,5)</sup> The aim of this study was to determine the diagnostic efficacy of routine serum chemistry tests in the seizures of children older than one month of age.

## METHODS

In this descriptive, retrospective study, charts of all hospitalised children with seizure (302 patients) in Shaheed Sadoughi and Shohadaye Kargar in Yazd, Iran, from March 2004 to March 2007 were reviewed. All patients with seizures (FS and AFS) were included. Excluded from the study were neonates (less than one month of age) and patients with prolonged seizures (> ten minutes), central nervous system (CNS) infections, seizures due to drug withdrawal, hypoxic-ischaemic encephalopathy, neurocutaneous disorders, CNS dysgenesis, inborn error

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**Table I. Results of biochemical tests.**

| Test            | Total no. of tests | No. (%) of abnormal results | Mean $\pm$ SD of serum level | No. of abnormal results requiring a change in management |
|-----------------|--------------------|-----------------------------|------------------------------|--|
| Glucose (mg/dL) | 295                | 0                           | 131.7 $\pm$ 65.3             | 0  |
| Sodium (mEq/L)  | 262                | 84 (32)                     | 133.1 $\pm$ 6.9              | 2  |
| Calcium (mg/dL) | 279                | 10 (4)                      | 8.8 $\pm$ 0.99               | 10   |
| Urea (mg/dL)    | 102                | 0                           | 30.8 $\pm$ 5.5               | 0  |
| Total           | 938                | 94 (10)                     | –                            | 12   |

of metabolism, shigellosis encephalopathy and those who are ill and not alert. As these disorders may cause prolonged or uncontrolled seizure, loss of consciousness and a poor general condition, the blood was drawn when the seizure had stopped and the children appeared well.

Data collected from the charts included the age, gender, developmental status and type of seizure. The charts were further reviewed to obtain information such as diarrhoea, vomiting, oligouria, anoxia, history of previous seizure, or a family history of seizure. Clinical signs like dehydration, tachycardia, oedema, weakness, restlessness and abnormal neurological examination were recorded. The serum sodium, calcium, urea and blood glucose levels, and changes in the therapeutic management of the patients based on the results of these tests were noted. It should be mentioned that a sodium level  $< 135$  or  $> 145$  mEq/L was considered to be abnormal (no treatment required), but a sodium level  $< 130$  or  $> 150$  mEq/L, blood glucose  $< 50$  mg/dL, calcium  $< 7$  mg/dL, and urea  $> 80$  mg/dL were considered as significant laboratory abnormalities that required treatment. Patients were classified into two groups, FS and AFS. Statistical analysis of data was performed by the Statistical Package for Social Sciences version 13.0 (SPSS Inc, Chicago, IL, USA).

## RESULTS

302 children with seizures, consisting of 185 boys and 117 girls, with ages ranging from one month to 12 years, were enrolled in this study. 227 (75.2%) patients had FS, and 75 (24.8%) had AFS. In the FS group, 21% had a family history of FS and 7% reported a family history of AFS. In contrast, 17% of patients in the AFS group had a family history of AFS and 17% claimed a family history of FS. AFS was more prevalent (75%) among children younger than two months of age. Also, the highest prevalence of FS (88%) was observed among children aged 13–60 months. 75 (33%) patients in the FS group and 43 (57%) patients in the AFS group had a history of recurrent seizures. 33% of girls and 43% of boys had a history of recurrent seizures, but this was not statistically different ( $p > 0.05$ ).

Table I illustrates the results of the serum chemistry

**Table II. Results of biochemical tests in the different age groups.**

| Age group (months) | No. (%) of abnormal result tests | Total no. abnormal |
|--------------------|----------------------------------|--------------------|
| 1–2                | 5 (27.8)                         | 18                 |
| 3–12               | 21 (10.9)                        | 192                |
| 13–60              | 62 (11.1)                        | 557                |
| 61–144             | 6 (3.5)                          | 171                |

tests. Overall, 10.0% (94/938) of tests were abnormal. In fact, 19 of 236 (8.1%) tests performed in the AFS group and 75 of 702 (10.7%) tests done in the FS group were reported to be abnormal. The two groups were not significantly different in this regard ( $p > 0.05$ ). In 1.3% (12/938) of cases, laboratory abnormalities resulted in a change in patient care that included four cases of hypocalcaemia and eight cases of hyponatraemia. There were only two (0.2%) cases where hypocalcaemia was not suspected on the basis of history or clinical examination in the age group of less than one year of age; one of the patients had FS, and both had vitamin D-deficient rickets. In addition, seven of the 12 (58.3%) cases of laboratory disorders that needed to be treated were in their first year of life.

Significant abnormalities that led to a change in the patient management were found in seven of 75 (9.3%) children in the AFS group and 30 of 227 (13.2%) children in the FS group. Table II shows the laboratory results in the different age groups. The highest rate of abnormalities was observed in patients 1–12 months of age (27.7%). Overall, the rate of serum chemistry abnormality under one year of age was 12.3%, but this rate was 9.3% for children older than one year. There were no significant differences between boys and girls with regard to the sodium, calcium, glucose and urea levels in the different age groups ( $p > 0.05$ ). The incidence of abnormal serum biochemical values was 11.7% for boys and 10.5% for girls, but this was not significantly different ( $p > 0.05$ ). The highest rate of change in the clinical intervention due to serum chemistry abnormalities occurred in the age group of 1–12 months. Indeed, 15% of children younger

than one year of age needed their treatment to be changed. In comparison, only 7% of patients older than one year of age required treatment modification ( $p < 0.05$ ).

## DISCUSSION

This study was conducted to determine the value of routine serum chemistry tests in paediatric seizures. FS patients comprised 75% of the subjects, similar to studies by Zerr et al (76%)<sup>(6)</sup> and Landfish et al (71%).<sup>(7)</sup> Like other studies, the rate of recurrent FS was 33%.<sup>(8-10)</sup> The rate of recurrence in the AFS group was similar to reports by Inallo and Ghofrani (51.7%),<sup>(11)</sup> Camfield et al (51.8%),<sup>(12)</sup> and Stronik et al (54%).<sup>(13)</sup> The highest rate of FS was observed among children aged 13 months to five years, which corroborated with other studies.<sup>(1,14)</sup> The incidence of abnormal serum chemistry values was 10.0%, which was lower than the 14.8% reported by Valencia et al.<sup>(15)</sup> This could be attributed to the different samples. It was found that 12.3% of children younger than one year of age had abnormal serum biochemical values and 58% of these led to changes in the therapeutic management. This was similar to Scarfone et al's study which revealed 43% of infants with AFS and 13% with FS had laboratory abnormalities requiring changes in the patient care.<sup>(16)</sup> As the biochemical abnormalities have nonspecific signs or have no signs and symptoms in infants, performing routine serum biochemical tests could be beneficial. Overall, the rate of change in the treatment as a result of serum abnormalities were similar in both FS and AFS groups; this is in agreement with the study done by Kenney and Taylor.<sup>(4)</sup>

In the current study, only two patients had abnormal test results that were not predictable on the basis of history or physical examination. Therefore, the prevalence of unexpected biochemical abnormality is two in 1,000 cases, similar to the results of other studies.<sup>(7,17-20)</sup> These two patients had hypocalcaemia due to rickets. In conclusion, routine serum chemistry laboratory work-up in paediatric patients presenting with seizures is unnecessary unless careful history and/or physical examination suggest otherwise. In fact, the routine use of these tests is costly, time-consuming and rarely contribute to seizure therapy. It should however be mentioned that in children younger than one year of age, these tests could be beneficial, since signs of serum chemistry disturbances are nonspecific or are even without signs at this age.

## REFERENCES

1. Johnson MV. Seizure in childhood. In: Behrman RE, Kliegman RM, Jenson HB. *Nelson Textbook of Pediatrics*. 17th ed. Philadelphia: WB Saunders, 2004: 1993.
2. Holmes GL. Generalized seizures. In: Swaiman KF, Ashwal S, Ferriero DM, eds. *Pediatric Neurology: Principles and Practice*. Philadelphia: Mosby Elsevier, 2006: 1021.
3. Duman S, Ginsburg SH. Neurologic problems, epilepsy (seizures). In: Friedman H. *Problem-Oriented Medical Diagnosis*. New York: Little Brown and Company, 1996: 409.
4. Kenney RD, Taylor JA. Absence of serum chemistry abnormalities in pediatric patients presenting with seizures. *Pediatr Emerg Care* 1992; 8:65-6.
5. Turnbull TL, Vanden Hoek TL, Howes DS, Eisner RF. Utility of laboratory studies in the emergency department patient with a new-onset seizure. *Ann Emerg Med* 1990; 19:373-7.
6. Zerr DM, Blume HK, Berg AT, et al. Nonfebrile illness seizures: a unique seizure category? *Epilepsia* 2005; 46:952-5.
7. Landfish N, Gieron-Korthals M, Weibley RE, Panzarino V. New onset childhood seizures: Emergency department experience. *J Fla Med Assoc* 1992; 79:697-700.
8. Berg AT, Shinnar S, Darefsky AS. Predictor of recurrent febrile seizures. A prospective cohort study. *Arch Pediatr Adolesc Med* 1997; 151:371-8.
9. Shinnar S. Febrile Seizures. In: Swaiman KF, Ashwal S, Ferriero DM, eds. *Pediatric Neurology: Principles and Practice*. Philadelphia: Mosby Elsevier, 2006: 79-89.
10. Waruiru C, Appleton R. Febrile seizures: an update. *Arch Dis Child* 2004; 89:751-6.
11. Inallo S, Ghofrani M. Risk of seizure recurrence following an initial acute unprovoked seizure in children. *J Sheed Sadoughi Univ Med Sci Health Serv* 2005; 13:17-25.
12. Camfield PR, Camfield CS, Dooley JM, et al. Epilepsy after a first unprovoked seizure in childhood. *Neurology* 1985; 35:1657-60.
13. Stroink H, Brouwer OF, Arts WE, et al. The first unprovoked, seizure in childhood: a hospital based study of accuracy of the diagnosis, rate of recurrence, and long-term outcome after recurrence. *J Neurol Neurosurg Psychiatry* 1998; 64:595-600.
14. Aicardi J. Febrile convulsion. In: Aicardi J. *Epilepsy in Children: International Review of Child Neurology Series*. New York: Raven Press, 1994: 253-7.
15. Valencia I, Sklar E, Blanco F, et al. The role of routine serum laboratory tests in children presenting to the emergency department with unprovoked seizures. *Clin Pediatr (Phila)* 2003; 42:511-7.
16. Scarfone RJ, Pond K, Thompson K, Fall I. Utility of laboratory testing for infants with seizures. *Pediatr Emerg Care* 2000; 16:309-12.
17. Smith RA, Martland T, Lowry MF. Children with seizures presenting to accident and emergency. *J Accid Emerg Med* 1996; 13:54-8.
18. Eisner RF, Turnbull TL, Howes DS, Gold IW. Efficacy of a "standard" seizure workup in the emergency department. *Ann Emerg Med* 1986; 15:33-9.
19. Nypaver MM, Reynolds SL, Tanz RR, Davis AT. Emergency department laboratory evaluation of children with seizures: dogma or dilemma? *Pediatr Emerg Care* 1992; 8:13-6.
20. Nordli DR, Pedley TA. Evaluation of children with seizures. In: Shinnar S, Amir N, Branski D, eds. *Childhood Seizures. Pediatric and Adolescent Medicine*. Basel: Karger, 1995: 67.