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SODIUM DETERMINATION IN NAIL CLIPPINGS BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS FOR THE DIAGNOSIS OF CYSTIC FIBROSTS

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ABSTRACT.

The present study indicates an incidence of 1/1200 cystic fibrotic (CF) patients among hospitalized children. It also reports the reliability of instrumental neutron activation analysis (NAA) method in the diagnosis of CF patients. There was no overlapping of the results of nail sodium concentration in CF patients and normal controls (mean 11763 $\pm$ 2930 vs 559 $\pm$ 244; $P < 0.001$).

KEY WORDS:Cystic fibrosis, nail clippings, neutron activation analysis

INTRODUCTION

Cystic fibrosis (CF) is a serious and often fatal affliction which occurs commonly in Western Europe and North American . The reported incidence in various parts of the world ranges from 1/2000 to 1/90000(2,4,6). Even though a few sporadic cases have been reported from Iran(1), the incidence of this genetic disorder in this country where intermarriages are frequently encountered remains unknown.

The purpose of the presently reported study was to investigate the following points:

1. Estimation of the incidence of CF in hospitalized Iranian children.
2. To examine the accuracy of instrumental neutron activation analysis(NAA) method in diagnosis of the disease.

MATERIALS AND METHODS

The records of the country's largest and best known paediatric center* were reviewed. There were 23,216 total admissions over the past seven years.

Nineteen cases of CF has been documented, giving an over-all incidence of 1/1200 among hospital patients.

In order to assess the reliability of the NAA method in the diagnosis of CF, nail samples were obtained from 9 proven cases of CF hospitalized in various centers. The hands had not been washed for 24 hours prior to sampling, in accordance with the usual recommendations. After mechanical removal of visible dirt, the entire nail

*Ahari Children's Hosital

was soaked with distilled water by means of a gauze pad. Three hours later, the nails were clipped with scissors which had been previously washed in distilled water and put into HCl-Cleaned polyethylene vials (3).

The free edges of fingernails from cystic fibrotic patients and controls were weighed in the precleaned, push-cap, high-purity polyethylene vials prepared by Viriage University, Amsterdam, Holland.

The chemical standard, sodium chloride*, was prepared by pipetting the solution in suitable concentration(1-10 microgram) into another polyethylene vial. The samples and standards were inserted into longer containers of push-cap polyethylene vials.

The samples, together with the standard, were irradiated in the reactor of the Nuclear Research Center at a thermal neutron flux of 2×10^{13} n.cm^{-2}sec^{-1} for 15 minutes.

After irradiation, the containers were opened and the vials were washed with dilute nitric acid and distilled water to remove surface contamination.

The sample and standard were counted after 24 hours, with a high resolution Germanium/Lithium/detector of 60 cc. active volume. A 4069 channel pulse height analyser was used to register the gamma-ray spectra.

The photopeak efficiency of the detector for the gamma-ray was determined using International Atomic Energy Agency standard sources.

The activity of Na^{24} from the reaction of $Na^{23}(n.\gamma)$ Na^{24} was measured in nails and in standards with conventional gamma-ray spectrophotometry. The concentration of sodium in the nails was obtained by comparing its specific activity with that of the standard.

* From Johnson Mattey, England

RESULTS

The age, sex and presenting symptoms of 19 cases of CF patients hospitalized in one of the country's largest paediatric centers are shown in Tables 1 and 2. The results of fingernail sodium obtained by NAA method,as well as age and sex distribution of the cases under study,compared to age and sex matched normal subject, are shown in Table 3.

TABLE 1

AGE AND SEX DISTRIBUTION OF PATIENTS* WITH C.F.

AGE Yrs	SEX M	SEX F
1	5	6
1-5	4	-
5	2	2

TABLE 2

PRESENTING SYMPTOMS OF C.F.PATIENTS*

AT THE TIME OF ADMISSION

PRESENTING SYMPTOMS	NO
MECONIUM ILEUS	4
RESPIRATORY INFECTION WITH FAILURE TO THRIVE	5
GASTRO-ENTERITIS WITH RESPIRATORY INFECTION	5
RESPIRATORY INFECTION	5

* These are the total number of reported cases at one of the country's largest pediatric centers over a seven year period.

AGE AND SEX DISTRIBUTION AND SODIUM NAIL CONCENTRATION
IN C.F. PATIENTS AS COMPARED TO
AGE AND SEX MATCHED NORMAL SUBJECTS

No	AGE Yrs	SEX	NAIL Na CONCENTRATION IN C.F. PATIENT PPM	NAIL Na CONCENTRATION IN NORMAL SUBJECTS PPM
1	1½	F	7882	450
2	2	M	8830	200
3	5	M	14810	640
4	6	M	12880	740
5	6	M	7830	500
6	7	M	14680	720
7	8	M	12690	661
8	13	M	14850	200
9	13	F	11420	921
			Mean = 11763	Mean = 559
			S.D. = 2930	S.D. = 244

DISCUSSION

It is difficult to draw meaningful conclusions about the true incidence of CF in Iran. It seems certain that the disease in not as rare as once considered(1).However, the investigation of gene frequency in this area where first cousin marriages are very common seems imperative. As is shown in Table 1, which is a retrospective study of 19 patients with CF, the age incidence in this group is below 5 years, and the sex ratio is 11 males to 8 females. The most common presenting symptom of the same patients on admission, as depicted in Table 2,is respiratory infection, which in half of the patients is coupled with failure to thrive and gastroenteritis.In only 4 patients, meconium ileus was the only presenting symptom.

The NAA method is a simple and practical means of screening for CF, where atomic reactors are accessible.It is our experience that in places outside of well-equipped medical centers the determination of sweat electrolyte concentrations is most inaccurate. Our data are somewhat contradictory to the claim made (5), that this technique is not accurate. There were no false negatives in the 9 proven cases. Therefore, it is suggested that all patients in whom fingernail sodium is in excess of 7000 ppm should undergo other investigations to confirm the diagnosis of CF.

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The unexpected Finding of blood glucose over 1000 mg.% in several patients during open heart surgery(incidental to monitoring of potassium changes) led us to investigate intraoperative responses reported herein.

Half-hourly blood glucose values were obtained in 45 randomly selected surgical patients: 27 undergoing open heart proceedures, 18 major general surgical operations. Sixteen were females, 29 males, ages from 24 to 74, in Physical Status II-III. Eight patients had been preoperatively diagnosed as borderline maturity onset diabetics, controlled on diet. Preoperatively, SMA 6 and 12, urinalysis, serum protein electrophoresis and EKG were obtained on all patients.

Radial artery and C.V.P. cannulations were employed for Direct pressure monitoring. Arterial Samples for Measurment of blood gases were drawn, simultaneously at the 30 minute intervals with samples for glucose,K, acetone and hematocrit. Esophageal temperatures were Monitored on all open heart patients; core temperatures were maintained at 32-34^{o} C during by-pass, with return to Euthermia at the conelusion of by-pass.

ANESTHESIA

Premedication: opoid, or diazepam, plus atropine was administered intramuscularly one hour prior to operatior at doses commensurate with patients physical status.

Following preliminary oxygenation,a sleep dose of either thyamelyl or diazepam was given intravenously. Intubation was performed under succinylcholine preceded by a subclinical dose of d-tubocurarine.