

## Evaluation of using urine strip in diagnosis of children's meningitis in Benghazi-Libya

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### Abstract

**Background:** Bacterial meningitis is still considered as one of the most dangerous infectious diseases, which causes numerous complications and high mortality if not diagnosed and treated timely.

**Objective:** to evaluate the usefulness of urine reagent strip tests in the diagnosis of meningitis Patients and methods: ninety of children aged less than 11 years were included. They clinically suspected to have meningitis from Benghazi children's hospital in the period from February 2017 to April 2018. CSF samples were tested using both Combur-10 urinary reagent strip and CSF microscopy examination as reference standards. Combur-10 was used to estimate ten parameters including protein, glucose, and leukocytes.

**Results:** The diagnostic accuracy of protein estimation by reagent strip show 91.7% sensitivity, 100% specificity for detection of CSF proteins, Glucose reagent strip positivity had 97.5% sensitivity and 72.7% specificity for detection of CSF glucose. Leukocyte esterase positivity by test strip had sensitivity of 100% and specificity of 98.8% for the detection of CSF granulocytes of more than 10 granulocytes/mm. The majority of meningitis were found in children aged less than 2 years (91.1%), and incidence of meningitis was found the same percentage in both males and females (41%) for each

**Conclusions:** our results suggest that reagent strips may be a useful additional resource in the diagnosis of bacterial meningitis, especially when it is difficult to collect a sufficient amount of cerebrospinal fluid or to indicate the initial treatment.

**Keywords:** Children, meningitis, urinary reagent strip, CSF

### Introduction

Meningitis is an inflammation of the meninges, the thin membranous covering of the brain and the spinal cord. In mammals, the meningeal layers are composed of three parts; the Dura mater, the arachnoid mater, and the pia mater. It is most commonly caused by infection (bacteria, viruses, or fungi), although it can also be caused by bleeding into the meninges, cancers, diseases of the immune system, and an inflammatory response to certain types of chemotherapy or other chemical agents (1).

Bacterial meningitis is a serious and life-threatening infection of the central nervous system. With high morbidity and mortality death can occur in as little as a few hours. While aseptic meningitis is a benign self-limited disease (2,3), and Differentiating both diseases is of great importance. The prognosis of bacterial meningitis depends on early diagnosis and treatment, which varies according to causing agent, patient age and time of diagnosis (4). And in low resource countries the major drawback is prompt diagnosis due to poor laboratory quality (2).

Although meningitis is a notifiable disease in many countries, the exact incidence rate is unknown. In (2013) meningitis resulted in 303,000 deaths – down from 464,000 deaths in (1990) In (2010) it was estimated that meningitis resulted in 420,000 deaths(3).

There are many factors associated with increased risk of bacterial meningitis such as (age, Poor Housing and overcrowding, Tobacco, Indoor air pollution, Socio-economic factors)(2).

The symptoms of meningitis in children are fever, headache, and neck stiffness may be absent or difficult to notice. The baby may be irritable, vomit, feed poorly, or appear to be slow or inactive. In young babies, doctors may also look for a bulging fontanel (soft spot on an infant's head) or abnormal reflexes(5).

Microbiology laboratories play a critical role not only in the early identification of the causative bacterium and its antibiotic susceptibility pattern but also in providing valuable information regarding the common incriminating pathogens in that area and also which drugs to start empiric treatment with(6).

The use of reagent strip test as a routine procedure may be considered as a useful complementary method for diagnosis of bacterial meningitis in cases where sufficient CSF is not easily obtained or in cases where quick decision, for antibiotic therapy must be taken immediately. (Ghada et al 2016, Roberta et al,2001). Earlier studies in many parts of the developing world, using urine reagent strips for diagnosis of meningitis had given a high sensitivity and specificity rates reached respectively %97 and 7,4,8) %100 ,%98).



## Materials and method

The current study was done in Benghazi Children's Hospital which is the largest paediatric health, disease treating, and research centre in the north Libya.

In our study all CSF samples of patients suspected to have meningitis admitted to the Children's hospital during the time frame of the current estimate were included in the study (from February 2017 to April 2018), then the diagnosis of meningitis was performed based on clinical manifestation, laboratory abnormalities, CSF analysis and culture results.

During the study period, any patient with a clinical picture suspecting the presence of meningitis was evaluated. Samples of CSF were divided into Three parts; first part for the strip, second for laboratory as a reference standard and last for culture, Samples of CSF were divided into Three parts; first part for the strip, second for laboratory as a reference standard and last for culture

### Reagent strip Multistix 10SG

Reagent strip analysis was carried out immediately. Combur10- (Roche Diagnostics, Basel, Switzerland) was a -10patch strip used to test CSF. This Strip was used to detect CSF cellularity (leukocyte esterase Estimation), glucose (glucose oxidase-peroxidase method), and Protein levels (protein error of indicator).

Each Bottle of the multistix 10 SG from Mission Expert contains 100 strips, the strips are ready to use upon removing from the bottle and maybe the result evaluated Visually or using CLINITEK instrument (It is an instrument which can automatically detect Color change and print results). For research purpose the reading was done visually.

### Protein

The test pad contains %0.3 tetrabromophenol blue, a buffer and a nonreactive ingredient and changes its color when it is brought into contact with proteins specifically albumin.

When the reagents are in Contact with albumin it will change its color from yellow to green or to Blue depending on the. concentration of albumin in the CSF  
Negative: No color change

Trace: Yellow green

(+) (30 mg/dL): Green

(++) (100 mg/dL): Darker green

(+++) (500 mg/dL): Blue green

### Leukocytes

The test is based on the principle that granulocytic contains esterase that catalyze the hydrolysis of the parole amino acid ester to liberate a -3hydroxy5- phenyl parole, which in turn reacts with diazonium, a salt buffer which in turn changes the color from white to purple. It can detect both lysed and intact leucocyte cells

The leukocyte can be read at 120 seconds and is defined as  
Negative: White (Nocolorchange)

(+) (25-10 cells/  $\mu$ l) grey

(++) (75 cells/  $\mu$ l) Light purple

(+++) (500 cells/  $\mu$ l): Dark purple

### Glucose

The principle of the test is based "on double sequential enzyme, reaction utilizing glucose oxidase and peroxidase and the color changes from green to dark green. It is read at 60 seconds and is specific for glucose. There are no substances that can interfere with the reaction of the glucose test pad to give false positive results, but a high concentration of ketone could give a false negative especially if glucose concentration is low. The glucose result was quantified as Negative Blue (+) (50mg/dL): Green

(+) (100mg/dL): Green

(+) (300mg/dL): Light Green

(+) (1000mg/dl): Dark Green

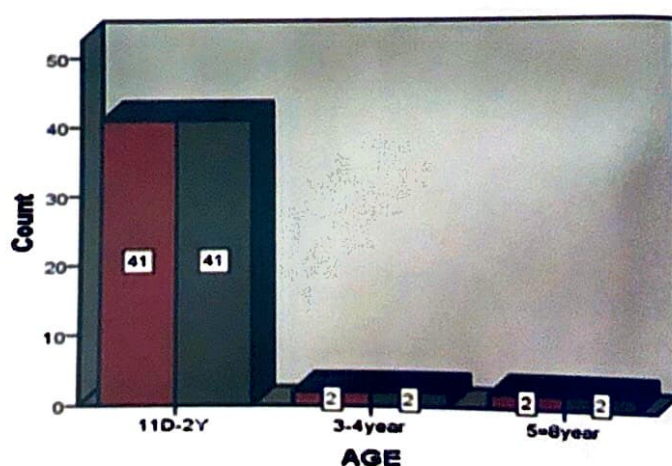
### Results

During two and a half months from (February 2018 to April 2018), CSF Samples of patients suspected to have meningitis were examined at (Benghazi Children's Hospital).

Of 98 patients were screened and 8 of them were lost due to an incident in lumbar puncture or it was not possible to obtain sufficient CSF for analysis,

The validity of screening tests measured and expressed as sensitivity, specificity, accuracy, (in comparison to diagnostic laboratory tests).

Regarding to the age distribution and gender, as can be seen in (Table 1) most of meningitis were found in children aged less than two years (%91.1). and the incidence of meningitis were found the same percentage in both males and females (%41 for each) Fig.1.



A Comparison between protein urine strip with the routine protein results of the biochemistry department were found as, sensitivity %91.7 and specificity = %100 and accuracy = %98.88



**Table 1: Gender age cross tabulation**

Gender			AGE		
			11D - 2Y	Y 4 - 3	Y 8 - 5
Female	Count		41	2	2
	of total %		45.6%	2.2%	2.2%
Male	Count		41	2	2
	of total %		45.6%	2.2%	2.2%
total	Count		82	4	4

**Strip Protein \* Protein Routine Cross tabulation**

Strip Protein			Protein Routines		
			Negative	Positive	Total
Negative	Count		78	1	79
	of total %		86.7%	1.1%	87.8%
Positive	Count		0	12	11
	of total %		0.0%	12.2%	12.2%
total	Count		78	12	90

Sensitivity = %91.7 and Specificity = %100  
Overall test accuracy = %88. 98

While a comparison between glucose urine strip and the routine glucose results in of biochemistry department results show that the sensitivity=%97.5 and specificity = %72.7 and overall accuracy test %94.44

**Glucose Strip \* Glucose Routine Cross tabulation**

Glucose strip			Protein Routines		
			Negative	Positive	Total
Normal	Count		77	3	80
	of total %		97.5%	27.3%	88.9%
Abnormal	Count		2	8	10
	of total %		2.5%	72.7%	11.1%
	Count		79	11	90
of Total	100.0%		100.0%	100.0%	

Sensitivity=%97.5 and specificity = %72.7 and overall accuracy test %94.44

Whereas Comparison of white blood cells done by urine strips with microscopic examination of specimens of microbiology department was found as sensitivity=%81.8 and specifically = %97.5 and accuracy = %95.55

**WBC Strip \* WBC routine Cross tabulation**

WBC Strip			WBC routine		
			Negative	Positive	Total
Negative	Count		79	0	79
	of total %		87.8%	0.0%	87.8%
Positive	Count		1	10	11
	of total %		1.1%	11.1%	12.2%
Total	Count		80	10	90
of Total	88.9%		11.1%	100.0%	

Sensitivity=100% and specifically = 98.8%overall accuracy test98.8% 5



## Discussion

From the study, there is a good correlation between the results of reagent strip test and laboratory methods of CSF protein, sugar, and leukocyte estimation.

We found that the sensitivity and specificity of the protein urine strip test as (91.7%), (100%), respectively and overall test accuracy (98.88%), for Leukocyte esterase positivity by test strip had a sensitivity of (100%), specificity (98.8%), and over test accuracy (98.8%), glucose positivity by test strip had sensitivity (97.5), specificity (72.7%). Our study is the first one of its kind in our country, and observations of it were comparable to those reported by (Ghada in Egypt who demonstrated that Leukocyte esterase positivity by test strip had sensitivity of (100%) and specificity of (75%). Protein reagent strip showed (100%) sensitivity, while the specificity was low (50%). Glucose reagent strip positivity had sensitivity (96.8%) and (100%) specificity. The sensitivity and specificity were high and acceptable (as observed in our study except in protein)(9).

The study of (Kathy et al,2018) in Uganda showed that the strip had a high sensitivity (94.9%) and specificity for proteins (79%) (Although the specificity for leucocyte (81.8%) was acceptable, the strip had only a moderate sensitivity for leucocytes (63.6%). For glucose, the strip was highly specific (100%), while the sensitivity was very low (6%)(10).

The present study found that was a high agreement with study of (Deepti et al ,2013) in India (except in specificity of protein) in which the sensitivity and specificity of protein were (98%), (57%), for glucose (92.6%),87.5%) and for leukocyte (85.2%) (89.6%) , respectively(11).

At the global level (Moosa et al.,1995)in London who demonstrated that a good agreement between reagent strips and laboratory results for the diagnosis of meningitis, with a sensitivity of (97%) and specificity of (100%) so, no normal CSF was diagnosed as meningitis(7).

Besides, another study done by (Kajal,2014) in Germany in their study on 180 csf samples observed the sensitivity of leukocyte was (82.6%), specificity (84.7%), while the sensitivity of protein tested by reagent strip was (78.12%), specificity (70.27%) and the sensitivity of glucose was (50%), specificity was (87.8%)(2). Acute bacterial meningitis is one of the most severe and potentially life-threatening infectious diseases, and no rapid diagnostic tests exist for analysis of CSF until now. Our research demonstrated that rapid diagnosis of meningitis can be made with the Combur-10 reagent strips with a high specificity and sensitivity. This test can help in making rapid decision whether to use or withhold antibiotics in patients with meningitis. It is easy to do and would be of particular value in parts of the world where no laboratory facilities exist and referral at higher centres is not possible.

## Conclusion

1.The accuracy of urine strip in the measurement of CSF (protein, glucose, white blood cells, and red blood cells)

was evaluated in the diagnosis of meningitis in children.

2. The urine reagent strip is a useful test to assess CSF and assists in clinical diagnosis.

3. The urine detector tape can provide more help in decision-making, whether to start antimicrobial treatment in low-resource settings.

4. Combur 10 strips were used for quick CSF analysis and good accuracy testing, and in these cases where routine testing facilities are not available, this can be very useful.

5. The urine detector tape is characterized by ease of performance and rapid appearance of results in a short time.

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