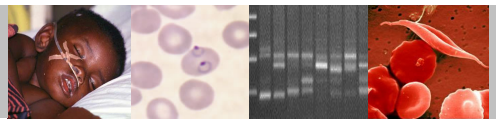
Einsatz des Vario-Photometers im Kampf gegen die Malaria

Nach neuen Wegen in der Behandlung malariakranker Kinder zu suchen, war das Ziel eines WHO-Projektes, das unter Leitung von Dr. Mockenhaupt (Institut für Tropenmedizin, Berlin) in Ghana durchgeführt wurde. Der Autor konnte aufzeigen, dass durch Bestimmung der Blutparameter Hämoglobin, Lactat und Glucose wichtige diagnostische Informationen erhalten werden, die eine verbesserte, in vielen Fällen lebensrettende Therapie ermöglichen.

Zur Messung dieser Parameter wurde das Vario-Photometer von Diaglobal eingesetzt.

„Das Vario-Photometer ist eine kleine portable Einheit, die im Wesentlichen überall platziert werden kann und nach kurzer Vorbereitung und Einweisung arbeitsfähig ist. Extreme klimatische Bedingungen (Hitze, Luftfeuchtigkeit) verursachen keine größeren Probleme.“
So das Urteil von Dr. Mockenhaupt

Nachfolgend der ausführliche Bericht:



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Application Note

Assessing basic parameters in severe malaria patients in Africa by the diaglobal vario photometer

Background: Severe malaria continues to kill at least one million children per year, most of them in sub-Saharan Africa. Diagnosis of severe malaria by criteria of the World Health Organisation is based primarily on clinical symptoms. Nevertheless, several laboratory parameters help to improve patient management and provide prognostic information, i.e. haemoglobin (*Hb*), glucose (*gluc*), and lactate (*lac*). Low *gluc* and high *lac* are prognostically unfavourable conditions but can be corrected. However, in many clinical settings in sub-Saharan Africa, even in referral centres, on-ward assessment of these parameters is not necessarily existent, and sending samples to a central laboratory may cause delays. In a descriptive study on the manifestation and outcome of severe malaria in children in Tamale, northern Ghana, we applied the diaglobal vario photometer to measure *Hb*, *gluc*, and *lac* in 290 children with severe malaria.

Setting: Tamale is the capital of the Northern Region of Ghana with a population of approx. 350,000 but of rather rural character. The Tamale Teaching Hospital comprises 390 beds, 50 of those in the paediatric ward. There, bed occupancy is commonly >100%, facilities for intensive care and on-ward laboratory are absent. Initiating the study in August 2002, we equipped the ward with microscopy and staining facilities, friges and the vario photometer. The on-ward laboratory was staffed with a doctoral student and a lab technician. Training in microscopy preceded the project. Training on handling samples and using the vario photometer needed some hours and was repeated several times. At initiation of the study, the one-ward laboratory provided the following parameters within 20 min. following collection of an individual blood sample: parasite density, parasite species, *Hb*, *gluc*, *lac*, urine dipstick, urine sediment. Measurements were free of charge for patients.

Patients: 290 children aged 0.5 to 9 years were included. Antiparasitic treamtent with artesunate was initiated immediately. Glucose substitution and, partially, intravenous rehydration was applied depending on *gluc* and *lac* values which were available within approx. 20 min. Transfusion was initiated in case of severe anaemia (Hb < 5 g/dL). Overall, low *gluc* (hypoglycaemia), high *lac* (hyperlactataemia), and severe anaemia were present in 17%, 39%, and 55% of the children, respectively (Tab. 1). Overall, 11% of the children died, most of them within 24 hours after admission. Causes of death are displayed in Table 3. Despite oral or intravenous glucose substitution, low *gluc* (hypoglycaemia) was a strong predictor of fatal outcome increasing its probability three-fold.

TABLE 1
Proportions of children with symptoms and conditions of severe malaria according to age groups

	All	Age groups		
		<2 years	≥2 <4 years	≥4 years
No.	290	99	129	62
Proportion with criterion (%, no.)				
Severe anemia	55.2 (160)	77.8 (77)	47.3 (61)*	35.8 (22)*†
Prostration	33.4 (97)	26.3 (26)	34.9 (45)	41.9 (26)*†
Respiratory distress	22.8 (66)	30.3 (30)	17.8 (23)*	21.0 (13)
Multiple convulsions	20.3 (59)	17.2 (17)	20.9 (27)	24.2 (15)
Impaired consciousness	19.3 (56)	14.1 (14)	20.9 (27)	24.2 (15)
Jaundice	11.7 (34)	2.0 (2)	12.4 (16)*	25.8 (16)*†
Circulatory collapse	3.4 (10)	4.0 (4)	2.3 (3)	4.8 (3)
Hemoglobinuria	2.8 (8)	0 (0)	3.1 (4)	6.5 (4)*†
Pulmonary edema	0 (0)	0 (0)	0 (0)	0 (0)
Abnormal bleeding	0 (0)	0 (0)	0 (0)	0 (0)
Proportion with other conditions				
Cerebral malaria	16.9 (49)	11.1 (11)	19.4 (25)	21.0 (13)
Hyperparasitemia	22.1 (64)	15.2 (15)	22.5 (29)	32.3 (20)*†
Hypoglycemia	16.9 (49)	10.1 (10)	19.4 (25)	22.6 (14)*†
Hyperlactatemia	39.3 (114)	42.4 (42)	32.6 (42)	48.4 (30)
Hyperpyrexia (> 40°C)‡	8.1 (23)	8.2 (8)	9.6 (12)	4.9 (3)

* Significant difference to age group <2 years old ($P < 0.05$).
† Significant trend with age groups ($P < 0.05$, by chi-square test for trend).
‡ n = 283.

TABLE 3
Symptoms and case fatality rates among 285 children with severe malaria*

Condition	Case fatality rate (%)	Univariate analysis		Multivariate analysis	
		Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
Defining criterion					
Circulatory collapse	77.8	35.1 (6.1–354)	< 0.0001	31.4 (4.7–207)	0.0003
Impaired consciousness	37.0	10.7 (4.5–25.9)	< 0.0001	8.1 (3.1–21.1)	< 0.0001
Respiratory distress	20.0	2.6 (1.2–6.1)	0.01	–	
Hemoglobinuria	12.5	1.1 (0.0–9.3)	1.0	–	
Multiple convulsions	12.1	1.1 (0.4–2.9)	0.82	–	
Severe anemia	10.1	0.8 (0.4–1.7)	0.51	–	
Jaundice	8.8	0.7 (0.1–2.6)	0.78	–	
Prostration	8.2	0.6 (0.2–1.5)	0.25	–	
Other conditions					
Cerebral malaria	36.2	8.4 (3.6–20.1)	< 0.0001	–†	
Hypoglycemia	35.4	8.1 (3.4–19.3)	< 0.0001	2.9 (1.1–7.7)	0.03
Hyperlactatemia	19.5	3.9 (1.7–9.3)	0.0003	–	
Hyperparasitemia	18.8	2.3 (1.0–5.4)	0.03	–	
Malnutrition	16.0	2.2 (1.0–5.1)	0.03	2.8 (1.1–7.0)	0.03
Hyperpyrexia (>40°C)‡	4.3	0.4 (0.0–2.5)	0.48	–	

* Factors were stepwise removed from the logistic regression models if they were not associated ($P > 0.05$). Multivariate odds ratios are adjusted for age (months) and sex. CI = confidence interval.
† In the logistic regression model replacing impaired consciousness, adjusted odd ratio = 5.4 (95% CI = 2.1–14.3); $P = 0.0006$.
‡ n = 283.

Performance: Although lacking a comparison group, the presence of the on-ward laboratory likely improved patient management and outcome. Parameters otherwise not available or only with considerable delay, i.e. *gluc* and *lac*, directed supportive treatment and were predictive for patients´ outcome. **Pro´s:** The vario photometer is a small, portable unit which can be placed virtually everywhere and is workable with only brief preparations and training. Extreme climate conditions (heat, humidity) did not cause major problems. Test vials stored at +4°C needed some minutes for condensed water to evaporate. Results are available within minutes. **Con´s:** Test vials for *lac* require cooling which in turn needs sufficient fridge space for large sample series, and constant power supply. Regular prices *per* test of approx. 0.5-1 € seem reasonable but in the context of an highly impoverished African population and a cash-and-carry approach (patients are charged for each individual diagnostic or therapeutic procedure) are considerable.

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Am. J. Trop. Med. Hyg., 71(2), 2004, pp. 167–172