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Controlling malaria in southern Africa

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Although the incidence of malaria in South Africa has decreased dramatically over the past 5 years, it remains one of the major public health problems within the southern African region. Efforts to control malaria are generally two pronged: the mosquitoes are the focus of vector control interventions, while the parasites are targeted by means of case management.

Vector control

The only vectors of malaria are female mosquitoes belonging to specific *Anopheles* species. The female mosquito actively seeks out hosts (human and/or animal) that provide her with a bloodmeal – essential for ovarian development. During the taking of a bloodmeal malaria transmission occurs between host and vector. Malaria parasites are injected into an uninfected host when the mosquito pierces the skin to take a bloodmeal, or parasites are transferred from an infected host to the mosquito as part of the bloodmeal. As male mosquitoes feed on plant juices only, female mosquitoes are the target of vector control interventions. The main aim of targeting female mosquitoes is to decrease the mosquito population by eradicating the females before they are able to breed. It is also essential to limit the longevity of female mosquitoes, so that the parasites imbibed during a bloodmeal have insufficient time to complete their sexual development within the mosquitoes. These two actions would then result in a decline in malaria transmission.

The two most popular methods of malaria vector control in southern Africa are indoor residual insecticide spraying (IRS) and/or insecticide-treated bednets (ITNs). IRS is seen as a measure that provides community protection as the few houses in a community that have not been sprayed will benefit from those houses that have been properly sprayed with insecticide. The use of ITNs is seen as a personal protective measure as the net provides protection mainly to the person/s sleeping under it.

Indoor residual spraying

IRS involves the application of residual insecticides to the inner wall surfaces and the roofs of houses in malarious areas. IRS repels mosquitoes that attempt to enter the dwelling, or kills those mosquitoes that rest on walls or other sprayed surfaces after feeding. Because of pyrethroid resistance, the most popular insecticides used in IRS are carbamate based and dichlorodiphenyl-trichloroethane (DDT). These insecticides have an effective residual life of 6 and 9 months, respectively. IRS has been the mainstay of vector control for over 60 years in most southern African countries and has resulted in areas such as Durban, Pretoria and the greater St Lucia becoming malaria free.

Insecticide-treated nets

Although ITNs are a less favoured intervention in southern Africa, some countries have a net coverage of 60%, i.e. 60% of households in malaria-endemic areas have at least one ITN. Bednets (treated or untreated) are suspended above the bed and, when in use, the ends of the nets are tucked under the mattress to prevent mosquitoes from gaining access to the person sleeping under the net. If correctly used, the bednet forms a barrier between the mosquito and the person under the net, thereby preventing the mosquito from obtaining a bloodmeal. However, if the net is treated with a residual insecticide that binds to the net fibres, the net not only prevents mosquitoes from feeding but can also kill mosquitoes landing on it.

In order to increase ITN usage, new long-lasting insecticide formulations are being used on nets. These new formulations enable nets to be washed at least 20 times without losing their insecticide efficacy. Consequently nets will provide protection for up to 5 years before needing to be re-treated with insecticides.

Parasite control: case management

The second crucial element in controlling malaria transmission is effective case management by early diagnosis and prompt treatment with combination therapy containing an artemisinin derivative. Case management is essential for malaria control, not only to prevent malaria-related mortality and morbidity, but also to decrease the pool of circulating gametocytes (the sexual stage of the malaria parasite). The game-

toocytes perpetuate the transmission of malaria.

Delay in diagnosis, and consequently delay in treatment, increases gametocyte carriage and thus malaria transmission. Although diagnosis by means of microscopy is regarded as the gold standard for malaria detection, it can take days if quality microscopy is not available at the health facility where the patient presents. Antigen-based diagnostic tests can provide an accurate diagnosis within 10 minutes and are becoming increasingly popular, particularly in countries using combination therapy.

In southern Africa the recommended treatment for uncomplicated falciparum malaria is the fixed-dose, artemisinin-based combination of lumefantrine and arthemeter. This combination ensures rapid and effective treatment of malaria.

Currently malaria control in Africa is receiving widespread attention, with the successes in southern Africa frequently given as an example. With more resources and tools being made available recently, malaria elimination is again starting to be considered as a feasible goal.

Further reading

Barnes KI. Rolling back malaria in Africa. *S Afr Med J* 2007; 97(1): 36-37.

Sharp BL, Kleinschmidt I, Streat E, *et al*. Seven years of regional malaria control collaboration – Mozambique, South Africa, and Swaziland. *Am J Trop Med Hyg* 2007; 76(1): 42-47.

Severe malaria: A case of too little too late

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Presenting history

NM, a 34-year-old woman, is brought to your hospital's emergency room in a semi-conscious state, with a high fever, sweating and rigors. Her husband provides the following history: NM lives in a rural village in KwaZulu-Natal on the Mozambican border. She visited a private general practitioner 4 days before with a 4-day history of headache, fever, joint pains, nausea and vomiting. She was given 3 sulfadoxine/pyrimethamine (Fansidar) tablets and sent home with paracetamol. She vomited soon after leaving the doctor and continued to deteriorate over the next

3 days until she became confused and very sleepy. Her husband took her to the traditional healer who gave her a special tea that he claimed would help her, but she did not improve.

Past medical history

Asthma controlled on an inhaler.

Medication

Unknown inhaler prn, traditional medicine for 2 days.

Physical examination (significant findings only)

General: Underweight, acutely ill woman in significant distress, with sweating and rigors. Palms mildly jaundiced. Sclerae icteric.

Vital signs: Blood pressure 117/67 mmHg, pulse 100 beats/min, respiratory rate 14 breaths/min, temperature 39.3°C, weight 47 kg, height 159 cm.

Abdomen: Soft and tender in epigastrium and right and left upper quadrants. Liver not palpable; normal bowel sounds present.

CNS: Semi-conscious, Glasgow Coma Scale 12/15 (eyes = 4, verbal = 3, motor = 5). No meningism or focal neurological signs.

Laboratory tests on admission

HRP2 antigen rapid diagnostic test for falciparum malaria: positive.

Malaria smear: *Plasmodium falciparum* parasite density 5%.

Full blood count: haemoglobin 6.9 g/dl, haematocrit 21.5%, platelets 253, white blood count 2.9×10^6 cells/mm³ (no differential).

Discussion

Consider the following questions:

1. Is this a case of uncomplicated or severe malaria?

The following clinical manifestations and laboratory investigations are indicators of severe malaria in this case:

- impaired consciousness
- jaundice
- hyperparasitaemia (>5%)
- haemoglobin <7 g/dl.

The presence of repeated vomiting, even without other symptoms, would be an indication that hospital admission for parenteral therapy is necessary.

2. What are the goals of therapy in this case?

For severe malaria the main goal is to prevent death, neurological deficit and other long-term disabilities. Secondary objectives include the prevention of

recrudescence, emergence or transmission of resistant organisms, and minimising complications related to therapy.

3. How could NM's progression to severe malaria have been avoided?

Delayed treatment seeking and consultation of complementary and traditional medical practitioners before seeking care at formal health facilities contribute significantly to malaria morbidity and mortality. This patient delayed seeking care, presenting only 4 days after the initial symptoms occurred. After receiving inadequate care from a general practitioner, proper management of the patient was delayed for a further 4 days while a traditional healer was consulted.

International and local guidelines recommend the use of an artemisinin-based combination therapy as first-line treatment for uncomplicated malaria. Artemether-lumefantrine (Coartem, Novartis) is the recommended treatment for uncomplicated malaria in South Africa. Studies in KwaZulu-Natal showed that drug resistance has rendered sulfadoxine/pyrimethamine monotherapy ineffective, with only 11% of patients cured by this treatment. Therefore, the GP prescribed ineffective oral treatment in a patient with a reported history of vomiting, both probably contributing to disease progression.

4. Was the assessment on admission adequate?

Malaria affects all organ systems. A thorough assessment on admission is essential, particularly when severe malaria is suspected. Additional tests on admission should include a renal function test, liver function tests (because of signs of jaundice in this patient), a random blood glucose to check for hypoglycaemia, particularly in the presence of impaired consciousness, and a urine dipstick test for the presence of haemoglobinuria. Information with regard to the last menstrual period and a pregnancy test would have been important in this patient of child-bearing age. HIV/AIDS testing may need to be considered in an underweight, sexually active woman with a low white blood count who lives in an area with a high prevalence of the disease.

5. What is the treatment of choice in the management of severe malaria and which drugs should be avoided?

Intravenous quinine is the treatment of choice for severe malaria. A slow quinine infusion should be started immediately with a loading dose (20 mg/kg IV in 500 ml glucose 5 - 10% infused over 4 hours), followed by a maintenance dose (10 mg/kg in 5% glucose infused over 4 hours every 8 hours). Hypotension, arrhythmias and cardiac arrest have been

reported with rapid infusion. Quinine treatment should continue for 7 days and can be switched to oral therapy when the patient has recovered adequately enough to be able to tolerate oral treatment. As outpatient compliance with oral quinine is generally poor, clinicians may elect rather to complete treatment with a full course of artemether-lumefantrine.

Although a recent study showed that intravenous artesunate is significantly safer and more effective in the treatment of severe malaria than intravenous quinine, this product is not yet licenced in South Africa.

Nephrotoxic drugs such as NSAIDs should be avoided in malaria patients, especially in those with renal failure. Patients with severe malaria should not be treated with corticosteroids or heparin, as these increase the risk of adverse outcomes.

6. What clinical and laboratory parameters should be monitored to ensure that the desired therapeutic goals are met?

A monitoring chart developed by experienced local clinicians provides a simple template for the ongoing monitoring of patients with severe malaria (Fig. 1). As severe malaria is associated with a high mortality rate, it should ideally be managed by an experienced clinician who sees the patient at least on a daily basis, including weekends, in a high-care or intensive care facility. Blood test results should be marked as urgent and followed up on the same day.

7. What additional community-based measures are needed?

The patient's family and neighbours should be tested for malaria promptly, especially the patient's children and husband. The community should be encouraged to seek early treatment for malaria symptoms at formal health care facilities. Indoor residual spraying and the use of insecticide-treated bednets reduce malaria risk in transmission areas.

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Further reading

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World Health Organization. *Guidelines for the Treatment of Malaria*. Geneva: World Health Organization, 2006.

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NAME:

FILE NO:

DATE																		
FBC																		
UK&E																		
Malaria smear %																		
Other test results	Urine Dipstix -						Urine Dipstix -						Urine Dipstix-					
TIME	02h00	06h00	10h00	14h00	18h00	22h00	02h00	06h00	10h00	14h00	18h00	22h00	02h00	06h00	10h00	14h00	18h00	22h00
TEMPERATURE	40																	
	39																	
	38																	
	37																	
	36																	
BP																		
Pulse																		
Resp rate																		
Glucose																		
Neuro obs	Alert Stable	Confused Improve	Coma Deteriorate				Alert Stable	Confused Improve	Coma Deteriorate				Alert Stable	Confused Improve	Coma Deteriorate			
Intake/24h																		
Output/24h																		
Fluid balance																		

Fig. 1. Malaria patient monitoring chart (Developed by Drs JJ Hugo and G Swart, Department of Health and Social Services, Mpumalanga Province, in consultation with clinicians from Mpumalanga, Limpopo and KwaZulu-Natal provinces.)