

MODULE

# *Onchocerciasis*

Diploma Program  
For the Ethiopian Health Center Team



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# TABLE OF CONTENTS

TOPIC	PAGE
Table of Contents .....	i
Acknowledgment .....	ii
Preface .....	iii
<b>UNIT ONE Introduction</b> .....	1
1.1 Purposes of the module .....	1
1.2 Directions for using the module.....	1
<b>UNIT TWO Core Module</b> .....	3
2.1 Pre-test.....	3
2.2 Significance and brief description of onchocerciasis .....	4
2.3 Learning objectives .....	4
2.4 Definition .....	5
2.5 Aetiology .....	5
2.6 Epidemiology.....	5
2.7 Clinical features.....	8
2.8 Differential diagnosis.....	10
2.9 Diagnosis .....	11
2.10 Case management.....	11
2.11 Prevention .....	12
2.12 Prognosis .....	13
2.13 Case study .....	13
<b>UNIT THREE: Satellite Module for Diploma Nurses</b> .....	16
<b>UNIT FOUR: Satellite Module for Laboratory technicians</b> .....	28
<b>UNIT FIVE: Satellite Module for Environmental health technicians</b> .....	38
<b>UNIT SIX: Satellite Module for extension package health workers</b> .....	53
<b>UNIT SEVEN: Glossaries</b> .....	61
<b>UNIT EIGHT: Abbreviations</b> .....	62
<b>UNIT NINE: Bibliography</b> .....	63
<b>UNIT TEN: Annexes</b> .....	65
10.1. Answer key .....	65
10.2. Authors.....	66

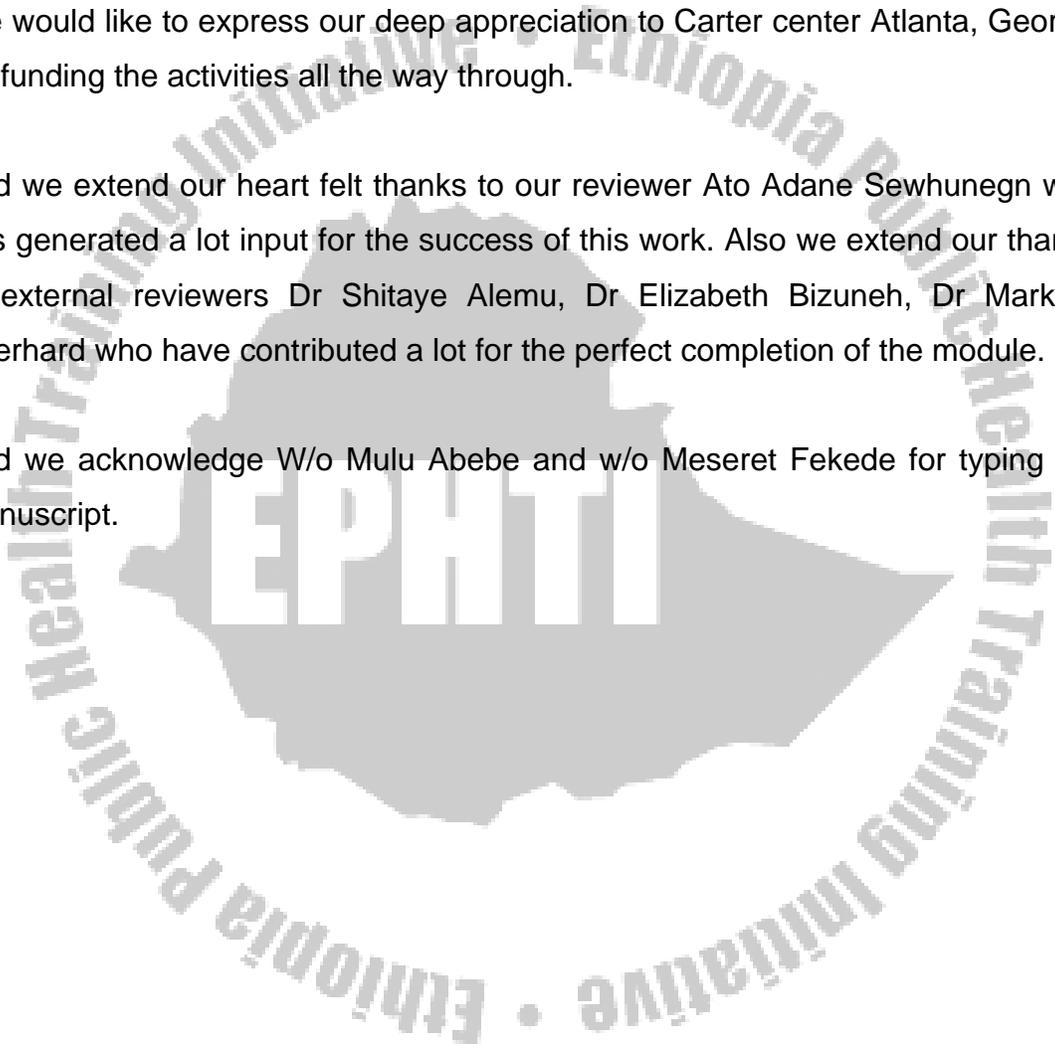
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## Preface

Onchocerciasis, also called “river blindness” is a tissue parasite transmitted by the vector black fly simulum. The microfilariae is responsible for the lesion in the skin and eye. It is not only the disease that causes personal suffering but also of very high socio economic significance in most endemic areas of Ethiopia. It is one of the diseases comprised in prevention and control program.

The health team who are working at lower health care delivery system, lack references and the surveillance of onchocerciasis is still weak in most health services. Considering the responsibility and involvement of the Health Centre Team in onchocerciasis control program the Carter Centre initiated and assisted the preparation of this module.

The module is designed for the Ethiopian Health Centre Teams who are expected to work at district level. The information contained in this module will benefit the health professionals working at middle health care level. By studying this module, the Health Center Team will have current knowledge and reliable information on morbidity, mortality and trends of the disease in order to guide onchocerciasis control program.

The purpose of this self-learning module is to provide the mid level health professionals with the necessary knowledge and skills to competently care for the patient and community at large.

This module is intended to cover the main aspects of onchocerciasis. It is hoped that this module has been prepared in a suitable form for use more selectively by the Health Centre Team. It is of course not intended to provide complete instruction, but intended for use as a guide. It needs to be supplemented by standard books and periodicals. The authors therefore encourage further reading to enrich your knowledge and maintain skills.

# UNIT ONE

## INTRODUCTION

### 1.1. Purposes and uses of the module

This module is prepared for Diploma Nurses, Environmental Health technicians, Laboratory technicians and Extension package health workers who need to work as cooperative team members. Other categories of staff such as clinical nurses and health centre team in the service areas could use the module too.

The module will serve as a practical guide to the management of Onchocerciasis. It enhances the theoretical knowledge acquired in the different disciplines with practical approach. However, it is not meant to substitute for other reference materials and text books.

The module will also help individuals to work together as a team. The core module emphasizes the areas that need to be known by all categories of health team members. The satellite modules however concentrate on specific tasks and skills that need to be acquired by each category of the health centre team. The contents of the satellite modules include portions that are not addressed by the core module, but are essential for each professional category.

After going through the module, the reader will be able to appreciate the contributions that could be made by each health centre team member and caregiver/self-care taker. Above all, it enables them to identify the tasks and activities required in preventing and controlling onchocerciasis.

### 1.2. Directions for using the module

To be well equipped with the necessary knowledge and provide competent care for a patient with onchocerciasis by using this module, follow these directions:

- Study and answer all the questions in the pre-test that correspond to all categories in the Core Module, and to the specific questions that correspond to your category in the respective Satellite Modules.
- After the pre-test go through the core module

- Each category of the health centre team should read their respective satellite module
- Answer all the questions in the pre-tests and compare your results using the keys after finishing the core and satellite modules
- Study and discuss the specific learning objectives, activities and roles of each category of the health centre team.



## UNIT TWO

### CORE MODULE

#### 2.1 Pre-test for all Categories of the Health Centre Team

Attempt all of the following questions.

1. What is the etiologic agent of onchocerciasis?
2. \_\_\_\_\_ is the important vector in the transmission of onchocerciasis
3. How much of the Ethiopian population do you think is at risk of getting onchocerciasis?
4. How is onchocerciasis transmitted?
5. List the complications of onchocerciasis.
6. Discuss the differential diagnoses of onchocerciasis.
7. Which of the following is (are) not clinical manifestations of onchocerciasis?
  - A. Subcutaneous nodules
  - B. Lichenification
  - C. blindness
  - D. Itching
  - E. Splenomegally
8. What diagnostic method can be used to diagnose onchocerciasis?
  - A. Skin snip
  - B. DEC Patch test
  - C. Blood film
  - D. Stool exam
  - E. A and B
9. Which one of the following is the drug of choice for the treatment of onchocerciasis?
  - A. Diethyl carbamazine
  - B. Ivermectin
  - C. Suramin
  - D. Doxycyclin
  - E. Albendazole
10. Which one of the following is the most feasible black fly control method?
  - A. Larvicide application at the breeding site
  - B. Adulticiding
  - C. Bush clearance
  - D. Clearing swampy areas
  - E. none

## **2.2. Significance and brief description of onchocerciasis**

Onchocerciasis is commonly called River blindness after its geographic locus and most visible symptom. Overall, it causes blindness, disfigurement, and unbearable itching in victims, while rendering large tracts of farmland uninhabitable. It is the second leading cause of preventable blindness worldwide and poses serious public health problem creating an obstacle to socio-economic development in Africa, where it is endemic in 30 countries. In the last fifty years onchocerciasis has been spreading to previously non-endemic regions of Ethiopia. Although comprehensive epidemiological surveys are lacking, it is estimated that 7.3 million people or 17.4% of the population of Ethiopia is at risk from this disease. In view of agricultural development projects and resettlement of millions of people from the highlands into endemic areas in southern and north-western parts of Ethiopia, further spread of onchocerciasis is expected.

Experience gained in the control of the disease in West Africa by WHO and the introduction of effective mass chemotherapeutic agents as well as primary health care programme and activities currently underway in Ethiopia indicate the feasibility of starting control programme. A plan is therefore made to consider controlling the devastating health impacts of onchocerciasis in Ethiopia urgently. Preparation of this module will have a great contribution to this end.

## **2.3. Learning objectives**

Upon completion of the activities in this module, the learner will be able to:

1. Describe the cause and mode of transmission of onchocerciasis.
2. Describe the clinical manifestations of onchocerciasis.
3. List the appropriate diagnostic methods for onchocerciasis at the health centre level.
4. Be able to administer the recommended treatment for onchocerciasis at the health centre level.
5. Mention the different preventive and control methods for onchocerciasis.

## 2.4 Definition

**Onchocerciasis** (river blindness) is a chronic parasitic disease affecting skin and eyes. The adult worms live inside fibrous nodules in subcutaneous tissues. The fertilized female worms release thousands of microfilariae that migrate through the lymphatic vessels and cause inflammatory reactions responsible for the skin and eye lesions while they die and degenerate.

## 2.5 Aetiology

The causative agent for onchocerciasis is a parasitic filarial worm *Onchocerca volvulus*, of the family filariidae, which lives in the human body for up to 14 years. Each adult female worm is capable of producing millions of microscopic prelarvae (microfilariae) throughout its life span.

## 2.6 Epidemiology of onchocerciasis

### 2.6.1. Magnitude

#### Global:

- Onchocerciasis occurs in 35 countries worldwide, predominantly in West and sub-Saharan Africa. Foci of infection occur in Mexico, Central and, South America, and the Arabian Peninsula.
- More than 123 million people live in endemic areas, and an estimated 18 million people are currently infected.
- Of those infected, about 270,000 are blind and an additional 500,000 have severe visual impairment
- Out of the estimated 18 million infected people worldwide more than 80% live in Africa.
- The incidence of onchocerciasis has been significantly reduced worldwide after the launching of OCP.

## Ethiopia:

In Ethiopia 7.3 million people are at risk of infection and 1.38 million people are estimated to be affected by the disease. The endemic areas extend from the northwest part to southwest part of the country that borders the Sudan. The main endemic focal areas in Ethiopia are Kefa-Sheka and Bench Maji zone in south west and Pawi –Metema in North West.



Fig.2.1. Geographic distribution of onchocerciasis in Ethiopia.

### 2.6.2. Susceptibility

- Race

All persons in endemic areas, regardless of race, are at risk of infection. Socioeconomic differences (occupation as related to exposure to black fly bites, i.e., farmers, fishermen) have been clearly identified as a contributing factors.

- Sex

Although no reported differences of exposure exist between men and women, men may be afflicted more often because of farm and field occupation.

- Age

Increased age results in cumulative exposure in endemic areas

### 2.6.3. Transmission/Life cycle

Onchocerciasis is transmitted by the bite of infected black flies of the genus *Simulium*. Black flies breed in fast flowing streams and rivers because of the demand for highly oxygenated water during the maturation of the larvae. Females require a blood meal for ovulation, and they transmit infective-stage (3<sup>rd</sup> stage) larvae as well as ingest microfilariae during the blood meal. The black fly tends to stay within 2 km of its breeding site.

Humans are the only definitive host of *O. volvulus* within the human host, harboring adult filarial worms. The gravid adult female worm releases microfilariae which then migrate out of the nodule and throughout the tissues of the host, concentrating in the dermis. Microfilariae are ingested from the host skin by the bite of a female black fly (*Simulium* species) during its blood meal. The microfilariae migrate from the gut into thoracic muscles of the black fly; then develop into infective larvae within 6-10 days. The infective larvae migrate to the mouthparts of black fly, and will infect a second human host in the process of taking a blood meal. Infective larvae develop into adult worms in humans over a period of 1 to 2 years. The adult worms pair and mate in the human host, and, unlike most nematodes that produce eggs, the female *Onchocerca* gives birth daily to thousands of microscopic larvae known as microfilariae. Those microfilariae migrate to tissues and induce inflammatory reaction when they die. The life span of microfilariae is 6-30 months. The adult worms may survive from 5 to 13 years during which time they release millions of microfilariae. The adult female worm reaches 40 to 45 cm in length while the microfilaria reach 0.3 mm in length.

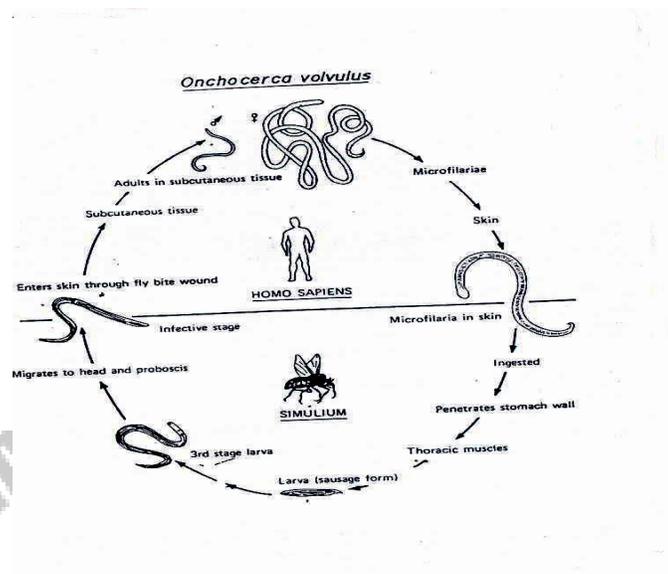


Fig 2.2. Life cycle of *Onchocerca volvulus*

## 2.7. Clinical features

### HISTORY

- People are living or coming from onchocerciasis endemic areas
- The earliest and most troublesome symptom of onchocerciasis is itching which may be severe.
- Itching is most severe over the sites of highest microfilarial concentration, generally over the lower trunk, pelvis, buttocks, and thighs.
- Other symptoms are subcutaneous nodules, lymphadenopathy, visual changes (can range from reduced vision to frank blindness) and weight loss

Physical findings include skin, soft tissue, and eye abnormalities.

#### ◆ Skin and soft tissue involvement

Early signs

- Erythema and edema of the skin with scratch marks

- Papular, pastular, nodular or urticarial lesions on the back, thighs, buttocks, extensor surfaces of upper and lower limbs.
- Subcutaneous nodules on the face, back, shoulder, hip, or trunk onchocercomata (containing adult worms).

#### Late signs

- Lichenification (hyperpigmentation, thickening of the skin with increased skin markings)
- Lizard skin (dryness, roughness and scaling of the skin)
- Leopard skin (atrophy with depigmented and hyperpigmented lesions usually pretibial area)
- Lymphedema (persistent swelling of legs)
- Hanging groin (atrophy of the skin and redundant folds with enlarged inguinal lymphnodes)
- Atrophy of the skin (thinning of the skin with loss of skin markings hanging skin folds seen around the buttocks)
- Redness and swelling of the skin resembling erysipelas rarely occur as Erysipelas de la Costa.

#### ➤ Eye involvement

#### Early sign

- Reduced vision
- Keratitis (redness and dryness of eyes)
- Iridocyclitis (redness around the cornea, photophobia and pain)
- Sclerosing Keratitis (pain and haziness of cornea)

#### Late sign

- -Sight impairment and blindness

## 2.8. Differential diagnoses

Onchocerciasis must be differentiated clinically from the following diseases that produce similar manifestations.

**Table 1.** The clinical differential diagnoses of onchocercal skin disease

<b>Main differential Diagnosis</b>	<b>Distinguishing features and Remarks</b>
Miliaria	Miliaria-heat rash , uniform fine papules mostly on trunk Acute popular onchodermatitis(APOD) vesicles are larger and more wide scattered over the trunk whereas in miliaria are usually limited to flexural sites.
Bites of Simulium and other insects (papular urticaria)	These papules are small; closely clustered and many have a tangential punctum.
Scabies –parasitic disease caused by <i>Sarcoptes scabie</i>	Involvement of extremities and presence of burrows indicate SCABIES. Examine other family members.
Eczema –recurrent itching, erythema, edema, oozing and crusting lesions	Eczema –recurrent itching, erythema, edema, oozing and crusting lesions Eczema per se is rarely limited to the buttocks, the commonest site for Chronic popular onchodermatitis(CPOD) The flat-topped papules of CPOD are characteristic.
Lichenified eczema – recurrent oozing lesion Lichenification secondary to chronic scabies- interdigital lesions	Lichenified eczema –recurrent oozing lesion Lichenification secondary to chronic scabies are interdigital lesions Eczema and scabies usually have a symmetrical distribution unlike LOD which may be strikingly limited to one limb. The lichenification of Lichenified Onchodermatitis (LOD) is usually more confluent.

Senile atrophy	Senile atrophy- thinning of skin with loss of skin marking Atrophy associated with old age is usually generalized where as onchocercal atrophy may be limited to one site e.g. buttocks, resemble onchocercal atrophy for patients less than 50 years old.
Other post-inflammatory/post-traumatic hypopigmentation	The shins are a common site for trauma; resemble onchocercal depigmentation for confluent patches of depigmentation surrounding “spots” of normally pigmented skin.

## 2.9. Diagnosis

A presumptive diagnosis can be made based on a history of exposure in an endemic area, the presence of subcutaneous nodules, or typical skin and ocular signs.

B. Skin snip: Identification of microfilariae in skin snips or of the adult worms from excised or aspirated nodules confirms the diagnosis.

C. DEC patch test

A mixture of 10% DEC and Nivea cream is applied under an occlusive dressing; the occurrence of a localized inflammatory response indicates a positive test result.

## 2.10 Case Management

**Goal:**

- ✓ Prevent complication
- ✓ Alleviate symptoms

## Pharmacologic treatment

**Ivermectin** is the drug of choice. Ivermectin is well-tolerated and highly effective microfilaricidal drug that rapidly reduces microfilarial numbers in the skin. Treatment with ivermectin decreases transmission, improves dermatitis, and decreases prevalence of blindness. Because it does not kill or sterilize adult worms treatment to suppress dermal microfilarial levels must be repeated at annual or semiannual intervals for the duration of the lives of adult worms, which may be as long as 13 to 14 years.

## Additional treatment

- Control itching with antihistamines
- Keratolytic preparations to resolve lichenification
- Emollients to prevent dryness of skin
- Antibiotics for secondary bacterial infection

**Surgical Care:** Removal of all subcutaneous nodules can be curative; however, many nodules are difficult to find. And in conditions where lymphedema and elephantiasis develop, the redundant fibrous tissue can be removed surgically.

## 2.11. Prevention and control

The primary objective of onchocerciasis control strategies is to reduce community microfilarial burdens to levels that are associated with negligible morbidity. The major control strategies for onchocerciasis is through:

- ✓ Vector control using larvicides to reduce the black fly population. This method of control is expensive and difficult to administer over remote areas.
- ✓ Mass treatment with ivermectin is employed in areas of high endemicity and has successfully reduced the morbidity associated with onchocerciasis in treated populations by reducing the microfilarial burden.
- ✓ Education of people in endemic areas is a crucial aspect of lowering the transmission rate

## 2.12. Prognosis:

- Patients undergoing ivermectin treatment every 6-12 months for the lifetime of the adult worm (approximately 15) have resolution of early, reversible lesions and most eye findings and most dermatitis
- Patients with scarring of the cornea, chorioretinitis, blindness, skin atrophy, and depigmentation do not improve with treatment.
- Patients who are blind have an increased mortality rate and a shortened life expectancy.

## 2.13. Case study

### ***“This itching is going to kill me!”***

Aba Temam Aba Gidi, a 20 year-old farmer from Yebu, scratched and scratched, but he just couldn't get relief from the itching sensation he felt in his lower leg. He never had this problem before, and as far as he could remember, he had done nothing to his leg, no injuries, no paste put on it or the like. At first, the itching had not been very strong, but recently it had gotten much worse, so now he even used rough objects to scratch himself.

The other problem was that it now involved a much wider area: it had extended from the left lower leg to the thigh and gluteal area and finally to the right side. When he looked at it, he saw that the skin at these parts had become somewhat thicker and darker.

Aba Temam started to get worried that it might be something serious, so he went to the traditional healer. The healer gave him some local drugs which Aba Temam dutifully applied, but nevertheless, the problem got worse.

### ***Group Exercise 1***

- 1.1. List the problems this patient is having.
- 1.2. Discuss the possible differential diagnoses.

After he had this problem for almost two years, Aba Temam, complained about his skin problem to his friend. His friend said “You know, the local drugs don’t help at all! well, may be you should go and see a medical doctor. Jimma is close by; why don’t you go there?”

Aba Temam thought about this for some time; after a week he decided that his friend was probably right and came to the Department of Dermatology at Jimma University Specialized Hospital.

The attending dermatologist recorded in the chart:

*Localised, pigmented plaque lesions with pigmented, oedematous and thickened skin on the left leg, thigh and gluteal area combined with few papules and a solitary lesion around the knee; mild pigmentation and thickening of skin on the right leg.*

Having a pretty firm suspicion about the underlying disease (but not being quite sure about the possible differentials), the physician sent her patient for appropriate tests.

### **Group Exercise 2**

- 2.1. What other examinations would you do?
- 2.2. What are the appropriate tests?

Aba Temam was told to go to the laboratory, where a skin snip was done.

On the paper the lab technician had given him, the Dermatologist could read:

*Multiple microfilariae from left leg lesion.*

Therefore, the diagnosis of onchocerciasis was confirmed.

The physician prescribed him tablets, some lotions and gave him advice.

Aba Temam thanked the physician and he was glad that finally something could be done against the itching...

### **Group Exercise 3**

**Based on the case history given above, try to answer the following questions.**

1. What do you think is the mode of transmission of the disease?
2. In which parts of the country is the disease common?
3. How do you treat this patient?
4. Discuss the prevention measures.

## UNIT THREE

### SATELLITE MODULE FOR NURSES

#### 3.1 Introduction

##### 3.1.1 Purpose:

Onchocerciasis is one of the diseases comprised in prevention and control program. Nurses who are working at lower health care delivery system lack references. Fortunately the surveillance of onchocerciasis is still weak in most lower health services. The purpose of this self-learning module is to provide the nurse with the necessary knowledge and skills to competently care for the patient and community at large.

By using this manual as a reference the nurse can perform nursing assessment, diagnosis and intervention. The nurse will also learn how they can make positive changes in the community through health education.

By studying this module the nurse should have knowledge and reliable information on morbidity, mortality and trends in order to guide onchocerciasis control program.

##### 3.1.2 Directions for using this module: -

- Before reading this part, be sure you have completed the pre-test and the core module.
- Continue reading this satellite module

#### 3.2. Pre-Test

1) Onchocerciasis is transmitted by:

- A. Mosquito
- B. Black flies
- C. Snails
- D. Ticks

2) The vector simulum prefer to breed in

- A. Fast running water
- B. Plasma
- C. Stagnant water
- D. Blood

- 3) One of the following is **NOT** the clinical picture of onchocerciasis
- A. Skin lesions                      B. Eye lesion  
C. Elephantiasis                      D. Hydrocel
- 4) The less toxic drug of choice to prevent blindness in onchocerciasis is
- A. Diethylcarbamazine                      B. Hetrazan  
C. Promethazine                      D. Ivermectin
- 5) Onchocerciasis diagnosis is confirmed by:
- A. Blood film                      B. Urine examination  
C. Skin snips                      D. Marked increase of eosinophilia
- 6) The common features of Onchoserciasis and its consequences include the following except:
- A) Blindness                      C) Dermatitis  
B) Nodule                      D) cough
- 7) Which one the following onchoserciasis drug has Nephrotoxic effect which should not be recomended?
- A) Ivermectin  
B) Suramin  
C) Diethylcarbamazine  
D) Mectizan
- 8) If the nurse identifies a patient with nodule in the head s/he should:
- A) Treat with suramin  
B) Incise the nodule at H.C OPD  
C) Refer for further investigation  
D) Counsel and send home
- 9) Some of the common therapeutic problems in onchoserciasis control program are:
- A) \_\_\_\_\_  
B) \_\_\_\_\_  
C) \_\_\_\_\_
- 10) The contraindications to ivermectin include:
- A) \_\_\_\_\_  
B) \_\_\_\_\_

- C) \_\_\_\_\_  
D) \_\_\_\_\_

### 3.3 Learning Objectives:

After studying this module the nurse will be able to:

- ❖ Identify common features of onchocerciasis.
- ❖ Write the diagnostic tests of onchocerciasis.
- ❖ Prepare the patient emotionally for skin snip testing procedure
- ❖ Carryout nursing management.
- ❖ Explain the dose, mode of action, side effect, and contraindication of the drugs.
- ❖ Implement methods of prevention and controlling measures of Onchocerciasis as indicated at National and local level (health education, and ivermectin distribution).

### 3.4. Some common features of onchocerciasis which the nurse must observe:

In addition to the core module, the following sign and symptoms have to be considered:

The disease in Ethiopia is mainly characterized as causing a wide spectrum of skin lesions ranging from intense itching to gross changes in elasticity resulting in hanging groins, lizard like skin appearance and color changes.

## Sings and Symptoms

### 1. Skin Conditions :

#### 1.1 Early Signs

- Persistent pruritis, erythema and edema of the skin
- Popular, pustular, nodular or urticarial lesions o the back, thighs, buttocks, extensor surfaces of upper and lower limbs.
- Subcutaneous nodules on the face, back, shoulder, hip or trunk onchocercomata ( containing adult worms)

## 1.2 Lates signs

- Lichenification ( hyperpigmentation, thickening of the skin with increased skin markings).
- Lizard skin (dryness, roughness and scaling of the skin)
- Leopard skin (atrophy with depigmented and hyperpigmented lesions usually pretibila area.
- Lymph edema ( persistent swelling of leggs)
- Hangin groin (atrophy of the skin and redundant folds with enlarged inguinal lymphnodes).
- Atrophy of the skin ( thinning of the skin with loss of skin markings hanging skin folds seen around the buttocks
- Redness and swelling of the skin resembling erysipelas rarely occur known as erysipelas delacosta.

## 2. Eye Involvement :

### 2.1 Early Signs

- Reduced vision.
- Keratitis ( redness dryness of eyes.
- Iridocyclis ( redness around the cornes, photophobia and pain).
- Secerosing keratitis ( pain and haziness of cornea)

2.2 Late sign - the most severe effect of the disease includes visual impairment and blindness

Unlike reports from West Africa the rate of blindness from onchocerciasis is not that much significant in Ethiopia. If not treated timely blindness occurs as consequences of the disease.



Fig.4.1. Onchocerciasis and its consequences.

### 3.4.1 Complication

- Nodule, lichenification, atrophy and dryness of the skin
- Onchodermatitis and secondary skin infection, cellulites and abscess formation
- Blindness

### 3.4.2 Diagnosis of onchocerciasis parasitic disease is based on:

- History of travel to endemic areas
- Duration of stay in endemic area. Although short duration exposure is enough to cause an infection there are literatures that indicate an average of 9-10 years stay in an endemic areas settled or working around the river banks would be enough to be infected with the disease.
- Characteristics of clinical sign and symptoms (sever itching and skin lesion)
- The use of appropriate laboratory test (skin snip) to confirm the clinical diagnosis.

### 3.4.3 Nursing procedures for a patient under going skin snip:

Nurses should explain about skin snip test and send the patient for laboratory procedure.

## 3.5. Nursing Management and prevention

### 3.5.1 Nursing Assessment, Diagnosis and intervention

- Examine by removing all clothing.
- Check the presence of nodule, atrophied & pigmented skin and pruritus to properly record the situation.
- Proper visual test & record by using E-chart and define blindness corresponding to the inability to count finger at a distance of 3 meters.
- Proper instruction on prevention of accident due to poor vision.

### 3.5.2 Measures of prevention and control

- ▶ Onchocerciasis is preventable disease.
- ▶ Preventing infection through primary prevention ( health education) activities is the most cost-effective public health strategy.
- ▶ Close collaboration with other sectors and the community, families, school children (who mostly play at the river side)
- ▶ Measures for prevention and control of onchocerciasis disease include:
  - i) Early diagnosis and treatment
  - ii) Improved personal or environmental hygiene.
  - iii) Effective vector control
  - iv) Community health education
- ▶ Onchocerciasis management can be addressed by:
  - Strengthening infrastructure
  - Training health workers in the community
  - Mass ivermectin treatment
- ▶ Annual treatment of endemic communities suffices to reduce the:
  - Parasite load
  - Prevent new cases of blindness
  - Improve anterior segment eye lesion
  - To effect in prevention of transmission.
  - Alleviate onchodermatitis

### 3.5.3 Drug Treatment:

Nurses should understand whom to treat:

- Infected people who have left the endemic areas
- Those whose eye sight is becoming impaired.
- Those incapacitated by itching
- Those incapable of avoiding reinfection

**NB:** 1 Diethylcarbamazine (DEC) can have severe side effect and it is not recommended.

2. Suramin is a highly toxic drug that can be lethal. It is also not recommended

#### 3.5.3.2 Ivermectin:

- ❖ Ivermectin has been successfully used in treating onchocerciasis.
- ❖ The most recent development in prevention of blindness from onchocerciasis is ivermectin; a non-toxic microfilaricide suitable also for large-scale or community based treatment.
  - Nurses should understand the contraindication and the side effects during giving ivermectin.
  - Present contraindications to ivermectin include:
    - Pregnant women
    - Mothers in the first month of lactation
    - Children under the age of five years or 15 kg body weight.
    - Those severely ill
- ❖ Since 1987, ivermectin is supplied free of charge in which the annual treatment is recommended at a dose of 150 micro gram per kilogram of body weight.
- ❖ The mectizan treatment chart must be used.



Fig.4.2. Mectizan treatment chart.

3 Mg tablet	Height
1	90-119cm
2	120-140cm
3	141-158cm
4	159 cm and above

❖ Some of the common therapeutic problems in OCP are the:

- High cost of drugs
- Drug resistance
- Toxicity

### 3.5.4 Nursing intervention

➤ Problems that should be relieved by proper nursing care are:

- Sever itching (mostly in the night) and other aspects of skin manifestation have serious psychological and socio economic

consequences that can never be undermined. E.g. studies reveal that the skin manifestation of onchocerciasis to be more important than blindness, because of their effect on relationship and marriage prospects.

- Loss of sleep that often leads to fatigue during the day which in turn results in low productivity and economic activities is a common occurrence in onchocerciasis affected communities.
- Moreover on top of the impoverishment & depressed life style, the social stigma and ostracization that each victim of onchocerciasis suffers is so enormous.
- There are so many villages with fertile farm lands that were completely abandoned due to onchocerciasis.

➤ Patient Care :

- ▶ Proper Psychological support and reassurance about skin colour and intensive itching.
- ▶ Health education of the community on the mode of transmission, prevention and availability of ivermectin.
- ▶ Appropriate way of providing drugs & nurses should give attention to immediate allergic reaction following treatment such as fever, headache , Dizziness, muscular and joint pain, diarrhea , vomiting etc.

➤ If surgery is planned, patient preparation physically & psychologically

- Where onchocerciasis is prevalent the itching skin makes the victim scratch a lot and the lesions become secondarily infected with streptococcus. The hands of the patient are then constantly harbour the organism & its spread is facilitated. Therefore nurses must give advise on personal hygiene and prevention of secondary bacterial infection such as:

- Frequent hand washing, keep the fingernails cut short (rimmed), to prevent scratching which leads to secondary infection.
- The nurse should explain the importance of not scratching. ( massaging instead of scratching).

- Itchy rash is common skin condition; nurses should identify the nature of lesion, possible cause, and treatment in short.

Nursing management is aimed at relieving the situations that causes pruritus, decreasing the associated discomfort and preventing additional trauma secondary infection to the skin.

- Provide antihistamine and apply soothing lotion.
- Pruritus is often caused by excessive drying of skin especially in older patients i.e. the severity is high in old if involved. Therefore advise on prevention of dryness of skin by oiling, frequent fast bath and avoiding excessive use of soap.
- Bathing should be limited. If soap is used it should be toughly rinsed from the skin for the reason the soap causes dryness of the skin.
- Oil may be added to the bath water, but care should be taken because oil makes the bath tub slippery.
- Lotions and moisturizing creams should be applied regularly to promote rehydration of dried areas.
- Health education and promotion aimed at changing individual and community behavior
  - teach specific vector control and personal protection measures
  - initiate school health program
- Involvement and Mobilizing community and intersectoral collaboration for participation is essential to successful implementation of OCP.
- Home visit should be initiated: discuss the mode of transmission and prevention with the family members. Provide family-centered case management and health education.
- Training community health agents (CHAs) for community directed distribution & treatment with ivermectin in the case of mass treatment. The training should focus on:
  - drug distribution
  - health education
  - community mobilization
  - Registration and record keeping

- Monthly report

**3.5.5 Referral:** Nurses should refer patients with nodule containing adult worm in the head region which is indicated because of increased risk of serious ocular disease.

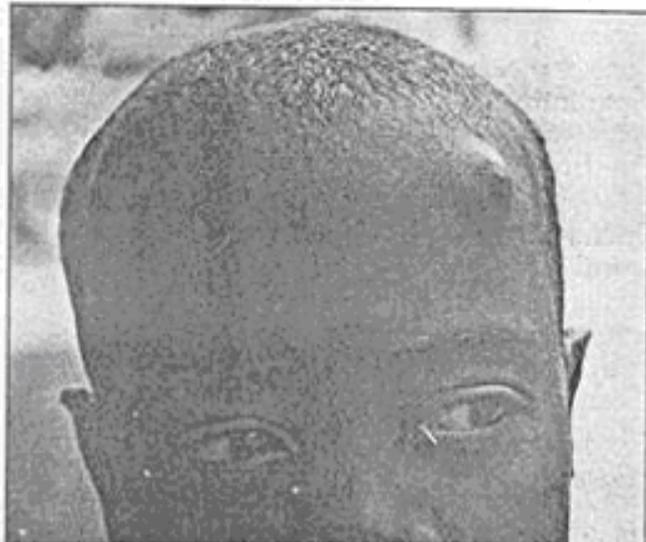


Fig. 4.3. Child with nodule onchocerciasis on head

**Personal record sheet:** -nurses should record age, sex, locality, birth place and duration of stay at present address for proper intervention and follow-up.

### 3.5.6 Summary:

Are you through with the core and satellite module? If so read the modules of other categories. Check the pre-test and answers

Onchocerciasis prevention and control program must move beyond providing drug treatment i.e. counseling for social & economic problems that arises due to the disease and its consequences.

Effective control of onchocerciasis requires the use of multi system approach having close cooperation with other members of interdisciplinary health care team focusing on

improving safety of the environment, facilitating social and economical changes to ensure health for all people living in endemic areas.



## UNIT FOUR

### SATELLITE MODULE FOR LABORATORY PERSONNEL

#### 4.1 Introduction

##### 4.1.1 Purpose:

This satellite module is planned to give pertinent and simple methods for laboratory diagnosis of O.volvulus.

##### 4.1.2 Directions:

- Read the core module before starting this part.
- Attempt the pre-test before reading this part.
- And continue reading this module

##### 4.1.3 Pre-test for laboratory personnel.

There is only one correct choice for each question. Attempt all.

1. Early immature stage of filarial worm is called
  - A. Amastigote
  - B. Microfilariae
  - C. Metacercaria
  - D. All
2. O.Volvulus adult worms are located in
  - A. Blood cells
  - B. Skin nodules
  - C. Small intestine
  - D. A and B
3. In Giemsa stain preparation, microfilariae of O.Volvulus appears as.
  - A. Hooked tail
  - B. Tail with nuclei to the end of the tail.
  - C. Globular head
  - D. None

4. Serology test has not widely applied in diagnosis of onchocerciasis because
- A. The test is costly
  - B. Filarial worms are less antigenic
  - C. Cross- reactivity
  - D. All
5. Which one of the following is not a site for skin snip?
- A. Skin from center of nodule
  - B. Buttock area
  - C. Skin over ribs
  - D. None
6. Slide technique of skin snip preparation
- A. Gives more microfilarial yield
  - B. Does not require physiological saline
  - C. Gives poor microfilarial yield than tube method
  - D. None
7. Which morphological feature is not used in differentiation of microfilaria of filarial worm
- A. Presence or absence of sheath
  - B. Position of nuclei in the anterior end
  - C. Tail nuclei arrangement
  - D. Color of microfilariae.
8. Number of skin snips that should be taken before issuing negative result.
- A. 2
  - B. 4
  - C. 6
  - D. 8
9. Patient for skin snip examination for onchocerciasis should.
- A. sit for half an hour under direct sun light
  - B. sit for half an hour under shade
  - C. A and B
  - D. Neither

10. Which one is not required for slide technique of skin snip preparation?

- A. slide
- B. centrifuge
- C. saline
- D. cover slip

### 4.1.3 Learning objectives

After reading the text, the laboratory personnel is expected:

- To demonstrate laboratory techniques for diagnosis of Onchocerca volvulus.
- To identify features of microfilariae in skin snip preparation.
- To describe and apply Giemsa staining procedure for species identification of filarial worms.
- To list advance laboratory techniques for Onchocerca volvulus diagnosis.

## 4.2 Laboratory diagnosis of Onchocerciasis

Methods

- Parasitological /skin snip/ method.
- Provocative test method – Mazzotti reaction.  
    \_ Patch test
- Serological test method and
- Polymerase chain reaction /PCR/ Method

### 4.2.1 Parastological Test /skin snip test

It is the most useful diagnostic procedure. It is bases on finding O.volvulus microfilariae in the skin snips. The natural habitats of the microfilariae are the lymphatics of connective tissue and cutaneous layers in the vicinity of the parent worm, as well as in the stratum germinativum and the corneal conjunctiva.

Bloodless skin snip should be taken after a patient has rested away from direct sun light for half an hour.

#### **4.2.1.1 Where to collect specimen**

##### A) Patients with nodules

Look for nodules:

- On the chest (over the ribs)
- On the hips
- On the legs (tibia)
- On the back (shoulder blades)

➤ Take the specimen from the skin in the center of the nodule.

##### B) Patients without nodules

Take specimens from

- The top of the buttocks (the upper outer part where intramuscular injections are given)

If the examination gives negative result, take specimen from: -

- The calf (upper outer part)
- The back (center of shoulder-blade)

It is recommended that 6 specimens (2 from buttocks, 2 from calves, 2 from shoulder – blades) be examined before reporting a negative result.

#### **4.2.1.2 Test principle**

Two to six skin snips are taken from an area of maximum microfilarial density. biopsy specimens are placed in normal saline on a slide or in tests tube for a length of time. They are then examined for microfilariae that migrate from the tissue. If no microfilariae are seen, the preparation should be left overnight and examined for microfiliariae the next day.

There are two types of skin snip techniques. These are

- Slide technique
- Test tube technique

The tube method is more reliable technique. It recommended in areas where Onchocerciasis less endemic. And it is used to confirm negative results with slide technique.

### 4.2.1.3 Slide technique procedure

Materials needed:

- Sterile needle
- Sterile razor (scalpel)
- Spirit swab.
- Slide
- Cover slip
- Microscope (10X)

Procedure

1. Cleanse the skin using a spirit swab. Allow the area to dry.
2. Insert a sterile fine needle almost horizontally into the skin, raise the point of the needle, lifting with it a small piece of skin measuring about 2mm in length and diameter.
3. Cut off the piece of skin with a sterile razor blade

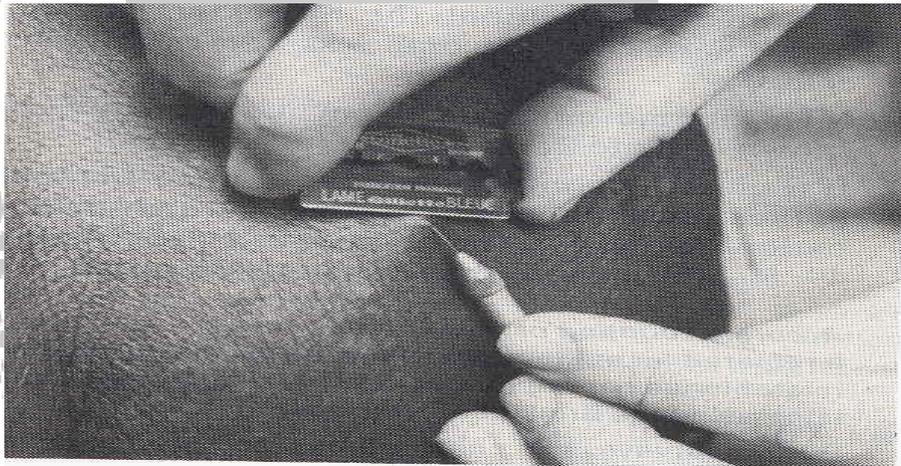


Fig.5.1. Procedure of skin snip taking

4. Immerse the skin snip in physiological saline on slide. Water can be used but the microfilariae take longer to emerge from the skin and may not remain active for as long.
5. Cover the preparation with cover glass. Place the slide or tray on a piece of damp tissue in a Petri dish or plastic box to prevent the preparation from drying.
6. Incubate the preparation at room temperature for a length of time needed for microfilariae to emerge. As a rule an overnight incubation period should be allowed

before recording a negative test. In practice most workers look at the preparation after 5 minutes of being incubated and if no microfilariae are detected, again at 15 minutes intervals for 1 hour. If no microfilariae are seen, the preparation should be left overnight and examined the following day.

7. Examine the preparation microscopically for actively motile microfilariae using 10x objective. With prolonged incubation movement of the microfilariae will become less and eventually cease.

#### 4.2.1.4 Test tube technique

Materials:

In addition to the above mentioned materials this technique requires:

- Centrifuge tube
- Centrifuge
- Forceps

Procedures

1. Immerse the skin snip in 2ml of physiological saline in a centrifuge tube. Incubate at room temperature over night.
2. Using forceps, remove the skin snip, place it on a slide, and cover with a cover glass.
3. Centrifuge the contents of the tube at a medium speed (approximately 2000 RPM) for 5-10 minutes. Remove or discard the supernatant fluid. Transfer the entire sediment to a slide.
4. Examine the skin and the sediment microscopically for microfilariae using 10 x objective with the condenser iris closed sufficiently to give good contrast

**NB:** - The microfilariae which emerge from skin snips appear colorless, transparent, and actively motile and the microfilariae is non periodic.

#### 4.2.1.5 Species confirmation of microfilariae of filarial worms

Microfilariae of filarial worms differ from one another on the bases of their: -

- Size
- Presence or absence of sheath

- Distribution of nuclei in the caudal Region of the Larvae.
- Periodicity of their appearance in the blood.
- And location of larvae

Giemsa stained preparation of microfilariae is examined microscopically using oil emersion objective for species confirmation.

**Giemsa staining procedure:**

1. Remove the cover glass and allow the preparation to dry completely.
2. Fix the dried preparation with absolute Methanol or ethanol for 2-3 minutes.
3. Cover it with 10% Giemsa staining solution
4. After 30 minutes wash off the stain with tap water and allow it to dry.
5. Examine the stained slide using low powerto find micro future and then examine the microfilarae using oil immersion-objective.

**4.2.1.6 Features of *O.volvulus* microfilarias after Giemsa stain**

- Size – Large measures 240-360 x 5-9 μm
- Has no sheath
- Has pointed tail without nuclei
- Has headspace free of nuclei.
- Anterior nuclei positioned side by side.



Fig 5.2 *O. volvulus* microfilariae (unsheathed).

Table 5.1 Morphological feature of O.volvulus microfilariae which aid in differential diagnosis from other filarial worm larvae found in the skin.

Species	Size	Body and tail	Other points
<u>O.volvulus</u>	Large & thick 240-300 x 5-9 mm	Head is slightly enlarged Anterior nuclei positioned side by side. There are no nuclei in the end of the tail which is long and pointed.	Differentiation is easy from <u>M.streptocerca</u> , but more difficult from <u>m.Ozzardi</u>
<u>M.streptocerca</u>	Small and thin 180-240 x 4.5 mm	Anterior nuclei are positioned in a single file. Nuclei extend to the end of the tail, which is rounded, and usually hooked.	Differentiation from <u>O.volvulus</u> is by its smaller size, single file anterior nuclei & tail feature.
<u>M. Ozzardi</u>	Small and thin 150-200x 4.5 mm	Anterior nuclei are positioned side by side. There are no nuclei in the end of the tail, which is long & pointed.	Differentiated from <u>O. volvulus</u> mainly by its smaller size and different shaped head.

**NB:** All species do not have sheath.

Demonstration of adult worm inside the excised nodule can also be diagnostic method.

Features of Onchocerca volvulus adult worm are: -

- Location – Nodules of subcutaneous tissue
- Size -male: 1.9 - 4.2cm by 0.13 - 0.21mm.  
- Female: much longer than male, measures 33.5 - 50cm by 0.27 - 0.40mm
- Appearance – white, opalescent and transparent with transverse striation on the cuticle.

**Note:** During heavy infection or following DEC microfilariae can also be found in urine, blood, and other body fluids.

#### **4.2.2 Provocative test Methods**

This method depends on the body's allergic response to destroyed microfilariae by diethyl carbamazine (DEC).

##### **4.2.2.1 Mazzottie reaction**

Test principle:

A dose of 50 mg of DEC is given and in infected patients usually followed 15-30 minutes, or occasionally hours, later by intense itching and erythema caused by allergic reaction to the destroyed microfilaria. This implies a positive test result.

The method is not popular because the response is very intense in heavily infected individuals so that it results in collapse, shortness of breath, coughing and vertigo. To minimize this it is advisable to provide smaller doses (10-20mg) for patients from endemic areas. Or restrict the test for a patient with a negative skin snip test result.

##### **4.2.2.2 Patch test**

Principle of the test:

The test involves applying a small amount of 10% DEC topically in Nivea lanolin cream to an area of skin about 5mm in diameter and covering the area with a dressing. The area is inspected 8, 12, 24, 48 and 72 hours later. A positive test is shown by a papular eruption developing 8-24 hours after applying DEC.

Patch test is simple, sensitive and has only limited itching thus, it can be used in countries where onchocerciasis is endemic.

**Test preparation:**

Dissolve 10 gm DEC in 100 ml Nivia milk (Nivia skin cream) and store on ice. Patches are prepared by soaking 3 cm by 2 cm filter paper in the 10% DEC Nivia cream solution. Apply the patches on the body preferably on the above mentioned body parts where microfilariae are in high density.

**4.2.3 Serological test**

Various serology methods (antigen – antibody reaction) have been developed, but all are non – specific and react with other filarial infections. Recently, more specific enzyme immunoassay using recombinant O.volvulus antigen OC 3.6 and OC 9.3 have been discovered as an aid in diagnosis of patients with suspected onchocerciasis, but requires an ELISA set up.

**4.2.4. Polymerase chain reaction (PCR)**

This is a highly advanced technique which detects after amplification O.volvulos DNA in skin snip samples. It is highly sensitive and specific, thus very important in the detection of early infection, but it is too expensive and complex for routine use.

# UNIT FIVE

## SATELLITE MODULE FOR ENVIRONMENTAL HEALTH TECHNICIANS

### 5.1. Introduction

#### 5.1.1. Purpose and use of this satellite module

This module is intended to be used by environmental health technicians and provide them with basic information that are not discussed in the core module but basic to undertaking prevention and control activities.

#### 5.1.2. Directions for using the module

- Before reading this satellite module be sure that you have completed the pre-test and studied the core module.
- Continue reading this satellite module

#### 5.1.3. Pre-test for environmental health technicians

Choose the best answer for each of the following questions

1. One of the following statements is wrong
  - a) Because of the feeding and metabolic requirements of the larvae, black fly eggs are laid in well-oxygenated waters.
  - b) *O. volvulus* can only be transmitted by black flies of the genus *Simulium*
  - c) It is only the female black fly that bite humans
  - d) Transmission of onchocerciasis usually occurs close to black fly breeding sites in fast flowing rivers, giving rise to the term 'river blindness' for this disease.
  - e) None
2. The best practical method at present available for the control of black flies is:
  - a) Insecticide spraying of vegetation thought to harbour resting adult flies
  - b) Environmental management
  - c) Weekly application of insecticides to their breeding places to kill the larvae
  - d) Personal protection measures

3. Select the correct statement

- a. The ultimate goal of African Program for Onchocerciasis Control (APOC) and thus Ethiopian Program for Onchocerciasis Control (EPOC) is to eliminate onchocerciasis as a disease of public health and socio-economic development importance.
  - b. The main control approach employed by EPOC is control of the disease by establishing community-directed treatment with the drug ivermectin (CDTI), supplemented with vector eradication in a few isolated foci.
  - c. To eliminate the vector and hence the disease is one of the objective of APOC and EPOC.
  - d. All
4. Personal Protection measures to prevent from being bitten by black flies include:
- a) Proper clothing
  - b) Insect repellents
  - c) Avoiding washing of the body in fast flowing streams or rivers
  - d) A and B
  - e) All
5. Select the false statement about black flies
- a) Adult black flies are quite small
  - b) The wings of black fly are colorless or almost so
  - c) The wings are short and broad
  - d) Black flies have humped thorax
  - e) None
6. Vector control of black flies needs the knowledge of:
- a) Breeding sites
  - b) Dispersal potential /flight range
  - c) Resting place
  - d) Life cycle of the vector species
  - e) A and C
  - f) All

7. Adult populations of black flies are difficult to control because of
- a) Insecticide resistance
  - b) Broad dispersal potential
  - c) The wide variety of resting places
  - d) All except A
  - e) All
8. Insecticides that are used for large-scale campaigns in the prevention and control of black flies must be
- a) Highly effective against the vector
  - b) Safe for the environment
  - c) Broad spectrum
  - d) All
  - e) All except C

## 5.2. Learning objectives

After reading this module the learner will be able to:

- Describe the life cycle of black fly
- Identify adult black fly and immature stages (especially larvae)
- Describe adult black fly behaviors that are very important in the prevention and control of black flies
- Undertake appropriate prevention and control measures to combat onchocerciasis if the disease exists in his/her work area
- Organize and mobilize the community for effective onchocerciasis prevention and control

## 5.3. Black flies (Simuliidae)

Simuliidae are in the class insecta and order diptera. Black flies have a worldwide distribution with the exception of a few islands. There are nearly 1720 species in 26 genera. However, only four genera Simulium, Prosimulium, Austrosimulium and Cnephia contain species that bite people.

Medically, Simulium is by far the most important genus as it contains many vectors. In Africa, species in the *S. damnosum* complex and *S. neavei* groups and in central and south America, species in the *S. achraceum*, *S. metallicum* and *S. exiguum* complexes

transmit the parasitic nematode *Onchocerca volvulus* which cause human onchocerciasis (river blindness).

### **5.3.1. External morphology**

The Simuliidae are commonly known as black flies. Adult black flies are quite small, about 1.5-4mm long, relatively stout bodied and, when viewed from the side, have a rather humped thorax (see figure 6.1). As their vernacular name indicates they are usually black in color but many have contrasting patterns of white, silvery or yellowish hairs on their bodies and legs, and others may be predominantly or largely orange or bright yellow.

Blackflies have a pair of compound eyes, which in females are separated on the top of the head (a condition known as dichoptic); in the males the eyes occupy almost all of the head, and touch on top of it and in front above the bases of the antennae (a condition known as holoptic). The antennae are short, stout, cylindrical and distinctly segmented (usually 11 segments) but without long hairs.

The mouthparts, being short and broad, do not penetrate very deeply into the host's tissues. Teeth on the labrum stretch the skin, while the rasp-like action of the maxillae and mandibles cuts through it and ruptures the fine blood capillaries. The flies then suck up the small pool of blood produced. This method of feeding is ideally suited for picking up the microfilariae of *O. volvulus*, which occur in human skin not blood.

The wings are characteristically short and broad and lack scales and prominent hairs. Only the veins near the anterior margin are well developed; the rest of the wing is membranous and has an indistinct venation. The wings are colorless or almost so. When at rest the wings are closed over the body like the blades of a closed pair of scissors.

The abdomen is short and squat, and covered with inconspicuous closely appressed fine hairs. The genitalia are not very conspicuous in either sex. Black flies are most easily sexed by looking at the eyes.

### 5.3.2. Life cycle

Black flies breed in flowing water but the type of breeding place differs greatly according to species. Breeding habitat can vary from small trickles of water, slow flowing streams, lake outlets and water flowing from dams to fast flowing rivers and rapids.

Eggs, usually 150-800 per females, are deposited in sticky masses on water surface, on aquatic plants, or on logs, on water-splashed rocks, or other solid surfaces in or at the edge of the water. Commonly the female drops eggs while flying over the water surface; some species will hover and oviposit through a thin film of water that covers sand, rock, or vegetation; others will settle and oviposit on water-lapped surfaces at the water's edge. Eggs of *S. damnosum* hatch within about 1-2 days but in many other tropical species the egg stage lasts 2-4 days.

There are six to nine (usually seven) larval instars and the mature larvae is about 4-12 mm long, depending on the species, and is easily distinguished from all other aquatic larvae. The head is usually black, or almost so, and has a prominent pair of feeding brushes, while the weakly segmented, cylindrical body is usually grayish, but may be darker or some times even greenish. The body is slightly swollen beyond the head and in most, but not all species, distinctly swollen towards the end. The rectum has fingerlike rectal organs, which on larval preservation may be extruded and visible as a protuberance from the dorsal surface towards the end of the abdomen. Ventrally, just below the head, is a small pseudopod called the proleg, which is armed with a small circlet of hooklets.

Larvae do not swim but remain sedentary for long periods on submerged vegetation, rocks, stones and other debris. Attachment is achieved by the posterior hook-circlet (caudal/anal sucker) tightly gripping a small silken pad. This is produced by the larva's very large salivary glands and is firmly glued to the substrate. Larvae usually orient themselves to lie parallel to the flow of water with their head downstream. They are mainly filter feeders, ingesting, with the aid of large mouth brushes, suspended particles of food. Larval development may be as short as 6-12 days depending on species and temperature, but in some species may be extended to several months, and other species larvae overwinter.

Mature larvae, which can be recognized by a blackish mark, termed the gill spot (the respiratory organ of the future pupa) on each side of the thorax, (figure 2) spin, with the silk produced by the salivary glands, a protective slipper-shaped brownish cocoon. This cocoon is firmly stuck to submerged vegetation, rocks or other objects and its shape and structure vary greatly according to species. After weaving the cocoon the enclosed larvae pupates; the pupa has a pair of, usually prominent, filamentous or broad thin-walled, respiratory gills (see figure 3). Their length, shape and the number of filaments or branches provide useful taxonomic characters for species identification. These gills, and the anterior part of the pupa, often project from the entrance of the cocoon. In both tropical and non-tropical countries pupal period lasts only 2-6 days.

On emergence adults either rise rapidly to the water surface in a protective bubble of gas, which prevents them from being wetted, or they escape by crawling up partially submerged objects such as vegetation or rocks. A characteristic of many species is the more or less simultaneous mass emergence of thousands of adults. On reaching the water surface the adults immediately take flight.

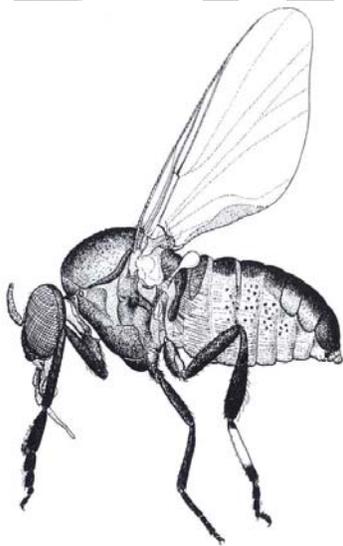


Fig.6.1. Adult Blackfly in lateral view.

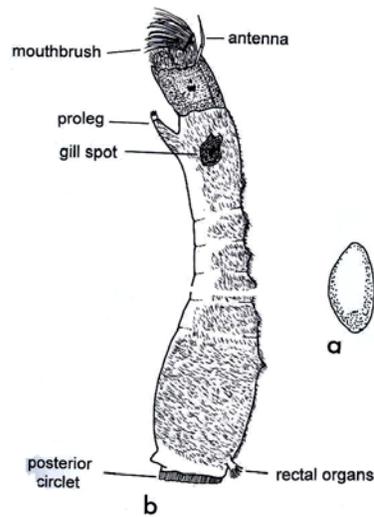


Fig.6.2. a) Simuliid egg; b) Lateral view of the last larval instar showing the body covered in minute dark setae and with dorsal tubercles.

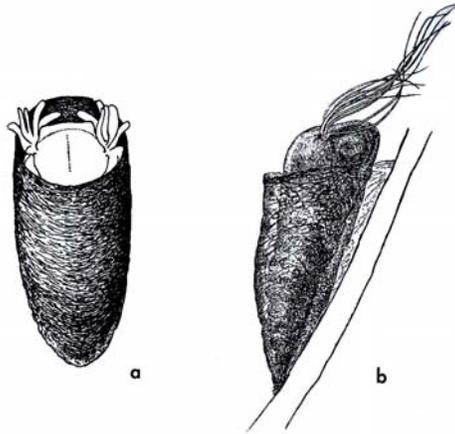


Fig.6.3. Simuliid pupae in cocoons.

- a) Dorsal view with broad and short respiratory filaments;
- b) Lateral view with long thin respiratory filaments.

### 5.3.3. Adult behavior and disease transmission

Both male and female black flies feed on plant juices and naturally occurring sugary substances, but only females take blood meals, which is necessary for maturation of eggs. Simuliids are daytime biters and are rarely found indoors. Species may exhibit marked preferences for feeding on different parts of the body; for example, *S. damnosum* feeds mainly on the legs whereas *S. ochraceum* prefers to bite the head and torso.

Many species of black fly feed almost exclusively on birds (ornithophagus) and others on non-human mammalian hosts (zoophagic). However, several species also bite people. Some human biting species seem to prefer various large animals such as donkeys or cattle and bite humans only as a poor second choice, whereas others appear to find humans almost equally attractive hosts; no species bites people alone. In many species sight seems important in host location but host odours and CO<sub>2</sub> out put may also be important. After feeding, blood engorged females shelter and rest on vegetation, on trees and in other natural outdoor resting places until the blood meal is completely digested. In tropics this takes 2-3 days, while in non-tropical areas it may take 3-8 days or longer, the

speed of digestion depending mainly on temperature. Relatively little is known about black fly longevity, but it seems that adults of most species live for 3-4 weeks.

Females of some species may fly considerable distances (15-30 km) from their breeding sites to obtain blood-meals and may also be dispersed long distances by winds. For example, adults of *S. damnosum* bite 60-100km from their breeding places, and in West Africa there is evidence that prevailing winds can carry adults up to 400-600km. The long distances involved in dispersal have great relevance in control programmes, because areas freed from black flies can be reinvaded from distant breeding places.

The female black fly mates only once during her life, on the day following emergence. She then seeks a blood meal, which is necessary for the maturation of her eggs, and is ready for oviposition 4 to 5 days after the meal. If the blood meal is taken from a person infected with onchocerciasis, microfilariae may be ingested with the blood. These do not multiply in the black fly but undergo development in to infective larvae ( $L_3$ ) capable of becoming sexually mature adult worms in the human hosts. The development is completed only by the time of the third blood meal.

Many of the microfilariae ingested during feeding are destroyed or excreted, but some penetrate the stomach wall and migrate to the thoracic muscles where they develop into sausage shaped stages and undergo two molts. A few survive and elongate into thinner infective larvae which pass through the head and down the short proboscis. Once the infective third stage larvae in the proboscis penetrate the host's skin when females attempt to feed, they may develop into adults producing microfilariae that may in turn be ingested by black flies thus completing the life cycle of the parasite (see the figure 2.2 for the life cycle in the core module). The interval between the ingestion of microfilariae to the time infective larvae are in the proboscis is about 6-13 days. The time between the entry of the larvae ( $L_3$ ) and the appearance of onchocercal symptoms, the incubation period, varies from one to three years.

- *For the black fly to function as a vector it must survive the laying of two batches of eggs.*

## 5.4. Prevention and Control of onchocerciasis

There are no animal reservoirs, so the disease is not a zoonotic. Black flies are the only vectors for transmitting onchocerciasis. There are no effective vaccines or chemoprophylactic agents for the disease. The prevention and control measures are vector control, chemotherapy, and personal protection measures from biting during the day and health education about mode of disease transmission and prevention and control methods.

### **African Programme for Onchocerciasis Control (APOC)**

From 1989 to 1994, the Nongovernmental Development Organizations (NGDO) pioneered mass distribution of ivermectin known as the Ivermectin Distribution Programme (IDP). As the result of this, the NGDO Coordination Group for Onchocerciasis Control was created in 1991 at the WHO Headquarters. However, building on the knowledge and experience gained in OCP, the sponsoring agencies and the NGDO Group launched, in 1995, a second programme to combat the rest of Africa's river blindness named the African Programme for Onchocerciasis Control (APOC).

APOC is a bigger partnership programme than OCP including 19 Participating Countries with effective and active involvement of the Ministries of Health and their affected communities, several international and local NGDOs, the private sector (Merck & Co., Inc.), donor countries and UN agencies. The World Bank is the Fiscal Agent of the Programme and WHO is the Executing Agency of the Programme. The Community-Directed Treatment with Ivermectin (CDTI) is the delivery strategy of APOC. It empowers local communities to fight river blindness in their own villages, relieving suffering and slowing transmission. After just 8 years of operations, APOC has established 107 projects, which in 2003 treated 34 million people in 16 countries. The programme intends over the following years to treat 90 million people annually in 19 countries, protecting an at risk population of 109 million, and to prevent 43 000 cases of blindness every year.

Ethiopia is a member of the APOC, which was established in December 1995. APOC was built on the success of the onchocerciasis control program in West African countries, which now have reached to the verge of eliminating the disease. APOC is unique partnership that has brought together donors, 19 affected countries in Africa NGDOs, the private sector and affected communities. The main control approach employed by this program is control of the disease by establishing community-directed treatment with the drug ivermectin (CDTI), supplemented with vector eradication in a few isolated foci.

National Onchocerciasis Task Force (NOTF) in Ethiopia was established soon after the government signed the agreement to implement CDTI in 1997. The members of the task force include MOH, the carter center, WHO and representatives from the academia and health research institutes. Immediately after its establishment, NOTF has developed a 5-year plan of action and 3 CDTI project proposals, which were submitted, were subsequently approved by WHO/APOC for funding and technical support. The first approved proposal was the Kaffa-Sheka project that marked the launching of the Ethiopian program for onchocerciasis control (EPOC) in 2000.

### **Goal**

The ultimate goal of APOC and thus EPOC is to eliminate onchocerciasis as a disease of public health and socio-economic development importance.

### **Objectives**

- To establish effective and self-sustainable CDTI through out the endemic areas
- To eliminate the vector and hence the disease

### **Strategy**

CDTI is the main strategy of APOC and EPOC.

## 5.4.1. Vector Control

Once the life cycle of *O. volvulus* and the role of black flies in transmitting infection had been established, it became clear that control of the disease might be feasible by attacking the vector. Vector control needs knowledge of breeding sites and certain factors such as dispersal potential and resting sites.

### 5.4.1.1. Larviciding

The only practical method presently available for the control of black flies is the weekly application of insecticides to their breeding places to kill the larvae. Insecticides need be applied to only a few selected sites on watercourses for some 15-30 minutes, because as the insecticide is carried downstream it kills Simuliid larvae over a long stretches of water. The flow rates of the water and its depth are used to calculate the quantity of the insecticide to be released.

The formulations of the insecticides that are used for large-scale campaigns must be highly effective against the vectors, but safe for the rest of the environment. The constituents should be biodegradable but there must be maximum “carry” downstream from the point of application. Temephos is the preferred larvicide because of its effectiveness, its range (the distance over which it remains effective), and its safety for non-target fauna. However, the appearance of insecticide resistance in 1980 of West Africa required users to adopt a strategy of alternating insecticides with different modes of action, if possible, so as to forestall the appearance of new resistance (Table 6.1). Because of the need for rotation, six insecticides are now used in the Onchocerciasis Control Programme area, namely temephos, pyraclofos, phoxim, permethrin, carbosulfan, and *Bacillus thuringiensis* serotype H-14. Temephos and pyraclofos, both organophosphorus compounds, are regarded as the most effective larvicides; they have fairly low operational doses and a carry of as much as several tens of kilometers when water levels are high. Pyraclofos tends not to be used at river discharge rates above 300m<sup>3</sup>/s and it is never used at rates below 15m<sup>3</sup>/s because of its toxicity. Phoxim does not endanger the environment, but is less effective and has a limited range. Permethrin has a more limited range than temephos and pyraclofos, although its operational dose is very low, so that its use is not limited by high rate of flow; however, because it is somewhat

toxic to non-target fauna, it is never used at less than 70m<sup>3</sup>/s and, if possible, it must be applied for no more than 6 weeks per year to the same stretch of water. Carbosulfan is a carbamate of carry and toxicity similar to those of permethrin, but both its price and operational dose are much higher; its primary use is in rates of flow between 70m<sup>3</sup>/s (the toxicity threshold) and 150m<sup>3</sup>/s (the cost threshold). Finally *B. thuringiensis* serotype H-14, a bacterial insecticide, is not particularly effective in rivers, since it has a high operational dose and a low range. For these reasons, it is never used above 15m<sup>3</sup>/s, although its use is justified by its environmental safety and by the unlikelihood of resistance developing.

When the rivers discharge rates are in the range 15-70m<sup>3</sup>/s, only organophosphorus compounds can be used, but there is then a high risk of resistance developing. In order to fill the gap, a non- organophosphorus larvicide is highly desirable.

Prolonged and intensive use of an insecticide encourages the development of resistance. Resistance can be managed by the rotation of insecticides. This rotational strategy has been implemented and gradually improved over the years by WHO. It can be summarized as follows:

- *Dry season:* rivers are preferably treated with *B. thuringiensis* serotype H-14, or treatments are stopped, if possible.
- *Start of rainy season:* application of organophosphorus compounds, namely temephos, phoxim and pyraclofos are gradually increased with emphasis on pyraclofos when river discharges are high. To reduce the risk of resistance, no organophosphorus compound is used for more than six successive weekly cycles.
- *Peak of the rainy season:* permethrin or carbosulfan (maximum of 6 weeks per year for each) is alternated with an organophosphorus compound with long carry (temephos and pyraclofos).
- *End of rainy season and the onset of the dry season:* the first two stages are repeated in reverse order, but with less emphasis on pyraclofos.

Table 1. Black fly larvicides currently used in the Onchocerciasis Control Programme

Insecticide name, formulation and concentration of active ingredient (g/l) <sup>a</sup>	Chemical Group	Dosage(l) Per m <sup>3</sup> /s river discharge	Optimal range of river discharge( m <sup>3</sup> /s)	Carryin large rivers (km)	Margin of safety <sup>b</sup> (fish and crustaceans)
Bacillus thuringiensis (water-dispersable concentrate)	Biological	0.72	0-15	<3	Extremely safe in most situations
Temephos(EC200)	Organophosphate	0.15-0.30	0-450	20-30	100X
Phoxim(EC500)	Organophosphate	0.16	15-70	≤6	7X
Pyraclofos(EC500)	Organophosphate	0.12	15-300	20-30	4X
Permethrin(EC200)	Pyrethroid	0.045	≥70	≤10	2X
Cabosulfan(EC250)	Carbamate	0.12	70-150	≤11	2X

<sup>a</sup> EC200, for example, denotes an emulsifiable concentrate containing 200g active ingredient per litre of formulated material.

<sup>b</sup> Indicates the level of overdosing at which fish and shrimps may be endangered; the multiplication factors apply to the value for dosage (l) per m<sup>3</sup>/s river discharge given in column 3.

#### 5.4.1.2 Adulthood

Adult populations are difficult to control because of their broad dispersal and the wide variety of their resting sites, about which little is known. Although insecticide fogging or spraying of vegetation thought to harbour resting adult flies has occasionally been undertaken, this approach results in very temporary and localized control. However, the use of this insecticide treatment can serve as a means of destroying reinvading black flies.

- Spray of insecticides could be hazardous to the environment and vegetation unless applied with care
- It is also expensive requiring facilities for spray and importing of chemicals

#### 5.4.1.3 Biological Control

1. *Bacillus thuringiensis serotype H-14*: This is a spore-forming bacterium that produces a crystal of toxic protein that is stomach poison for blackfly larvae. This control agent, which is specific for Diptera, has little impact on non-target fauna. It is already in operational use in WHO Onchocerciasis Control Programme although formulations are not yet ideal because of the high dosages required.
2. *Insect Pathogens*: Microsporidia, entomophagous fungi, and mermithids have all been found in blackflies, including some vector species. These pathogens certainly act as natural agents to control the black fly density.

#### 5.4.1.4. Environmental management

- The construction of small hillside dams, causeways, irrigation channels, etc, that bring breeding places of vectors close to human populations should be removed when they are no longer needed or are broken
- Damming a stream or river to reduce the speed of the water flow and then reduce the amount of dissolved oxygen and eventually the immature stage (larvae) will die due to lack of oxygen
- Selective bush clearance with caution to avoid exacerbating ecological problems
- This is environmentally safe vector control measure. It is also less expensive and feasible in many oncho endemic Africa Countries, where resources for OCP not well established.

#### 5.4.1.5. Integrated vector Control

The integrated vector control of onchocerciasis requires the availability of a range of methods, including both medical treatment, in the form of chemotherapy and nodulectomy, and techniques aimed at suppressing the vector. At present, vector control is based entirely on the use of chemical or biological larvicides. In integrated vector control, all appropriate technological and management techniques are used to suppress the vector populations in cost effective manner.

The development of effective macrofilaricide and microfilaricidal drugs suitable for large scale treatment of onchocerciasis and better formulations of chemical and biological larvicides for Simulium species would allow the broad integration of control techniques and resources and the use of chemotherapy in association with vector control.

#### **5.4.2. Medical treatment**

As a microfilaricide for the treatment of human onchocerciasis only ivermectin proved to be both highly effective and well tolerated and it may be necessary to take the drug for at least the life span of adult worms (since it does not kill the adult worm), i.e. up to 15 years.

#### **5.4.3. Personal protection measures**

Black flies bite at daytime and out of doors. Personal protection measures to prevent from being bitten by the flies include:

- Proper clothing
- Insect repellents: some protection, usually lasting up to 2 hours can be gained by use of repellents such as diethyltoluamide (deet), dimethylphthalate (dimp), and butyl-tetrahydro quinoline.
- Avoiding contact with fast flowing streams or rivers, such as bathing

#### **5.4.4. Health education**

Health education provision about mode of disease transmission and prevention and control methods to the populations living in onchocerciasis prone areas is essential.

#### **Summary**

- Now you are through with the core and satellite modules, but in order to evaluate yourself you need to do the pre-test and post-test. Use a separate answer sheet.
- At last compare your answers of the pre and post-tests with the answer given.

# UNIT SIX

## SATTELITE MODULE FOR EXTENSION PACKAGE HEALTH WORKERS

### 6.1. Introduction

#### 6.1.1. Purpose of the module:

- Extension package health workers (EPHWs) are intended to use this module for their home-based management of onchocerciasis.
- Nurses who are working at lower level health care units and those who supervise the Extension Package Health Workers are also intended to use the module, so that they can guide them properly,
- It guides the EPHWs working at lower health care unit and community level during community directed treatment with ivermectin.
- Gives basic information needed in the prevention & control of onchoceciasis
- Helps to conduct home visit for case finding and management.
- Provide reliable information on morbidity pattern of the disease

#### 6.1.2. Directions for use the module:

- Start with doing the pre- test by using a separate sheet.
- Study the text including the task analysis.

#### 6.1.3. Learning objective:

After reading this module the learner will be able to:

- Recognize that onchocerciasis is a disease of public health importance.
- Identify the cause and mode of transmission of onchocerciasis.
- Recognize that onchocerciasis is a preventable disease
- Participate in community-based distribution of ivermectin in the onchocerciasis control program.
- Teach the community how to prevent onchocerciasis.

- Describe the life cycle of the black fly
- Describe adult black fly behaviors that is very important in the prevention and control of black flies
- Undertake appropriate prevention and control measures to combat onchocerciasis
- Organize and mobilize the community for effective onchocerciasis prevention and control

#### 6.1.4. Pre-Test

**Write true or false for the following questions.**

- 1 Onchocerciasis is transmitted by Aedes mosquito.
- 2 Onchocerciasis is a disease that cannot be prevented
- 3 Blindness in onchocerciasis can best be prevented by early diagnosis and treatment.
- 4 Community mobilization and home based management of onchocerciasis in identified endemic area is the responsibility of EPHW

#### **Multiple choice questions**

5. One of the following statements is wrong
  - a) Because of the feeding and metabolic requirements of the larvae, black fly eggs are laid in well-oxygenated waters.
  - b) *O. volvulus* can only be transmitted by black flies of the genus *Simulium*
  - c) It is only the female black fly that bites humans
  - d) Transmission of onchocerciasis usually occurs close to black fly breeding sites in fast flowing rivers, giving rise to the apt term 'river blindness' for this disease.
  - e) None
6. The best practical method at present available for the control of black flies is:
  - a) Insecticide spraying of vegetation thought to harbour resting adult flies
  - b) Environmental management
  - c) Weekly application of insecticides to their breeding places to kill the larvae
  - d) Personal protection measures

7. Adult populations of black flies are difficult to control because of
- a) Insecticide resistance
  - b) Broad dispersal potential
  - c) The wide variety of resting places
  - d) All except A
  - e) e) All

### Short answer questions

8. Write the name of the drug that is currently used in the onchocerciasis control program.
9. List the typical characteristics of the small black fly that helps to differentiate it from other flies.

## 6.2. Definition

Onchocerciasis or “river blindness” is filarial parasitic disease affecting the skin and eyes. The adult worm lives inside fibrous nodules in the subcutaneous tissue. The fertilized female worms release thousands of microfilariae that migrate through the lymphatic vessels and cause inflammatory reactions responsible for the skin and eye lesions where they die and degenerate.

## 6.3. Cause

Onchocerciasis is caused by macrofilarial worm *Onchocerca volvulus*

## 6.4. Mode of transmission

Onchocerciasis is transmitted by the vector female black fly of the genus *simulium*. The vector breeds in fast flowing rivers or streams because of the demand for highly oxygenated water during the maturation of the larvae.

Factors that favour transmission are:

- ▶ The presence of fresh flowing river.
- ▶ Presence of black fly.
- ▶ Presence of people infected with onchocerciasis.
- ▶ Working or living near rivers
- ▶ Long stay in the endemic area

The history should determine:

- People living or coming from onchocerciasis endemic areas.
- Presence of persistent itching with skin lesions.
- Periodicity of itching (When does the itching get worse?  
day time/evenings)
- Intensity (severity) of itching (How much the itching interferes with the persons daily activity?)
- The distribution of the skin lesions (Which parts of the body are most affected)

## 6.5. Signs and Symptoms

### 1. Skin conditions:

#### 1.1 Early signs

- Persistent pruritis, erythema and edema of the skin.
- Popular, pustular, nodular or urticarial lesions on the back, thighs, buttocks, extensor surfaces of upper and lower limbs.
- Subcutaneous nodules on the face, back, shoulder, hip or trunk onchocercomata (containing adult worms)

#### 1.2 Late signs

- Lichenification (hyperpigmentation, thickening of the skin with increased skin markings)
- Lizard skin (dryness, roughness and scaling of the skin)
- Leopard skin (atrophy with depigmented and hyperpigmented lesions usually pretibial area)
- Lymphedema (persistent swelling of leggs)
- Hanging groin (atrophy of the skin and redundant folds with enlarged inguinal lymphnodes)
- Atrophy of the skin (thining of the skin with loss of skin markings hanging skin folds seen around the buttocks)
- Redness and swelling of the skin resembling erysipelas rarely occur knownas Erysipelas delacosta

## 2. Eye involvement

### 2.1 Early signs

- Reduced vision
- Keratitis (redness dryness of eyes)
- Iridocyclitis (redness around the cornea, photophobia and pain)
- Sclerosing keratitis (pain and haziness of cornea)

2.2 Late sign- the most severe effect of the disease includes visual Impairment and blindness

## 6.6. Diagnosis

- The Extension Package Health Worker must observe such skin conditions according to sign and symptoms.
- If they are doubtful during home visits they should send for further investigation (laboratory investigation skin snip).
- Identify typical differences with other skin diseases having similar characteristics, e.g. scabies.

## 6.7. Management

Main control strategies of onchocerciasis are early diagnosis, prompt treatment and selective vector control.

- ❖ Itching which is severe during the night must be distinguished from scabies. Nurses should teach and show clear distinction between onchocerciasis and scabies.
- ❖ Any chronic dry skin condition observed during home visits should be sent for investigation.
- ❖ Proper visual test and record by using snellen chart.
- ❖ Participating in home based (community directed) treatment of ivermectin.
- ❖ Teaching to prevent accident due to poor vision. EPHWs participate in large scale or community based distribution and treatment of ivermectin once or twice per year. Initially it has to be decided that:
  - Who should distribute ivermectin

- How the drug should be distributed (for example, at central place, house-to-house and at clinic)
- When the drug is distributed
- ❖ They must list the contraindication and side effects during ivermectin treatment so as to refer ill person timely manner.
- ❖ Ivermectin is contraindicated to:
  - Pregnant mothers
  - Severely ill patients
  - Lactating mothers for a child less than 1 week
  - Height less than 90 cm or body wt less than 15 kg.
- ❖ Rehabilitation – when blindness occurs as a consequence of onchocerciasis, social, psychological and vocational rehabilitation. EPHWs can actively participate the blind person needs physical if they are guided properly.
- ❖ EPHWs provide family- centred survey and case management by providing ivermectin.
- ❖ EPHWs teach the community they serve to wear long sleeved clothes and about typical characteristics of black flies to prevent the bite of the black fly.
- ❖ Keep records properly to report periodically. There are two record books:
  - Mectizan treatment record book.
  - Drug reaction record book for mectizan.
- Monthly report

### **Prevention and control:**

- The disease is diagnosed by its characteristics and confirmed by skin snip.
- The disease is preventable. Early diagnosis and start of the treatment is important. The patient must take the drug ivermectin once or twice per year for the recommended period of time.
- Failure to diagnose and start treatment timely and failure to take the drug as directed by onchocerciasis control program and failure to refer timely will result blindness.
- The disease can be prevented by the following methods:
  - ◆ Vector control
  - ◆ Early diagnosis and treatment (early start of ivermectin) and continued periodically (at least once a year)

- ◆ Preventing secondary infection and early treatment when the problem arises.
- ◆ Health education of the family and the community on the importance of:
  - Wearing long sleeved cloths
  - Understanding the patient's problem and how to reassure the patient.
- The training should mainly focus on:
  - Drug distribution
  - Health education
  - Community mobilization
  - Record keeping
  - Reporting monthly
- Regular surveillance in endemic area
- Information education and communication
- Annual distribution of ivermectin based on a national strategy.
- Proper record keeping and monthly report.

## **6.8. Guidelines to refer patients with onchocerciasis to the nearest HC during home based management by EPHW.**

Refer the patient

- If the nodule is on the head
- If there is sever allergic reaction following the treatment such as:
  - Muscular and joint pain
  - Sever itching
  - Fever
  - Dizziness
  - Diarrhea
  - Headache
  - Redness of the eye
  - Vomiting
  - Edema

- Any individual showing skin manifestation and who does not improve with symptomatic or supportive treatment within five to ten days.
- If the village level EPHW is not sure about the skin disease.
- If there is a history of vision impairment which has occurred during adult life following chronic skin disease.

### Task Analysis for Extension Package Health Workers

Learning Objective	Learning Activities
To define the nature of onchocerciasis	Study that onchocerciasis is the disease of skin and eye
To describe the cause	Identify that onchocerciasis caused by <i>Onchocerca voluvulus</i>
To state the modes of transmission	Recognize that onchocerciasis is transmitted by the bite of the female black fly simullium
To identify the major conditions of onchocerciasis	Study the signs and the symptoms of onchocerciasis. If possible by showing lizard skin.
To study factors initiating the occurrence of onchocerciasis.	Recognize factors that favour transmission such as: <ul style="list-style-type: none"> <li>❖ The presence of oxygenated river.</li> <li>❖ Presence of black fly</li> <li>❖ Working or living near the rivers that exposes for repeated bite of simullium.</li> <li>❖ Long stay in the endemic area</li> </ul>
To identify the preventive measures of Onchocerciasis	<ul style="list-style-type: none"> <li>• State early diagnosis and treatment to prevent the consequences of onchocerciasis</li> <li>• State the need for wearing long sleeved clothes</li> <li>• Study the importance of health education</li> <li>• State the need for vector control</li> </ul>
To believe that onchocerciasis is a public health problem	Give emphasis on health education to patients, family, school children and community.

Onchocerciasis is caused by infection with the filarial worm *O. voluvulus*. The microfilaria is one stage of the worm, but microfilaria does not cause onchocerciasis by itself.

## UNIT SEVEN

### GLOSSARY

- *Biopsy*- Tissue taken for examination from living organism.
- *Collapse*- to fall down suddenly.
- *Giemsa stain*- Romanousky stain used to stain blood cells and parasites.
- *Mectizan*: a synonym of *ivermectin*
- *Microfilaria*- Immature first stage of larva of filarial worm.
- *Nodule*- a small round swelling.
- *Oil emersion objective*- Microscope eye piece of 100x magnification.
- *Patch*- a pad worn over an injured body part.
- *Serological test*- A test method which bases on antigen antibody reaction.
- *Sheath*- Cover fitting closely over the larvae.
- *Skin snip* – Sharp and quick cut of skin with scissors or razor blade.
- *Topical*- external application of drug usually ointment.
- *Vertigo*- A feeling of loosing one's balance.

## UNIT EIGHT

### ABBREVIATIONS

- DNA-deoxyribonucleic acid
- ELISA- Enzyme linked immuno assay.
- PCR- polymerase chain reaction
- WHO-World Health Organization.
- OCP: Onchocerciasis control program
- APOC- African Program for Onchocerciasis Control
- EPOC- Ethiopian Program for Onchocerciasis Control
- CDTI- Community –directed treatment with the drug ivermectin
- NGOs- None governmental development organizations
- NOTF- National Onchocerciasis Task Force



## UNIT NINE

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## UNIT TEN

### ANNEXES

#### Answer keys to pre-test for all categories

1. Onchocerca volvulus
2. Black fly of the genus Simulium
3. 7.3 million
4. through the bite of infected black fly during a blood meal
- 5.
6. See the core module
7. E
8. D
9. B
10. A

#### Answer keys to pre-test for diploma nurses

1. B
2. A
3. C
4. D
5. C
6. D
7. B
8. C
9. Muscular and joint pain severe itching, fever, dizziness, diarrhea, vomiting, etc.
10. -pregnant woman
  - Mothers in the first month of lactation
  - Children under the age of five years
  - Those severely ill

## **Answer keys to pre-test for laboratory students**

1. B 2. B 3. C 4. C 5. D 6. C 7. D 8. C 9. B 10. B

## **Answer for Environmental Health Technicians**

1. E 2. C 3. D 4. E 5. E 6. F 7. D 8. E

## **Answer key for extension health package workers**

1. F 2. F 3. T 4. T 5. E 6. C 7. D

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