AFRICAN JOURNAL OF MEDICINE and medical sciences

Volume 37 Number 4 December 2008

ISSN 1116—4077

Afr J Med Med Sci (2008) 37, 327-332

APOC impact assessment studies: baseline ophthalmological findings in Morogoro, Tanzania

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Summary

The goal of the African Programme for Onchocerciasis Control (APOC) is to eliminate Onchocerciasis as a disease of public Health significance and an important constraint to socio-economic development in the 19 none OCP (Onchocerciasis Control Project) countries covered through Community-Directed Treatment with Ivermectin, CDTI. In 1998, impact assessment studies were carried out in Morogoro, Tanzania during which baseline ophthalmological parameters were established. The hypothesis being tested is that CDTI will prevent or delay progression of onchocercal eye lesions and blindness. A total of 425 subjects aged 10 years or more from 14 villages within Bwakira district of Morogoro region in Tanzania were examined for Snellen visual acuity, ocular microfilaria, lens opacities, uveitis and posterior segment disease especially chorioretinitis and optic nerve disease. Motion Sensitivity Screening Test (MSST) was carried out as well. Microfilaria was present in the anterior chamber of nearly half (49.2%) of all subjects examined. Prevalence of blindness was extremely high at 15.2%. Onchocercal lesions were responsible for blindness in 41.5% of these, followed by cataracts (27.7%), glaucoma (10.8%) and trachoma (6.2%). The main pathway to onchocercal blindness in this population was anterior uveitis with or without secondary cataracts. There is an urgent need to get CDTI underway and institute other horizontal primary eye care measures, especially cataract backlog reduction, in order to reduce the excessive burden of avoidable blindness in this community.

Keywords: *Baseline, ophthamological, APOC, onchocerciasis, impact, Tanzania*

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Résumé

Le but du programme Africain pour le controle de l'onchocércose(PACO) est d'élliminer l'onchocércose comme une maladie de santé publique significantive et une contrainte au developement socio économique dans 19 pays couvert par le traitement a l'ivermectin en CD1. En 1989 les études d'évaluation de l'impact étaient faite a Morogoro, Tanzanie ou les paramétres ophthalmologiques étaient établies. L'hypothese testée que le CD1 previendra ou retardera la progression des lésions onchocercales des yeux et l'aveugleté. Un total de 925 individus agés d'au plus 10 ans de 14 villages dans le district de Bwakira, Morogoro, Tanzanie étaient examinés pour l'acuité visuelle, microfilaire occulaire, opacités des lentilles uvete et désordre du fragment posterieur speciallement chorioretinité et du nerf optique. Le test de depistage de sensibilité du mouvement était aussi faite. Le microfilaire était present dans la chambre antérieure chez presque la moitié des sujets(49.2%) examinés. Le taux d'aveugleté était extremement élevée de 15.2% avec les lésions onchocercales responsable de l'aveugeté etait de 41.5%, suivi par le catarract de 27.7%, glaucome 10.8%, et trachome(6.2%).le chemin principal de l'aveugleuté onchocercale dans la population était uvete antérieure avec ou sans catarract secondaire.Il y a un besion urgent au CD1 et d'instituer d'autres mesures des soins ophthalmologiques primaires speciallement la réduction du catarract, afin de réduire la ménace excessive de l'aveugleté dans cette communaute.

Introduction

Onchocerciasis is estimated to affect 17.5 million persons most of whom live in sub-Saharan Africa [1,2]. The Onchocerciasis Control Programme, (OCP) set up in 1974 to carry out vector control activities in 11 west African countries, has recorded

remarkable success, and is now on the verge of eliminating the disease as a problem of public health importance. However, 85% of those affected live outside the OCP Zone [3] and have not benefited from the success of the programme. With the discovery in 1987 of Ivermectin, a new and safer microfilaricide for large scale use became available. The African Programme for Onchocerciasis Control (APOC), incorporating 19 none OCP countries with endemic onchocerciasis was therefore launched in 1995 with the aim of eliminating onchocerciasis as a disease of public health importance. APOC has adopted the control strategy of Community Directed Treatment with Ivermectin (CDTI), and the vector elimination when necessary and when feasible. The objective of CDTI is to put in place a community controlled sustainable mechanism of continuous ivermectin distribution even after the APOC programme ends.

The effect of large-scale distribution of Ivermectin on transmission of the disease as observed till date suggests that total interruption may not likely occur without prolonged and sustained mass chemotherapy [4]. CDTI may therefore need to be continued for decades in order to control the disease as a public health problem. In order to determine the long term clinical, epidemiological, social and economic impact of CDTI, it became necessary for APOC to conduct baseline studies in ophthalmology, epidemiology and the social sciences. To that end, 13 sites in nine countries, which on the basis of available information fulfilled certain criteria, were selected for the study. These criteria included uniformity in endemicity (meso-or hyper), adequacy of social and cultural stability, ivermectin treatment coverage below 25%, accessibility and the availability of REMO data.

Tanzania is located just south of the equator between latitudes 20-90 and longitudes 280-420E. Morogoro region is in the east central area of the country with 4 rural districts, including Bwakira. Onchocerciasis was first reported in Tanzania by Wagesa [5] in Bwakira district. In 1973, some clinical surveys were carried out in the same area by Abaru and Van Dam [6]. In some of the villages surveyed, skin snip prevalence was as high as 65% in children and 85% in adults. Recent research was also carried out in the area as part of a multi-country study into the importance of onchocercal skin disease in the endemic countries of sub-Saharan Africa. [7]. The Kilombero river watershed supports onchocerciasis transmission in its upper reaches. Both *S. dammosum* and *S. neavei* (species) vectors occur, but the majority of transmission is due to the *S. Dammosum* complex [8,9,10]. Communities within rural Morogoro region of Tanzania appear to have fulfilled the criteria listed above. Bwakira was selected for the impact assessment study on account of its being, based on available REMO data, hyper-endemic for onchocerciasis. At the time of the study, there were no Ivermectin control activities going on.

The aim of the study was to establish baseline ophthalmological parameters with a view to comparing them with findings in five years time following CDTI. The hypothesis being tested is that CDTI will prevent or delay progression of onchocercal eye lesions and blindness.

Materials and methods

The study was designed as a cross sectional survey. Following an enumeration exercise, the total population of the villages targeted within Bwakira districts was determined to be 1,740. After obtaining informed consent, all eligible persons aged five years or more from the 14 villages within the area were invited. A random sample of 750 persons was raised from this group, using a computerised random numbers program. All had skin examination, but only those aged ten years or more had their eyes examined. In this way, 425 individuals were selected for eye examination.

Certain critical indicators of eye health were selected for assessment. A computer data base compatible protocol was prepared and utilised in the recording of variables. The first examination to which patients were subjected was the Motion Sensitivity Screening Test (MSST) component of the computerised Visual Function Test (CVFT) as described by Wu *et al* 1992 (11). Essentially, a laptop perimeter and mouse were used for the test, the essence of which was explained to the subject in a language he understands. The test screen consisted of a number of vertical white bars, arranged in a 6 by 8 array, making a total of 48 bars. The test examined six locations within this grid which correspond to crucial positions in the visual field. At any stage, only one bar moved. Prompted by the motion of a bar, the subject, while maintaining fixation on a centrally marked point on the screen, clicks on the mouse in response. The programme obtained six or ten repeat measurements for each test location, depending on whether a rapid or standard test was being performed, which is usually a factor of the time available to the examiner. Detection of motion only between 0-2 times out of six or 0-3 times out of ten as the case may be, was categorised as a severe

defect, while 3-4 or 4-7 was taken as a moderate defect, and 4-6 or 8-10 was taken as normal. These scores were then aggregated for each eye to give an overall impression of the visual field performance. Hence, a total score of 12 (i.e.2X6) or less (18 or less for standard test) was taken as a severe field defect, and 24 (4X6) or less (42 or less for standard) as moderate field defect, and scores above these as normal.

Visual acuity was carried out using Snellen "E" optotypes in available outdoor light.

pallor without sheathing while the late form was severe pallor with sheathing. These conditions were graded and the distribution noted.

Data were entered on site using EPI Info version 6.4 and cleaning and analysis, using SPSS, done at APOC Headquarters in Ouagadougou.

Results

The mean age of the examined population was 42.9 year.+- 19.3 years , range 10 to 88 years, and modal age group 15.24 years. There were 220 males and 205 females. Overall M: F ratio was 1:0.9.

Table 1: Ocular disease indicators in Morogoro, Tanzania

Age yrs	Indicators (prevalence %) DMFC (Dead Microfilaria in Cornea)	MFAC (Microfilaria in Anterio chamber)	Punctate keratitis	Sclerosing keratitis	Iridocyclitis	Cataract (Any degree)
(M, F)	(14, 12)	(102, 106)	(24, 17)	(14, 6)	(27, 32)	(53, 60)
5-14 (22)	0 (0)	9 (11.2)	0 (0)	0 (0)	0 (0)	0 (0)
15-24 (82)	5 (6.1)	40 (48.3)	2 (2.4)	0 (0)	0 (0)	0 (0)
25-34 (44)	5 (11.4)	32 (72.7)	5 (11.4)	1 (2.3)	1 (2.3)	1 (2.3)
35-44 (59)	1 (1.7)	30 (50.9)	2 (3.4)	2 (3.4)	2 (3.4)	3 (5.1)
45-54 (72)	3 (4.2)	42 (58.4)	8 (11.1)	4 (5.6)	8 (11.1)	13 (18.6)
55-64 (79)	5 (6.3)	36 (45.6)	9 (11.5)	7 (9.0)	23 (29.1)	44 (57.9)
65+ (67)	7 (10.5)	20 (29.9)	15 (22.4)	6 (9.4)	25 (31.3)	52 (86.7)
Total (425)	26 (6.1)	209 (49.2)	41 (9.5)	20 (4.6)	59 (14.3)	113 (27.4)

Normal vision was taken as an acuity of 6/18 or better, visual impairment as acuity worse than 6/18 and better than or equal to 6/60 while severe visual impairment was acuity worse than 6/60 and better than or equal to 3/60. Blindness by acuity criteria alone was taken as acuity worse than 3/60 in the better eye. A slit lamp was used to examine for the presence of dead microfilaria, sclerosing keratitis (characteristic greyish white changes in the cornea in typical positions such as three and nine O'clock) and microfilaria within the anterior chamber following a two-minute head down posture. Signs of anterior uveitis were recorded and the presence of lens opacities was sought. Lens opacities were assessed as proportion of red reflex obliterated in the undulated pupil. Following assessment of pupillary responses, the pupils were dilated with short acting mydriatics and the posterior segment examined with both direct and indirect ophthalmoscopy. The fundi were examined for the presence of onchocercal chorioretinitis (characteristic changes in the retinal pigment epithelium, from mottling to confluent loss, to chorioretinal atrophy) and optic nerve disease (the 'early' form was a pink disc, possibly optic neuritis or mild/moderate disc

Considering both eyes, 303 (71.3%) subjects had normal vision, 43 (10.0%) were visually impaired, 11(2.6%) had severe visual impairment while 65 (15.2%) were blind by acuity criteria alone. Vision was unobtainable in 3 subjects. Visual impairment and blindness were more common with advancing age (Table 2). A total of 81 persons were blind in the right eye and 84 were blind in the left. Considering only the right eye, 218 (51.3%) had normal vision, 39 (9.2%) had visual impairment, and 90 (21.2%) were blind by acuity criteria alone.

Motion sensitivity test results were available for 89 subjects. Results were analysed for the right eye. Moderate field loss was demonstrated in 17 subjects (19.1%) but there was only one case of severe field loss. Field loss was first demonstrable in the 25-34 year age group (28.6%) but was most common in the 55-64 age group (33%). Field loss was also more common in females (M: F, 1:3.8) Results were similar for the left eye but the right eye is used as a sentinel as we analysed by individual not by eyes.

The age specific rates of ocular parameters measured are given in Tables 1 and 2. Dead

microfilariae (Mf) were found in the cornea of 26 (6.1%) subjects (M: F, 1:1.2). There is no clear trend with age. However, microfilariae were found in the anterior chamber (AC) of almost half of all subjects examined (209, 49.2%), M: F, 1:1.2). Punctuate keratitis (snowflake opacities), which are considered a reaction to the death of microfilariae in the cornea, were found in a total of 41 subjects (9.5%). The distribution did not show any particular age predilection but it was most common in the 65+ group. Sclerosing keratitis was found in 20 subjects (4.6%); there was a steady increase in the prevalence with age, attaining a peak of 9.4% in the 65+ age group. Iridocyclitis was also found in 59 subjects (14.3%) and was again commoner with advancing age. The prevalence of lens opacities also showed a strong tendency to increase with age and 27.4% of the total population had some degree of significant lens opacity. The overall prevalence of glaucoma was 4.2%. The prevalence was highest in the 65+ age group (13.6%).The prevalence of optic nerve disease also tended to increase with age. The overall prevalence in this cohort was 4.8%. It was highest in the 55-64 age group at 9.0%. It was of the 'early' from (i.e. pink disc, possibly optic neuritis or mild/moderate disc pallor without sheathing) in 18 subjects (4.3%) and late (severe pallor with sheathing) in 2 cases (0.2%). Onchocercal chorioretinitis was relatively uncommon in this cohort, being present in only 11 cases (2.6%). There was no clear trend with age.

Intraretinal deposits of all forms were found in 59 individuals (13.9%), 5 were drusen, 1 cotton wool spots, and 53 'other'. It is not clear if these were related to onchocerciasis. Overall blindness prevalence was extremely high in this cohort as 65 subjects were blind (15.3%). Blindness increased sharply from 1.7% in the 35-44 age group to 44.8% in the 65+ group. Essentially therefore, a little less than half of all subjects became blind by the 65+ age group. The contribution of onchocercal lesions to overall blindness was significant. Overall, 27 individuals (6.3% of entire population, 41.5% of the blind) were blind as a result of onchocercal lesions (Fig.1). Onchocercal blindness was twice as common in females (M: F, 1:2). Analysing the onchocercal blind indicated that 19 cases were due to anterior lesions only, 1 to posterior lesions only and 7 to both anterior and posterior lesions. Iritis with secondary cataract formation was the main pathway to anterior onchocercal blindness in this cohort accounting for 13 cases, while advanced sclerosing keratitis was a factor in 6 cases.

Table 2: Ocular disease indicators in Morogoro, Tanzania

Age group yrs (N)	Indicators (age specific prevalence %) Glaucoma	MSST (all defects) (N=89)	Optic nerve disease	Intra-retinal deposits	Oncho-chorioretinitis	Visual Impairment	Overall blindness	Onchocercal blindness
M, F	7, 10	2, 15	12,8	23, 36	5, 6	23.31	30, 35	9, 18
5-14 (22)	0 (0)	0	0	0	0	0	0	0
15-24 (82)	0	0	0	0	0	1 (1.2%)	0	0
25-34 (44)	0	2 (28.6)	1 (2.3)	2 (4.6)	1 (2.3)	0	0	0
35-44 (59)	0	2 (15.4)	3 (5.1)	1 (1.7)	0	2 (3.4%)	1 (1.7)	1 (1.7)
45-54 (72)	3 (4.4)	1 (6.7)	5 (7.1)	6 (8.4)	3 (4.2)	10 (13.9%)	8 (11.1)	3 (4.2)
55-64 (79)	5 (7.1)	4 (33.3)	7 (9.0)	27 (34.1)	5 (6.3)	18 (22.8%)	26 (32.9)	14 (17.7)
65+(67)	9 (13.6)	8 (20.2)	4 (7)	23 (34.3)	2 (3.0)	23 (34.3%)	30 (44.8)	12 (17.9)
Total (425)	17 (4.2)	17 (19.1)	20 (4.8)	59(13.9)	11 (2.6)	54 (12.7%)	65 (15.3)	27 (6.3)

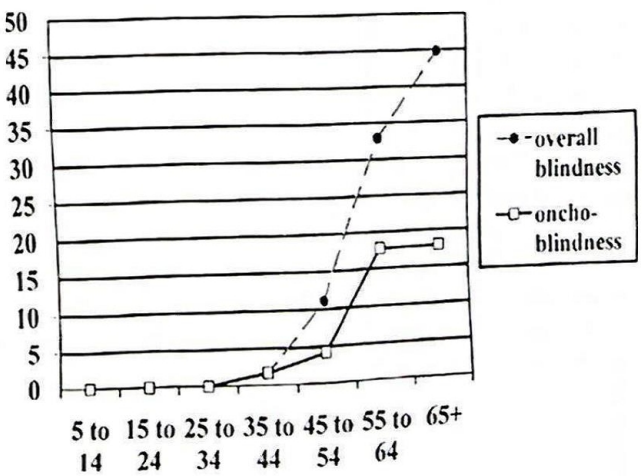
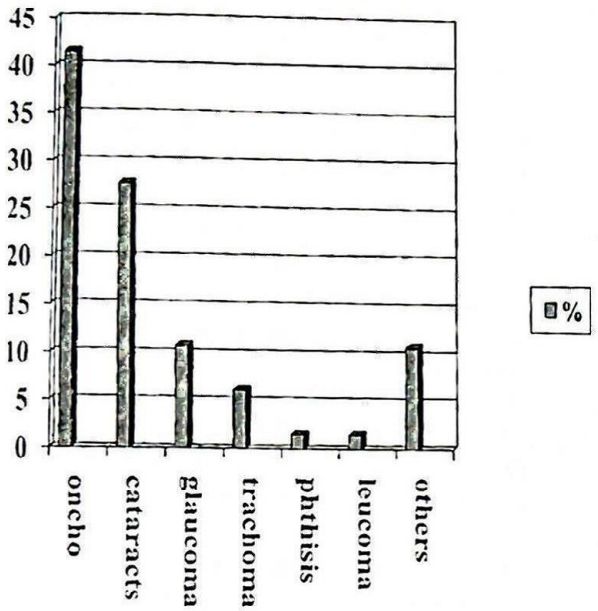


Fig. 1: Age (yrs.) specific prevalence (%) of blindness and onchocercal blindness, Morogoro, Tanzania

For all causes of blindness, the aetiology was as follows: onchocerciasis (41.5%), cataracts (27.7%), glaucoma (10.8%), trachoma (6.2%) phthisis bulbi (1.5%) and corneal opacity of unknown aetiology, (1.5%). Other conditions accounted for 10.8% (Fig.2)

Figure 2. Causes of Blindness in study sample, Morogoro, Tanzania. N=65.



Discussion

The prevalence of blindness (15.3%) was found to be extremely high in this community. Forty one percent of the blindness (6.3% of population) was associated with onchocerciasis in general and in particular with anterior onchocerciasis. The prevalence of microfilaria within the anterior chamber was also extremely high, with almost half of the examined population affected. There is little doubt that this is an extremely hyper-endemic focus for ocular onchocerciasis. The pattern in general was that of more anterior segment disease, and reminiscent of hyper endemic blinding Savannah onchocerciasis. Morogoro region in particular would appear to be a forest-savannah mosaic area. It had onchocerciasis foci in all its four rural districts. The Kilombero river watershed supports onchocerciasis transmission in its upper reaches, as the numerous streams flow downstream from the Udzungwa range. This rift valley wall separates the Rufiji valley from the southern highland zone. Prospection carried out at the time of this study by one of our team revealed that both *S.damnosum* and *S.neavei* species vectors occur, but the majority of transmission is due to the *S.damnosum* [9]. Monthly transmission potentials showed a diurnal range during the year and peaked in July (219 infective larvae/man/month) and in December (240 infective larvae/man/month). The total annual transmission potential therefore approached 1182, a level normally associated with blinding eye disease.

The main pathway to blindness in this cohort was anterior uveitis with secondary cataract formation. Iridocyclitis was responsible for three-quarters of the anterior segment onchocercal disease. There was a paucity of posterior segment disease, especially chorioretinitis which is often the case in classical savannah ocular onchocerciasis, although experience in Kaduna, Nigeria [2] showed that in some so called savannah foci, oncho-chorioretinitis and optic nerve disease could be common and a major factor in blindness. By the same token, optic nerve disease did not appear to be a prominent cause of ocular morbidity, disc pallor being found in only 20 subjects (4.8%), of the early variety except in one case. MSST data revealed a 19.1% defect rate. However it must be noted that corneal and lenticular media problems may have contributed to this overall figure and it may therefore not reflect directly the prevalence of optic nerve disease.

In the older age groups, cataracts emerged as a more prominent problem. In subjects 65 years and above, 86% were found to have some degree of clinically significant lens opacity. Of this number 58.2% (39) had opacities obscuring more than half of the pupillary light reflex. Of the 30 blind persons in this age group, 10 had operable cataracts as a 'main cause' of ocular pathology, meaning that 1/3 of the patients in this group could potentially benefit from sight restoring surgery. There appears to be a significant cataract backlog in this area.

Intra-retinal deposits, found in about 14% of all cases in this cohort, may be associated with early posterior segment onchocerciasis. However it was difficult to distinguish from them from drusen. It is not clear what they represent at present.

In summary, an onchocerciasis endemic area in Morogoro region of Tanzania is described in which over half of the population demonstrates evidence of ocular onchocerciasis. Onchocerciasis is also found to be a major cause of ocular morbidity and blindness, the prevalence of blindness being extremely high at 15.3%. There is an urgent need to get CDTI underway and institute other horizontal primary eye care measures, especially cataract backlog reduction, in order to minimise the excessive burden of avoidable blindness.

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Received: 16/01/08
Accepted: 20/10/08