British Journal of Medicine & Medical Research
4(8): 1672-1679, 2014

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Assessment of Antiretroviral Effects of a Synthetic Aluminum-magnesium Silicate

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Authors' contributions

All the authors collaborated for the research. Author MCE synthesized the AMS, designed and coordinated the experiments and drafted the manuscript. Authors IA, BA, PO and IFI confirmed the samples as HIV positive while authors AAN and JOE tested effects of the AMS on titres of HIV in the samples. Authors IKK and IOE analyzed the results for statistical differences. Author IJM processed the manuscript for publication. All authors read and approved the final manuscript.

Original Research Article

Received 25th September 2013
Accepted 9th December 2013
Published 24th December 2013

ABSTRACT

Aim: For an affordable therapy for Human immune-deficiency virus (HIV) infections, antiretroviral effects of a synthetic aluminum-magnesium silicate (AMS) were tested.
Materials and Methods: Plasma that tested positive to HIV and the AMS were mixed, on equal volume to weight basis, incubated one hour at room temperature and centrifuged for ten minutes at 3,000 revolutions per minute. These procedures were repeated on each supernatant. HIV titres of the two sets of supernatants and the titres in portions of the plasma, not incubated with the AMS were assessed by direct passive hemagglutination test.
Results: Mean HIV titres of the plasma increased from 4.00±1.60 to 14.00±2.00 when incubated with the AMS. Repeating the incubation, reduced mean HIV titres in plasma from 14.00±2.00 to 6.50±1.50 (P=0.024).
Conclusion: It was concluded that the AMS has antiretroviral effects and could be an

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inexpensive antiretroviral therapy for regular treatment to reduce high rate of HIV infection among low income groups.

Keywords: Opposite electrical charges; human immune deficiency virus; aluminum-magnesium silicate (Nanoparticles).

1. INTRODUCTION

Africa had highest number of new HIV/AIDS cases reported in 2012 [1-4]. World health organization [5] also, reported that, of over 33 million people, living with HIV in 2011, more than 95% of the new infections came from Asia, South America and Africa.

Available antiretroviral therapies (ARTs) are too expensive for most people living with HIV in Africa. So, there is need for cheaper ARTs. Even the developed countries need new ARTs, because, rate of occurrence of new HIV infections is reported to outpace available drugs [6].

Antiviral medicines should inhibit activities of viruses but cause no harm to animal cells [7]. They terminate infection process of specific viruses by inhibiting viral attachment to host cells, virus-host cell fusion, viral uncoating or reverse transcription of viral genomic RNAs [8,9].

Molecules of aluminum–magnesium silicate (AMS) are composed of platelets which have negative electrical charges on their surfaces and the positive charges on their edges [10]. Also, genome of viruses is positively charged, while viral phosphate component is negatively charged [11]. So, some viruses end up with net positive electrical charges while others end up with the net negative charge. HIV has net positive electrical charges [12].

AMS has been used as medicine and in drug formulations for many decades without report of toxicity [10,13,14]. Possession of both negative and positive electrical charges makes AMS a broad spectrum antiviral medicine, because, when a significant number of particles of invading viruses adsorb onto its molecules instead of onto their hosts cells, viral infections are terminated.

Platelets of AMS molecules are also, only 0.96 nm thick [10]. So, it is made of *Nanoparticles* [15]. Small size of *Nanoparticles* makes it possible for them to pass physiological barriers. Therefore, AMS may get to and adsorb to HIV particles in any organ of infected persons. Adsorbing out HIV means that millions of new virions usually released from each infected cell would be inhibited from establishing new infections in more cells. Thus, HIV would be prevented from overwhelming the body immune systems and the acquired immune-deficiency syndrome (AIDS) stage may be prevented. When the AIDS stage is prevented, the immune systems have advantage over HIV infections and clear viral particles that escape the AMS molecules [5].

To overcome impurities in natural AMS, aluminum silicate and magnesium silicate, which are also, safe medicines[13], were reacted, to get a synthetic AMS [16]. Dextrose monohydrate, was added to *The synthetic AMS,* to transport its molecules across mucouse membranes of the gastro-intestinal tract, into blood and then to all organs [17].

Studies have shown that the AMS has antiviral effects against all seven viruses so far tested [18-24]. Since net electrical charge of HIV is positive, while those on AMS platelets are negative [10,12], AMS may have antiretroviral effects.

The substances reacted to get the AMS are very cheap minerals that are readily available in many parts of Africa. So, the AMS promises to be a cheap ART which low income patients can afford, for regular treatment, to reduce HIV infection rate in the continent.

2. MATERIALS AND METHODS

Five plasma, confirmed positive for HIV antibodies, by solid phase ELISA, were treated with the AMS, in vitro. **E**qual amounts, on volume to weight basis, of each plasma and the AMS were mixed, incubated at room temperature for one hour and centrifuged at 3,000 revolutions per minute, for 10 minutes. The incubation and centrifugation were repeated on a portion of each plasma. Another portion of each sample, not incubated with the AMS served as control. HIV titres of, supernatants of the plasma incubated with AMS once, plasma on which the incubation was repeated and the controls were assessed, by direct passive hemagglutination test [25]. Reciprocal of highest dilution of each plasma or plasma supernatant that gave complete passive agglutination of sheep red blood cells, was read as its HIV titre, on the condition that its next higher dilution tested positive to HIV antibodies, by the ELISA test. Mean titre of the control group and mean titre of the group of plasma supernatants on which the incubation with AMS was repeated were each compared with mean HIV titre of the group incubated only once, for statistical differences, by the *Students T test*.

3. RESULTS

One of the plasma samples gave HIV titre of 32 initially, but when incubated with the AMS, its HIV titer was above 4096. Second incubation of this particular plasma with the AMS reduced its HIV titre from $\geq$ 4096 to 16 (99.60% reduction). Also, a plasma that tested positive to HIV antibody by the solid phase ELISA, was initially negative for the virus but when it was incubated with the AMS it gave positive result for the virus.

HIV titres of all the four samples, also increased significantly (P = 0.009) from a mean of 4.00±1.63 to 14.00±2.00, when incubated with the AMS once. When incubation with the AMS was repeated, the plasma HIV titres reduced significantly (P=0.024) from a mean of 14.00±2.00 to 6.50±1.50 (Tables 1 and 2).

Table 1. Human immune deficiency virus titres of plasma samples incubated, with a synthetic Aluminum-magnesium silicate

Plasma samples	HIV titer	
	Control	Incubated with AMS
1	0	8
2	4	16
3	8	16
4	4	16
Means	4.00±1.63	14.00±2.00

First incubation of specimens of the Human immune-deficiency virus with the synthetic AMS, significantly (P= 0.009) increased their viral titres.

Table 2. Human immune deficiency virus titres of plasma samples, on which incubation with a synthetic Aluminum-magnesium silicate was repeated

Plasma samples	HIV titer	
Number of incubations with AMS:	1	2
1	8	2
2	16	8
3	16	8
4	16	8
Means	14.00±2.00	6.50±1.50

A second incubation of specimens of the Human immune-deficiency virus with the synthetic AMS significantly (P=0.024) reduced their viral titres.

4. DISCUSSION

Earlier studies conducted by treating virus-infected animals with the synthetic AMS (per os), confirmed its antiviral effects [18,21,22]. Chicks infected with *Newcastle disease virus* and treated with the AMS had their mortality rate reduced from 20% to zero % while those challenged with *Infectious bursal disease virus* also had zero % mortality rate against 30% of the untreated group. *Canine parvovirus* infected dogs treated with it had 100% recovery while all untreated cases died. Untreated dogs that died of the CPV challenge had histopathologic lesions in their hearts, lungs and livers, while those treated with the AMS had no organ lesions. This suggests that the AMS gets to different organs of treated animals to inhibit viral activities.

Results of the antiretroviral effects of the AMS*,* showed that incubating HIV positive plasma with it caused an increase in their viral titres at first, but a repeat incubation with the AMS reduced HIV titres in all the samples. The 99.60% reduction of HIV titre in the specimen that had its HIV titre increased more than 4096, following the repeat incubation, is significant. It has been reported that when antimicrobial drugs achieve 95 % reduction of infection rate or above, the patient would be cured of the infection [26]. So, the reduction of the virus titre by as much as 99.60% suggests that the AMS may lead to effective treatment of HIV infections.

The observation that when HIV specimens were incubated with the AMS, their viral titres increased initially, instead of reducing, is similar to results got with *Peste des petits ruminants virus* (PPRV) and *Fowl pox virus (FPV)*.

Replication processes of HIV, PPRV and FPV are similar in that their new virions are released from infected cells by budding off [5,27,28]. When viruses bud off, instead of destroying infected cells, some virions remain, attached to the cells. Virions that remain attached to cells would not sensitize (infect) RBCs used in direct passive hemagglutination test*.* So, the test may not have detected HIV virions that were attached to cells in the plasma samples.

One of the uses of Aluminum-magnesium silicate in drug formulations is to aid disintegration of capsules when swallowed, to release the active drugs [10]. It is therefore possible that first incubation with the AMS selectively disintegrated cells to which some HIV particles were attached. HIV particles released from cells by the AMS may be responsible for the increased

titres, recorded with all the samples. With the second incubation, the viral particles that were now free may have been bonded to the AMS molecules by electrostatic attraction between the positive electrical charges of HIV and the negative charges on faces of AMS platelets. So, centrifugation removed the particles, hence the significant reduction in the viral titre, from 14.00±2.00 to 6.50± 1.50(P=0.024).

It was suggested that when a sample tests negative for HIV with direct passive hemagglutination test, the test should be repeated, with the plasma diluted in HIV specific serum, in place of PBS, to ensure presence of HIV antibodies, before it can be concluded that such plasma is negative for the virus [25]. However, in this experiment, one out of the five plasma that tested positive to HIV antibodies by solid phase ELISA, was initially negative for the virus by direct passive hemagglutination test, but following incubation with AMS, it became HIV positive. This observation therefore requires that when samples test HIV negative by direct passive hemagglutination test, they should be incubated with AMS, to release any viral particles that may be attached to cells. If a repeat of direct passive hemagglutination test with a portion of the specimen, incubated with AMS still gives negative result for HIV, in the presence of HIV antibodies, the patient can then be declared negative for the virus. It may be that all the HIV particles in that plasma were attached to the host cells, until the first incubation with the AMS.

Apart from its antiviral effects, the AMS, has enhanced antimicrobial actions of Sulphadimidine [29], Piperazine [30], Chloroquine [31] and Ampicillin [32] to make their lower doses achieve better infection clearance than their recommended doses. This may have resulted from the fact that use of lower doses of drugs minimizes their side effects. So, immune systems of the treated animals functioned optimally, while prolonged bioavailability of the drugs, by stabilizing them with the AMS, led to improved actions of the lower doses. When dose of Ampicillin trihydrate was reduced to 75% in order to minimize its side effects and its bioavailability was prolonged with the AMS and feeds of experimental chicks were fortified with immune-stimulants, 95.8% of an Ampicillin-resistant *E. coli* infection was cleared [33].

Medication regimen of AMS-antimicrobial drug formulations and immune-stimulants may be effective in managing HIV/AIDS patients since major harm in the disease is done by secondary infections. The formulations of AMS and antimicrobials, effective against secondary infections known to associate with HIV in each environment could be administered to HIV/AIDS patients in that environment at start of antiretroviral treatments. After the treatment has lasted for the recommended course of treatment of the antimicrobials, the combined drug could be withdrawn while the patients continue on AMS and immune-stimulants alone, till their plasma test negative for the virus.

5. CONCLUSION

Low cost of Aluminum-magnesium silicate, its none toxicity, its ability to potentiate antimicrobials against secondary infections and to selectively disintegrate virus-infected cells, plus antiviral effects of *The Synthetic Aluminum- magnesium silicate* against all viruses of five families earlier tested and the significant reduction in mean HIV titre it achieved in this study, justify its use for clinical trials on people living with HIV.

CONSENT

The authors declare that the hospital authorities consented to, use of the samples, for in vitro studies, only.

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=380&id=12&aid=2831