Kala-azar: Past, Present and Future

A Review

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Kala-azar

- A vector born disease

- Confined to some of the tropical and sub-tropical regions

- In India, it appeared first in Bengal Gangetic plains and from there spread to Assam and Bihar, further to Tripura and eastern UP

- Sporadic cases reported from Gujrat, Maharastra, Tamil Nadu, Orissa, Himanchal Pradesh and Jammu & Kasmir

- Transmitted by female sandfly

- In India,
  - female *P. argentipes* is the vector
  - Causative parasite: *L. donovani*
## Incidence of Kala-azar in Bihar

<table>
<thead>
<tr>
<th>Year (July)</th>
<th>Case</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>37819</td>
<td>172</td>
</tr>
<tr>
<td>2008</td>
<td>28489</td>
<td>142</td>
</tr>
<tr>
<td>2009</td>
<td>20519</td>
<td>80</td>
</tr>
<tr>
<td>2010</td>
<td>23084</td>
<td>95</td>
</tr>
<tr>
<td>2011</td>
<td>25175</td>
<td>76</td>
</tr>
<tr>
<td>2012 (July)</td>
<td>11190</td>
<td>19</td>
</tr>
</tbody>
</table>
BIOTOPES OF ENDEMIC VILLAGES

- Peridomestic Vegetation: predominance of deciduous and thorny bushes
- Water bodies
- Interaction of Human beings and Livestock
- Interaction of Human beings and Livestock
Field Photographs
Field Photographs
Amastigote
Promastigote
General features of sandfly

- Small in size
  (less than 3.5 mm, about 1/3 of mosquito size)
- Large conspicuous compound eye
- Body covered with sandy or brown coat of hairs
- Hind legs longer than body
- Erected V-shaped wings
- Wings are almost parallel in the resting position
Life cycle of Sandfly

- Egg
- Larva
- Adult
- Pupa
Adult

- Pupa emerges into adult.
- Development from egg to adult takes about 20-36 days.
- Crepuscular in habit and endophilic in nature.
- Found in cracks & crevices in dark corners of house/ cattle shed, caves, animal burrows, termite hills, tree holes.
- Incapable of flying long distance, just hops.
Longevity

- Very meager information available
- Under lab. Condition,
  - Gonotrophic cycle of 4-5 days
  - Max. longevity 23-27 days
- Triparous females are found in more numbers between July – Sept.
Distribution of *P. argentipes*

- Prefers hot & humid climate
- Found in VL endemic areas of Bihar, West Bengal, Assam and Eastern UP
- Also recorded in high densities in Southern peninsula and Central India.
- Vertical distribution has been recorded up to 1300 meters above the sea level in Garhwal (Uttaranchal) and 1100 meters in Nilgiri hills (Tamil Nadu)
Disease transmission

- Through bite of infected *P. argentipes*
- Leishmanial form enters the gut of the vector, when it feeds on infected host
- In gut of sandfly, leishmanial form develops into nectomonoid form
- Nectomonoid form multiplies by binary fission and large number of flagellates are produced.
- When infected *P. argentipes* bites uninfected people, disease may be transmitted.
Disease transmission
Parasite development in sandfly gut

- Three types of development:
  - **Suprapylarian**: *L. donovani*
  - **Peripylarian**: *L. braziliensis* complex
  - **Hypopylarian**: Sauroleishmanial group
Suprapylarian development

- Nectomonoids migrate to anterior part of foregut, undergo morphological changes and transform into stumpy electron light forms “heptomonoids”.
- Heptomonoids migrate into pharynx, undergo morphological changes and transformed into “Opisthomastigotes”.
- Opisthomastigotes penetrates into the bucal cavity and enters into next vertebrate host during blood sucking.
Peripylarian development

- Development of parasite in the hindgut and migrate to anterior region for transmission through bite

- Observed in case of *L.brazilliansis* complex
Hypopylarian development

- Development of parasite in the hindgut and transmission through engulfment
- Observed in case of *Sauroleishmania* Group
Detection of natural infection

- **Direct Method**
  - Traditional dissection method and steroscopic examination

- **Indirect Method**
  - Using non-radioactive probe based on the total DNA of the parasite.
  - The probe was labeled with Diagoxigenin and used to detect *L. donovani* in *P. argentipes*.
  - Sample size: 428 sandflies collected from infected households
  - Positive signal detected in 12 (32%) of the 38 pools (2-30 sandflies)
  - Others are monoclonal antibody test and PCR
Transmission season

- Several views by several workers

- **Sanyal et al:**
  - Peak incidence of VL is June-August, which coincides with peak density of sandfly

- **Dhiman and Sen:**
  - Two transmission season; one before monsoon and another after winter

- **Kishore et al:**
  - Transmission occurs round the year
Control of sandfly

Best method to interrupt any vector borne disease is to reduce man-vector contact.

Methods

- Chemical method
  - DDT
- Environmental method
- Biological Method
- Prophylactic method
  - Malathion
Chemical Control Method: DDT

- DDT (50% w.d.p.) spray up to a height of 6 feet
- PHC area as unit of the spray
- Supply of DDT by Govt. of Bihar & West Bengal in their respective endemic areas.
- Two rounds of DDT spray
  
<table>
<thead>
<tr>
<th>States</th>
<th>1st Round</th>
<th>2nd Round</th>
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<tbody>
<tr>
<td>– Bihar</td>
<td>Feb. – March</td>
<td>May – June</td>
</tr>
<tr>
<td>– West Bengal</td>
<td>May – July</td>
<td>Aug. – Oct</td>
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- Insecticide susceptibility test in Vaishali (Bihar) reveals DDT resistant foci as only 18-53% susceptibility was observed.
DDT SPRAY OPERATION

- Suspension making
- Suspension Quality Check
- Spray Preparation
- Discharge rate
Spraying

Stencil on wall

Sprayed wall

Leakage
Chemical Control Method: Malathion

- SRES (Slow Release Emulsified Suspension)
- A WHO sponsored project undertaken by RMRI
- In study village, 5% malathion suspension was used in the dose of 2 gm/m².
- Control village sprayed with recommended dose of DDT
- Study reveals the effectiveness of malathion for 24 months in comparison to only 3 months for DDT.
- No toxicity was observed.
- P-value for Plasma cholinesterase level conducted are as below:
  - For spray men within one week <0.01*
  - For exposed individuals after one month <0.01*
  - For exposed individuals after one year >0.01
    (* Significant, but within the normal range)
- A cost effective approach
Environmental Control Method

- Aimed at source reduction
- A study on Techno-ecological control was undertaken by RMRI
- Pre evaluation of sandfly density carried out in study area
- All cracks & crevices of human dwellings and cattle-sheds were plastered with mud and lime
- Post operation evaluation of sandfly density revealed successful interruption of sandfly breeding.
MUD PLASTERING
APPLICATION OF LIME
Biological Control Method

Palit et al. (RMRI) demonstrated that mites are helpful in checking the population of sandfly.

Prophylactic Control Method

- Self protection by use of bed nets and repellants
- Nets of 36-42 mesh will definitely prevents from sandfly biting
- Effective repellants compounds are Deet, DMO, Citronella
- 2% neem oil mixed with coconut or mustard oil provides 100% protection against *P. argentipes*. 
Identification and characterization of *L. donovani* (promastigote) antigen of naturally infected *P. argentipes*
Identification and characterization of *L. donovani* (promastigote) antigen of naturally infected *P. argentipes*

- Demonstration of natural infection in *P. argentipes* for the infectivity status with the help of immuno dot- Blot.

- Determination of peptide responsible for parasite infection in *P. argentipes* by SDS-PAGE.

- Identification of immuno-reactive poly peptide band by Western blotting &

- Development of polyclonal as a diagnostic tool.
Evaluation of impact of DDT indoor residual spraying being used in Kala-azar control programme on the disease prevalence.
Efficacy of impregnated bed-nets as a vector control measure
i. To assess the efficacy of impregnated bed-net use as vector control measure.

ii. To assess the impact of the intervention measure at the community level.
COMMUNITY PARTICIPATION
CL Patients in Bikaner
Future scope for Elimination of Kala-azar

- Inclusion in middle lass curriculum for awareness in the coming generation
- Self Help Group at village/ panchayat level
- Social mobilization
- Improved IEC activities
- Thorough two round spray for at least 3 consecutive years
- Monitoring & evaluation of the programme with commitment at all levels
- Strict vigil on maintenance phase