CLINICAL PROFILE OF LEPTOSPIROSIS IN NORTH CHENNAI -A STUDY OF 106 CASES

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CERTIFICATE

This is to certify that the dissertation titled **"CLINICAL PROFILE OF LEPTOSPIROSIS IN NORTH CHENNAI- A STUDY OF 106 CASES"** is the Bonafide original work of DR. B.KRISHNAKUMAR in partial fulfillment of the requirements for M.D. Branch – I (General Medicine) Examination of the Tamilnadu DR. M.G.R Medical University to be held in September 2006. The Period of study was from May 2004 to December 2005.

PROF. S. NATARAJAN, M.D. Professor and Head of the Dept. of Medicine, Govt. Stanley Medical College and Hospital Chennai-600 001.	**PROF. S.SHIVAKUMAR** Professor of Therapeutics Govt. Stanley Medical College and Hospital Chennai-600 001.

DEAN
Govt. Stanley Medical College & Hospital,
Chennai – 600 001.

DECLARATION

I, **DR. B.KRISHNAKUMAR ,** solemnly declare that dissertation titled **"CLINICAL PROFILE OF LEPTOSPIROSIS IN NORTH CHENNAI- A STUDY OF 106 CASES"** is a Bonafide work done by me at Govt. Stanley Medical College and Hospital during May 2004 to December 2005 under guidance and supervision of my unit chief **Prof. S.SHIVAKUMAR**, Professor of Therapeutics.

This dissertation is submitted to Tamilnadu DR. M.G.R Medical University, towards partial fulfillment of requirement for the award of **M.D. Degree (Branch – I) in General Medicine.**

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Date :

(Dr. B.KRISHNAKUMAR)

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Introduction

Infectious disease is an important cause of morbidity and mortality in our country. Leptospirosis has been considered a rare zoonotic disease in India, with only sporadic cases recorded. Recently, however the disease was reported in Chennai during monsoon months in mini-epidemic proportions.[1]

In Chennai leptospirosis occurs in severe form causing jaundice and renal failure. It is usually reported during monsoon months. Recently diagnosis of leptospirosis has been simplified using modified Faine's criteria. This criteria utilizes clinical, epidemiological and laboratory parameters for diagnosis. This criterion has been useful for diagnosis of milder forms of leptospirosis. This study has been undertaken to study the clinical features, epidemiological profile of leptospirosis in our hospital which caters to population in north Chennai.

Leptospirosis has been frequently under diagnosed and under reported due to lack of awareness of disease and lack of appropriate diagnostic facilities. Combining clinical expertise & aware ness with laboratory backup, increases the recognition of the disease.

Aim of the study

1) To study the clinical features of mild & severe leptospirosis utilizing modified Faine's criteria in North Chennai.
2) To evaluate the epidemiological risk factors in these patients.

Review of literature

Organism:

The genus leptospira comprises the pathogenic leptospires (L.interrogans) and saprophytic leptospires (L.biflexa). L.interrogans comprises 23 serogroups and over 200 serotypes.

Leptospires have narrow diameter of 0.1mm and vary in length from 3 to 20microM. It ends are hooked. It has both primary & secondary coils. They are actively motile, spin about long axis & bend sharply. It cell is covered by 3-5 layered membrane, the outer envelope. It encloses protoplasmic cellular components. Two flagella are located between outer envelope & protoplasmic cylinder, one at each end of cell. The cytoplasm contains nuclear material, ribosomes, mesosomes and inclusion bodies.

Epidemiology

Animal reservoirs

Mammals are the most important animal reservoirs. Leptospires are parasites of both wild and domestic animals. Wide variety of animals may serve as a source of infections like rats, field mice, hedgehog, fox, mongoose, deer and domestic animals like cattle, sheep, goats, and poultry. Intensity of infection in animals depends upon climatic conditions**.** Infection in animals may vary from in apparent infection to fatal disease. In infected animal, initial leptospiremic phase followed

by a period in which organism confined to kidneys. Leptospires are excreted in the urine and the animal is a carrier.

Man is accidental host, the carrier state is transient, and in maintenance host it may be present for many years. It is well known that particular host species may serve as a reservoir for one or more serotypes of leptospires and conversely a given serotype may be hosted by multiple animal species. The serovars most frequently associated with rodents are ictero hemorrhagiae and autumnalis, with cattle are Pomona and tarassovi; with sheep & goats are Pomona and grippotyphosa and with dogs are canicola & icterohemmorhagiae.

Transmission to human host

Transmission to humans can be

Direct – by contact with blood, tissues, organs & urine of infected animals.

Indirect – by exposure to an environment contaminated with leptospires. Water & soil contaminated with infected urine

Human to human transmission is rare. The organism enters through cuts & abrasions in the skin and mucous membrane such as conjunctiva, vagina, nasopharynx & intestine. They do not cause local inflammatory reaction at the site of infection.

Contaminated environment

It is defined as an environment which has both water source & infected animal. Since transmission of leptospires depends not only on the relationship between animal reservoirs and man, but also on the environment that favors survival of leptospires outside animal host.

Factors favoring survival of leptospires are moisture, temperature 28-32 deg. C, PH of the soil & surface water 6.2 – 8.

Factors impede the survival are salinity, chemical pollution & acidic PH.

Flooding after heavy rains is particularly favorable for leptospires. It can survive few hours in dry soil abut can survive up to 6 months in flooded conditions. Fresh water was recognized as an important vehicle for the transmission of leptospiral infections to man.; rat urine contamination of water in wells, sewers etc. remain an important mode for the transmission of leptospirosis to man. Surface waters into which organisms are excreted may remain infectious for several weeks.[2]

Smith and **self** first demonstrated the survival of leptospires in culture infected soil for 43 days and in urine infected soil for 15 days. Under favorable conditions in cane- field, soil becomes contaminated by rodents and after rains. The surface waters are probably contaminated by migration of leptospires from soil. [2]

Beck & barbehem were able to isolate leptospires from soil at multiple sites along a river bed in St.louis County. [2]

Everard & Everard pointed that in urban & rural areas of developing countries where leptospires is wide spread in the environment and where disease is endemic, infection will be related to " the way of life" as well as to specific occupation. Thus where large number of rodents, stray dogs and wild animals, where people drink or bathe in untreated water, where sewerage and drainage are inadequate, where garbage disposal is inefficient and where open shoes or none at all worn, leptospiral infection can be common.[1]

In Barbados 97% of human hospital cases are caused by L.bim, L.copenhageni and L.arborae, all of which are mainly maintained by rodents on the island.[3]

In England & wales between the year 1985 – 89 the average annual number of confirmed cases was 60, 12/100000 per year. The minimum incidence of severe illness in Dominica between 1989 – 90 (23/ 100000) was 192 times higher than that of England & wales implicating environmental contamination.[3] Another potential threat arises from live stock handling. Many are likely to contract the infection from rodents attracted to animal feeds. In Chennai maleness, high rainfall & outdoor manual occupation (Table-1) encourage higher incidence rates of leptospirosis and that more specific source cannot be pinpointed with certainty.

Occupation

Table - 1

Work category	**Chennai, 1990 n=57 (1) %**
Outdoor manual	49%
Outdoor non- manual	12.3%
Indoor manual	8.8%
Indoor non- manual	10.5%
Manual	57.8%
Non –manual	22.8%
Outdoor work	61.3%
Indoor work	19.3%
House wife	12.3%
Students	
Unemployed/ retired/ unknown	7.1%

Leptospirosis can survive outside the host vertebrae easily under conditions of warmth and adequate rainfall & if looked for it can be readily detected in man and other mammals throughout the tropical belt.

In another study from Chennai, there has been dramatic increase in leptospirosis during the past few years. Between the years 1979 – 84, there were only 9 cases of leptospirosis in the govt. general hospital, Chennai. While between the years 1987 – 93 there were 176 cases [4] as shown in table-2

Table – 2

Annual incidence of leptospirosis (4)

Year	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**Total**
Leptospirosis	4	21	26	60	48	8	9	176

Serosurvey

Serosurvey is an important epidemiological tool for assessing the burden of infection in the community.

A Serosurvey for leptospiral antibodies we made of 1375 persons in northern Trinidad between the years mid 1977-78. Subjects were employees in seven occupational risk groups and three rural & urban communities from general population. They were questioned about occupation, house hold water supply and effluent & contact with animals. The following prevalence rates were observed. Highest prevalence was found n sugar cane workers-45%, rural village – 37% & 5% - wood brook. Keeping cattle, walking bare foot and hunting was associated with significant leptospiral serology. Overall, serogroups icterohemmorhagiae and autumnalis each accounted for about 25% of seropositives in general population. Among the occupational groups autumnalis was common (36%). It accounted for 42% of the seropositives sugar cane workers and 57% of seropositives rice farmers.[5]

In another study leptospiral antibodies in subjects more than 5 years of age was taken in Trinidad & Barbados between the years 1980 – 82. House holds were randomly sampled from one urban & two rural communities on each island. From Barbados 576 eligible individuals and 524 from Trinidad were taken for study. All participants were sampled annually for 3 times. Seropositivity using MAT >1:50

was 18.5% in Barbados and 21.9% in Trinidad. Prevalence rate was increased steeply with age and sex and higher in males than females. Autumnalis (42%) was seen in Barbados, bataviae (29%) in Trinidad. Seroconversion was 2.9% per annum for Barbados & 3.5% perannum for Trinidad. Occupational risk varied between islands. Highest seropositivity (>50%) was found in outdoor manual workers & lowest in indoor non manual workers and urban home workers. Lack of inside toilet was associated with increased seropositivity. In Barbados seroprevalence was high in person cleaned drains and handled live stock.[6]

In a prospective study of 584 conservancy workers who lived in slums & who worked in four corporation circles of Chennai, about 192 (32.9%) were found to positive for L.interrogans. seropositivity increased with age, similar in males and females, but in youngest age group males predominated. Prevalence in 4 study areas ranged from 17.8 to 40.5%. Among 152 serovars autumnalis was recorded commonly of about 33.6%, icterohemmorhagiae 15%, sejroe 14.5%, others 21.7%. Titer range 1:50 – 1:3200. among a group of 46 automobile workers, who lived in middle class were having a sero prevalence 17.4% half that of sanitation workers and titer range was 1:50 – 1:200, sanitation group were the urban population at highest risk of leptospiral infection. The prevalence rate in this study was 33%.[7]

Occupational risk factors

In most areas of world, leptospirosis is primarily an occupational disease. Agricultural workers have the highest risk of infection, but persons who work in other rodent infested environment are also at risk of infection. Other occupations related to risk are conservancy workers, abattoirs, hunters, fisherman, garbage cleaners, vetnarians & laboratory workers and live stock handlers.

Agriculture

Agricultural workers account for more leptospirosis. The raising of wetland crops such as rice and taro is particularly hazardous. Rice field workers often work with their bare feet and hand immersed in water for prolonged periods of time. The skin changes resulting from prolonged immersion in water and the abrasions in there skin provide portals of invasion for leptospires. The risk of infection for rice field workers varies from areas to areas depending on factors such as water, PH, soil type and rodent density in the fields. Major epidemics can occur when seedlings are transplanted into flooded fields by farmers who work for long periods bare footed and bare handed and when crops that are particularly vulnerable to attack by rodents are harvested. Wet soil and heavy early morning dew, mixed with urine voided at night by nocturnal rodents or infected livestock in pastures poses a threat to early morning field workers, particularly in the tropics. Cutting and handling of

crops like sugar cane and pine apples frequently cause skin abrasions which may increase possibility of infection.

In one survey in the Caribbean region found that 45% sugarcane farmers, 33% of rice workers, 36% of vegetable and fruit farmers and 20% of animal handlers had been exposed to disease.[8] Persons involved in raising dry land crops such as sugarcane, vegetable, grains are at highest risk during harvesting. Persons involved in dry land farming are also at increased risk.

Dry farming

Dry farming refers to method where animals are stabled and husbanded indoors and where they are fed and watered by hand. The fodder freshly cut or dried are risk for both animals and attendants. Persons who raise live stock may be infected from exposure to their animal's urine. Exposure may be direct- splashing of urine while milking in diary farmers or indirect- walking barefoot in wet or muddy animal pens. Infection also can occur while conducting delivery to infected animal from contact with discharges form reproductive tract or while cutting up infected dead animals.

Fishing industry

The raising of fish and prawns in fresh water pond has been associated with human leptospirosis. It is also an occupational disease among workers in poultry and fish processing plants, slaughter houses where the working area is infested with rodents.

Mining

Mine & sewer- workers are also at increased risk of infection as they work in wet environments that are often infested with rats. Vetnarians & lab animal handlers are at equal risk.

A review study done by Heath, Alexander and Galton of 483 cases of human leptospirosis reported in united states between 1947 – 60 emphasized the importance of occupation or related to risk of infection (Table-3). The probable infecting source was ascertained in 191 cases 31% involved contact with rats, while 30% were associated with dog exposure, in 20% cattle were implicated as the source of infection. When cases of contact with cattle and swine were combined, the rate exceeded by 34%, that both dogs and rats as the probable source of infection. Infection with dog occurred almost exclusively in the home or as a result of vetinary work. Disease associated with cattle largely took place in farm environment (31 of40 cases), while swine acquired disease was seen most frequently in the abattoir (13 of 24 cases). The possible infecting serotype was established by Heath in 409 of 481 cases by serological studies. The commonly encountered serotypes were icterohemorrhaghiae-41%, canicola- 28%, Pomona-20%. Majority of infections due to icterohemmorhagiae could be traced to rat exposure either directly or indirectly through water immersion. Canicola related cases generally were linked to dog contact, while majority of Pomona infections were associated with cattle & swine exposure. In majority of cases collected by

Heath, infection was acquired during the summer and early fall months (63% during June to September). This probably explained by climatic conditions in many parts were favorable.[9]

Table – 3

Distribution of 483 cases – place and infecting serotype (year1947 – 61) (9)

Serotype	Home	Water contact	Abattoir	Vetenary work	Hunting	Lab Worker	Garbage dump	Sewer	poultry	Rice field	Farm	Miscellaneous	Unknown	Total
Ictero	28	33	4	1	2	1	2	4	4	2	9	13	63	166
Canicola	40	10	-	14	2	2	2	1	-	-	1	2	42	116
Ictero or Canicola	2	-	1	1	1	-	-	-	-	-	1	-	9	15
Pomona	2	3	29	2	1	-	-	-	-	-	34	-	10	81
Grippotyph	1	-	-	-	2	-	-	-	-	-	2	-	6	11
Autmnalis	-	1	-	-	-	1	-	-	-	1	3		5	11
Australis	-	2	-	-	1	-	-	-	-	-	-	-	3	6
Hebdomad	-	2	-	-	-	1	-	-	-	-	3		3	9
Bataviae	-	-	-	-	1	-	-	-	-	-	-	-	2	3
Ballum	-	-	-	-	1	1	-	-	-	-	-	-	1	3
Pyrogenes	-	-	-	-	1	1	-	-	-	-	-	-	1	3
Unknown	3	8	1	1	1	-	3	1	1	1	10	1	28	59
Total	76	59	35	19	13	7	7	6	5	4	63	16	173	483

In another study from kottayam (kerala) about 900 cases of fever, jaundice, renal failure over a period of 10 years the following data was noted. About 50% of patients were in age group of 29 – 39years and male/ female ratio was 7:1. About 74% of the cases occurred during the rainy season from June to November. Disease was commonly seen in agricultural workers, fisherman and oyster shell catchers (82%).[10]

Rainfall

Rain fall is one of the important epidemiological risk factors of spread of leptospirosis. In temperate climates, infections are more common in the warm months. In tropical climates, seasonal fluctuations of cases may also occur in association with factors such as periods of rainfall and crop raising cycles. Flooding after heavy tropical rains elevates the water table, allowing saturation of the environment by subsurface leptospires. It prevents animal urine from evaporating or penetrating the soil so that leptospires may pass directly in to the surface waters and tops up swampy zones, causing invasion by aquatic rodent or carnivore population from neighboring cultivated fields. Large out breaks typically involve a group of people who have been immersed in floods.

In one study form Barbados for period of 7 years nov1979- dec1986, 248 cases were confirmed and the annual incidence of leptospirosis was 19.2/lakh

population. There were 173 males and 62 females and for cases aged 15- 34 years leptospirosis was 9.6 times more common in men than women. The incidence in areas with rainfall > 1800mm (32.6/lakh) was nearly that in areas without rainfall <1600mm (17.3/lakh). There is a clear link between cases of severe disease & recent rainfall.[11]

In another study from Chennai, south India there has been dramatic increase in leptospirosis recently. Chennai has land area of about 172 sq.km. Population is around 5.3 million. Weather is warm & its average rainfall 1500mm/yr. Rainfall occurs with north-east monsoon (oct- dec). The time period of 5 years from 1979-84, there was only 9 cases of leptospirosis in Govt. General Hospital, Chennai. While from 1987-93 there were 176 cases [4] as shown in table- 4

Table - 4

Annual incidence of leptospirosis (4)

Year	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**Total**
Leptospirosis	4	21	26	60	48	8	9	176
Leptospirosis ARF	4	20	21	45	30	8	7	135

Most cases were seen during monsoon months (Table-5)

Table – 5

Monthly incidence of leptospirosis- 1987-93 (4)

Jan	**Feb**	**July**	**Sep**	**Nov**	**Dec**	**Total**
5	1	1	4	100	65	176

Male preponderance was noted in 83%. The infection is probably transmitted to people when they wade through stagnant rain water contaminated by infected urine of animals. There was no relationship to any specific occupation though most of them were outdoor manual workers. There was no geographical clustering.

Recreational exposure

Recreational water sports are one of the important risk factors for infection. Waters located in rural areas which have been developed for recreational purposes provide a habitat for wild life and also are used as a water supply for livestock. In 1951 sheeffer reported 50 cases of Pomona infection among a group of 80 young people which followed a swimming party in a creek located in pasture for swine & cattle. It is likely that the natural water sources supplying the pool were contaminated by dog or deer.[2]

In another study of 140 cases of human leptospirosis were reported from 1947 – 64 in Iowa. Of these, 55 cases occurred in 2 outbreaks in 1959 – 64 as a result of swimming in water contaminated with leptospires. Galton et al summarized several other recent outbreaks of leptospirosis acquired by swimming in contaminated water sources. Pet animals, particularly dogs are another common source of infection. Importance of dogs in the transmission of leptospirosis to man was highlighted as a result of an investigation following an outbreak of

leptospirosis in st.louis, Missouri suburb in nov.1972. the vaccine administered to animals will protect against developing clinical disease but not against in apparent renal infection in animals which results in widespread dissemination of leptospires.[2] In one study from Hawaii, united states it was found 43% of cases were exposed though recreational activities, including fresh water swimming , hiking, camping & hunting.[12]

Animal studies

Animal's play an epidemiological role in spread of leptospirosis

Cycle of infection in animals

Leptospirosis is characterized by the spread of infection within species or groups of animals in cyclical fashion. Usually carrier animals which survive acute infection can affect younger animal or urine of carrier animal contaminates the moist soil which acts as a source of infection. The pollution of surface water also leads to risk of infection of other animals. Certain serovars are often found in association with particular hosts.

E.g.: rats- icterohemmorhagiae, field mice – grippotyphosa

Infection between farm animals

Infectious cycle can occur between cattle to cattle, sheep population, pigs either through congenital transmission or neonatal infection followed by recovery & continuing urinary carrier or spread of urine of carriers in farm yard, drinking

water source. This is most important source through which human infection can arise.

Infection between farm animals & rodents

Rats may infect farm animals & their own species. This is common infection of cattle & pigs particularly if they are harbored indoors. Man may be infected from either source.

Infection between farm animals, water & rodents

Rodents contaminate the soil, which acts as a source of infection of animals which can also contaminate environment and infect rodents. Contaminated water is additional epidemiological problem which acts a source of infection to man. This is common epizootological/ epidemiological pattern in the rice growing world.

Interaction with feral rodents

Infectious cycles confined to feral rodents are self maintaining and related to the territorial limits of families, species of animals in their natural habitats. The intrusions into the habitat by either human & domestic rodents or animals pose a risk of infection.

Pet animals

Dogs & cats may act as main source of infection by contaminating soil with urine..

A wide variety of animals may serve as a source of infection to human. The species type differs from area to area depending on population density, human housing, occupational & leisure activities. Mammals bearing hair or wool are the most important source of infection. Most mammal like cattle, sheep, goat, buffalo,

horses, dogs & cats may be infected and act as a source of infection. Rodents such as rats, mice, voles, gerbils are important wild mammal source of human leptospirosis. Jackal, bandicoot, rabbits can also act as a source & carrier of infection. Infected animal shed large number of leptospires in their urine. Leptospires can survive for weeks in soil & water. Environmental contamination may reach high levels in areas where carrier animals frequently urinate. More cases can arise from this mechanism of indirect transmission.[8]

In one serological survey done by Ratnam et al, since 1961in Tamilnadu.[13] The seroprevalence shown in table-6

Table – 6

Seroprevalence in animals (13)

Animal	**Sero prevalence %**	**Serovars**
Dogs	16.3	Canicola, Pomona, autumnalis
Sheep	54	Pomona, sejroe, autumnalis
Goats	47.4	Autumnalis, Pomona, pyrogenes
Buffalo	35.1	Pomona, sejroe, autumnalis
Cattle	44.2	Pomona, sejroe, autumnalis

Pathogenesis

Once the organism gains entry, leptospires spread though the blood stream to all organs. Virulent organisms multiply in blood stream in a day or two. Agglutinating antibodies start appearing in the blood around 4^{th} day. The organism is removed by reticuloendothelial system. These antibodies are detected by MSAT (macroscopic slide agglutination test) and MAT

(Microscopic slide agglutination test). After 4 – 7 days the organisms persist in the aqueous humor and in the renal tubules and are excreted in the urine for about 1-4 weeks.

Mechanism

Direct effect- Extensive endothelial injury resulting in multiple hemorrhages, transudation of fluid from the vascular compartment and hypovolemia.

Kidney- It penetrates glomeruli, peritubular capillaries, intersitium, tubular lumen ultimately leading to acute tubular necrosis and acute interstitial nephritis.

Liver- it produces hepatocellular necrosis, cholestasis

Immunological reaction- meningitis and uveitis in leptospirosis are result of immunological injury.

Non-specific factors- hypovolemia, hypoxemia, hyperviscosity, DIC, intravascular hemolysis & myoglobinuria. All these factors contribute to widespread disturbance in microcirculation.

Clinical features

The clinical features of leptospirosis are varied with mild anicteric illness to severe illness

Mild – Fever, Myalgia, Conjunctival suffusion

Severe – Jaundice, Meningitis, Renal failure.

The incubation period is 7 – 14 days but ranges from 2 -21 days. 90% of cases are anicteric. The usual course of illness is biphasic consisting leptospiremic phase and immune phase.

Anicteric leptospirosis

This can be mild with fever, headache & body pain. Body pains are severe and most marked in the mower limbs especially thighs & calves. Severe pain in back, neck, abdomen and upper limbs are frequent. Anorexia, vomiting is frequent. The most characteristic finding on examination is conjunctival suffusion and severe myalgia. Leptospiremic phase subsides in 4 – 7 days. The immune phase is characterized by severe headache due to meningeal involvement, uveitis and low grade fever.

Icteric leptospirosis

This type of illness is severe manifestation of infection characterized by renal failure, jaundice, hypotension, cardiac, pulmonary complications. Death occurs

usually due to renal failure. Sudden death may occur due to massive bleeding, arrhythmias. If patient is not severely ill, diuresis occurs & renal failure improves.

Kidneys

Renal involvement is the most serious complication & commonest cause of death. Renal manifestations range from urinary sediment changes (pyuria, hematuria, granular casts), to severe renal failure. Hematuria may be due to hemorrhagic diathesis rather than glomerular injury. Renal failure can be due to prerenal component, ATN, AIN. Renal failure occurs in the 2^{nd} week of illness but it can occur as early as the 4^{th} day.

Liver

Jaundice is the most important clinical feature of severity of illness. It usually occurs between 4^{th} to 6^{th} days of illness. Here liver is enlarged and tender. Jaundice is mainly due to hepatocellular damage. Marked elevated transaminases are characteristic. Death is rarely due to hepatic failure.

Eyes

Conjunctival suffusion is common feature of the septicemia phase and usually associated with conjunctival hemorrhage. It usually occurs in the first 3 days. More important late complication of eye is anterior uveal tract inflammation presenting clinically as iritis, iridocyclitis. It usually occurs as early as 2^{nd} week.

Heart

Cardiac complication are frequent in severe leptospirosis like atrial fibrillation, low voltage complexes, non- specific ST & T wave changes, conduction defects & arrhythmias. Cardiac failure can also occur.

Lung

Severe hemorrhagic pneumonitis may occur usually in the 2^{nd} week.

Hemostasis

Bleeding is constant feature of leptospirosis due to vascular damage. Bleeding may occur from respiratory, alimentary, renal and genital tracts.

Hypotension

It is due to hypovolemia secondary to vomiting, increased insensible water loss & diminished fluid intake, massive hemorrhage from gastro intestinal tract, vascular injury and myocardial dysfunction.

Nervous system

Meningitis occurs in the immune phase. CSF shows lymphocytic pleocytosis, raised proteins and normal sugar.

In one study of 150 cases of American service men in Vietnam (Table- 7) with leptospiral infection fever, headache & myalgia and gastro intestinal complaints were common. The most characteristic physical finding was muscle tenderness (42%) & conjunctivitis (42%). Aseptic meningitis occurred in 9 patients. Oliguria & azotemia seen in 7 patients, but none required dialysis. Only 2 patients were jaundiced. Microscopic Hematuria was noted in 8 patients. The BUN concentration was elevated in 22 of 84 patients (26%) & ranged from 30 to 115mg%. In absence of jaundice, renal failure due to leptospirosis is almost never fatal. Hepatomegaly was noted in 15% & overt jaundice in only 1% patient. The Bilirubin concentration exceeded 1.5mg% in 5 patients & exceeded 3mg% only in 2 jaundiced patients. SGOT & SGPT were elevated in 43% & 39% respectively & were not related to hepatomegaly & muscle tenderness.[14]

In another study from Hawaii during the years 1974 to 1998- a study of 353 confirmed cases of leptospirosis (Table-8 &9). The following observation was made. Fever, headache, myalgia was the most common presentation. Nausea vomiting are also relatively common & jaundice occurred in 30 – 40% of patients. Thrombocytopenia & polymorph nuclear leukocytosis is common. Elevations of both BUN & creatinine levels are frequently found. But in mild disease this may reflect a prerenal pattern related to dehydration. During the initial leptospiremic phase, even in mild cases there is typical some hepatic involvement with elevated levels of Bilirubin & mild increases of aminotransferases. [12]

Table – 7

Signs & symptoms in 150 patients with leptospirosis in South Vietnam (14)

Clinical features	**South Vietnam n=150 %**
Fever	97
Headache	98
Myalgia	79
Conjunctival suffusion	42
Meningism	12
Vomiting	33
Diarrhea	29
Anicteric presentation	98
Abdominal pain	28
Cough	20
Hepatomegaly	15
Splenomegaly	22
Jaundice	2
Renal failure	4.6

Table -8

Hawaii study – Clinical features (12)

Clinical features	**n= 353 %**
Fever	99
Myalgia	91
Headache	89
Vomiting	73
Arthralgia	59
Diarrhoea	53
Abdominal pain	51
Backache	51
Jaundice	39
Conjunctival suffusion	28
Nuchal rigidity	27
Oliguria	26
Hepatomegaly	16
Pneumonia	17
Splenomegaly	4

Table – 9
Laboratory data – Hawaii study (12)

Renal data –	Elevated BUN >20mg%	49%
	Elevated creatinine > 1.5mg%	54%
	Hematuria	72%
	Proteinuria	54%
Hepatic -	Elevated ALT	73%
	Elevated total Bilirubin > 1mg%	70%
Hematology -	Elevated WBC >10000 cells/ cu.mm	39%
	Decreased WBC < 4300 cells/cu.mm	7%
	Platelet < 1.4 lakh	58%
	Decreased HCT <34%	32%

In one study by **MSP & Shiva Kumar et al** from Chennai duing 1989-90 from Govt. hospital Chennai out of 70 patients fever 57 cases of confirmed leptospirosis with the following clinical data (Table-10) was obtained.[1]

Table - 10

Clinical features	**Chennai study (1990) n=57 (1) %**
Fever	100
Jaundice	84
Myalgia	82
Oliguria	72
Conjunctival suffusion	58
Vomiting	58
Altered sensorium	42
Volume depletion	39
Gastrointestinal bleed	26
Diarrhoea	26
Headache	26
Abdominal pain	18
Hemoptysis	9
Meningitis	7
Epistaxis	3

Of 57 cases of leptospirosis 84% had jaundice and 72% had renal failure. All patients were febrile. Renal failure was 76% with Oliguria and anicteric renal failure was 9.7% .myalgia occurred in 82%, conjunctival suffusion in 58% and volume depletion in 39%.thrombocytopenia occurred in 13 patients.23 patients were dialyzed.

Leptospirosis constituted about 8% of acute febrile illness (Table- 11). In one study of 361 cases about clinical profile of infectious fevers by Shiva Kumar et al from Chennai following data was obtained. [15]

Table – 11
Clinical profile of infectious fevers (15)

Disease	**Frequency n= 351 (%)**
Tuberculosis	51.3
Pneumonia	15.4
Malaria	12.8
Leptospirosis	8.2
Enteric fever	4.6
Rheumatic fever	2.6
Liver abscess	2.6
Pyogenic meningitis	2.6
Infective endocarditis	1

Leptospirosis constituted about 8% of acute renal failure (Table-12). In a study from Govt.general hospital, Chennai during the year 1995 – 03 of about 951 patients of ARF pointed out it. This was less when compared to previous study in which ARF was 31% in the year1987 – 91.[16, 17] The probable explanation for this

decline could be due to improved diagnostic facilities in diagnosing lot of anicteric cases and treating them aggressively to prevent complications.

Table – 12
Etiology of ARF – Chennai comparative data (16, 17)

Etiology	**1979- 84** **%**	**1987 – 91** **n=387** **%**	**1995 – 03** **n=951** **%**
Acute diarrhoeal disease	23.5	30.5	30
Leptospirosis	5.3	31	8.2
Drugs	5.3	5.4	9.8
Glomerulonephritis	26.2	8.5	9.3
Snake bite	3.2	4.7	8.5
Copper sulphate poisoning	11.2	3.4	4.7
Falciparum malaria	-	-	4.2
Obstetric	8.5	3.4	8.6
Surgical	-	1.5	3.3

Table – 13
In another comparative study the following data was observed

Clinical features	**Barbados (Edwards et al) n=88 (18) %**	**United states (heath et al) n=345 (9) %**	**Korea (park et al) n=93 (19) %**	**Chennai, 1990 (MSP et al) n=57 (1) %**
Fever	85	100	97	100
Renal failure	49	26	15	72
Jaundice	95	43	16	84
Conj.suffusion	54	68	88	58
Myalgia	49	68	88	72
Bleeding diath	2	4	40	9
Cns complication	2	21	6	12
Anicteric presentation	5	57	84	16

Fever, nausea, jaundice & renal failure were the important clinical features noted (Table-13). The incidence of anicteric renal failure is low because lack of diagnostic facilities.

In an Indian study the following clinical data was noted (Table- 14). Jaundice and renal failure were the most important complications noticed in Mumbai study of about 33% and28%. Similar picture were also seen in kottayam and previous Chennai study. In Gujarat study conjunctival suffusion was common of about 58% and bleeding diathesis of about 34%.

Table – 14
Indian studies-Clinical features comparison

Clinical features	**Mumbai 2000 n=74 (20) %**	**Kerala (kottayam) n=900 (10) %**	**Gujarat (surat)1997, n=80 (21) %**	**Chennai,1990 n=57 (1) %**
Fever	100	95	100	100
Headache	91.8	53	-	26
Myalgia	67.5	85	-	82
Conjunctival suffusion	35.1	65	58	58
Cough	35.1	-	13	9
Jaundice	33.7	80	-	84
Oliguria	28.3	59	46	72
Meningitis	-	15	3.1	42
Bleeding diathesis	-	-	34	3
Cardiac	-	-	4	-

DIAGNOSIS OF LEPTOSPIROSIS

Laboratory support is needed:

1, To confirm the diagnosis

2, For epidemiological and public health reasons, to determine which serovars caused the infection, the likely source of infection, potential reservoir and its location.

The tests depend on the phase of the infection. During leptospiremic phase (<7days) leptospires can be isolated by blood culture and PCR, while in the immune phase, rising antibodies can be detected by serological tests [8, 22]

Culture: The isolation of leptospirosis by culture of blood, CSF and urine is the most definite way of confirming the diagnosis of leptospirosis. Unfortunately, culture of blood dos not contribute to an early diagnosis as results come late, weeks or even months after inoculation of culture medium, however it is valuable in critically ill patients who might die in the first week before the development of antibodies.

PCR is promising on both sensitivity and specificity, but is complicated and expensive. Its value for rapid diagnosis is not been evaluated and is not widely used.

Serology: The serological tests for diagnosis of leptospirosis have been classified as serovar specific tests and genus specific tests.

Serovars specific tests: Microscopic agglutination test (MAT): MAT is the gold standard test for diagnosis of leptospirosis because of its unsurpassed diagnostic specificity. The main advantage is that serovars can be identified which is of epidemiological importance. [12, 22] The difficulties in utilizing MAT are due to the following factors.

a) The antibody titers rise and peak only in 2nd or 3rd week, making it a less sensitive test.
b) The high titers of past infection persist for a long time (1-5years) and therefore interfere with the diagnosis of current leptospirosis. Positive titers may represent a rising titer of current infection or declining titer of past infection.
c) The cut off titer for diagnosis of current infection depends on whether the area is endemic or nonendemic, for example the cut off titer varies from 1/80 to1/400 according to various studies.[22] Therefore a second sample is usually required (to demonstrate 4 fold rise in titer) to diagnose current infection. In endemic area titer of 1:400 is taken high titer and non endemic area 1:100 is taken as diagnostic titer. Seroepidemiological studies are required for determining the cutoff value, as a single titer may not be adequate.
d) The test is complicated requiring dark field microscopy and cultures of various live serovars. This may not be available in small laboratories.

Genus specific tests: The two common tests are the ELISA & Macroscopic slide agglutination tests (MSAT). The other tests are latex agglutination test, complement

fixation test and haemagglutination tests. The genus specific tests are the test of choice for the diagnosis of current infection. These tests are simple, more sensitive and become positive earlier than MAT.[23]

These tests detect genus specific antibodies, which are shared by pathogenic and saprophytic leptospira. These test become positive early in the disease (5-6th day) as they detect specific IgM antibodies and help in rapid diagnosis of current infection.[1]

ELISA: This is a popular test & can be performed with commercial kits or with antigen prepared "in house".[22, 24]

MSAT: The slide agglutination test is a simple macroscopic test in which a drop of the dense suspension of leptospira is mixed with drop of serum on a slide and is examined by the naked eye for agglutination. If these tests are positive, they should be confirmed with MAT to identify the serovars. If these tests are positive, they should be confirmed by MAT, to identify to the serovars. A 2+ agglutination titer is considered significant. [23, 25, 26]

In one study form Brazil by Angelo Brendo et al noted that SAT seems to be a convenient test for the initial diagnosis of leptospirosis. It detected 65% of the cases of illness with admission sample & 94% with 2nd serum sample collected on about 17th day of symptom. Whereas, MAT showed only 40% positive rate by 1st sample. This shows SAT both sensitive & specific test.[23]

In another study from Chennai medical college, out of 592 samples received 317 samples was positive by IgM ELISA. MSAT was positive in 310 samples (Table-15)

(Sensitivity 97.8%). 303 samples had MAT titers of >1: 80. in all these patients, the MSAT was positive. Autumnalis was the most common serogroups (59.9%). 275 samples which were negative by IgM ELISA were also negative by MSAT. The MSAT has shown good correlation with both IgM ELISA & MAT.[25]

Table – 15

Test positive	**Patients (n= 568) (25)**	**Samples (n=592)**
IgM ELISA	293	317
MSAT	286	310
MAT > 1:80	279	303

Galton et al used 9 cultures & divided them into 3 groups & found MSAT to be a sensitive as MAT

Laboratory criteria for diagnosis of leptospirosis

1. CULTURE: Positive

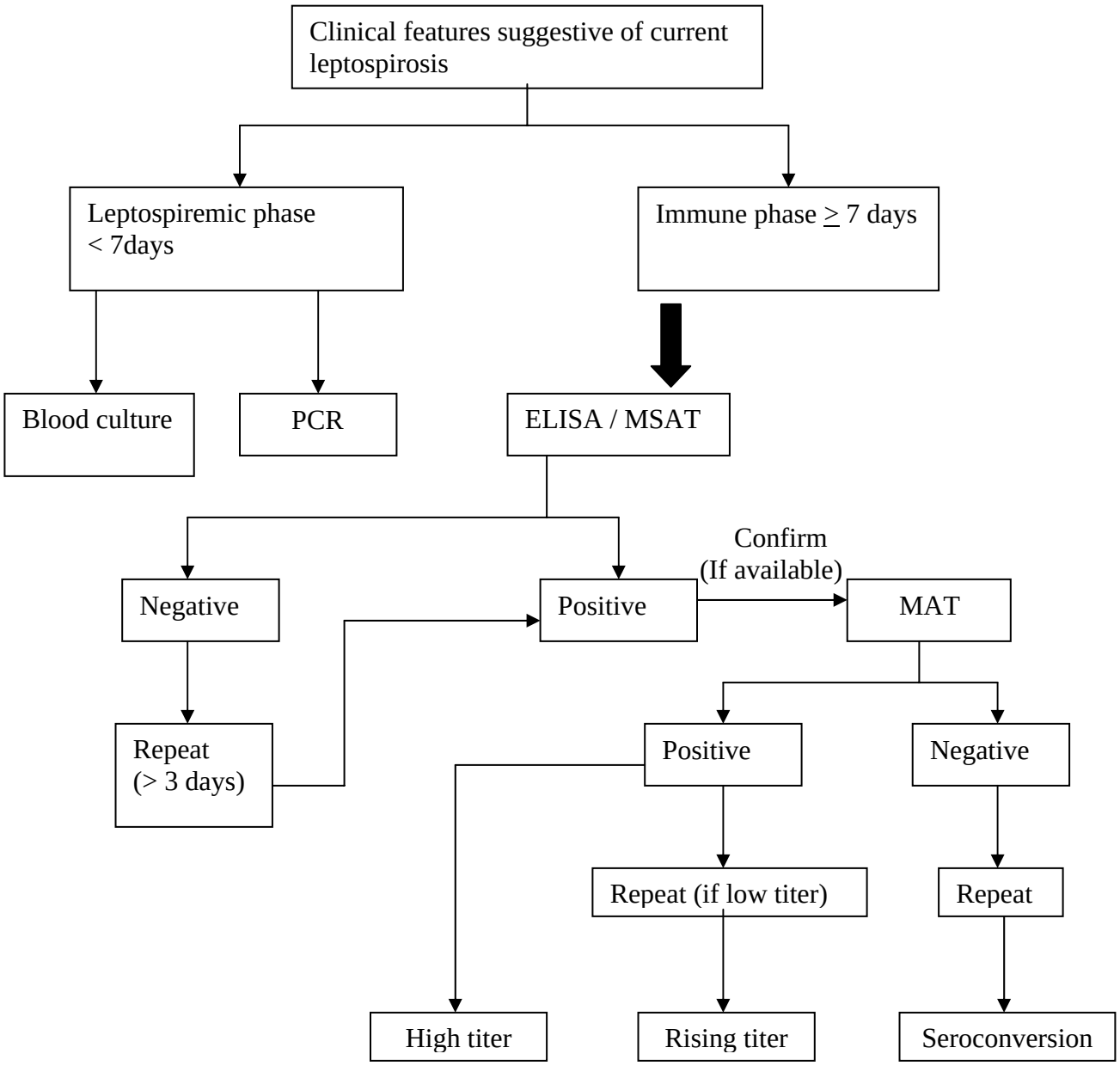
2. MAT: a) Seroconversion / 4 fold rise in the titer

b) High titer.

3. ELISA / MSAT: positive.

A simple algorithmic approach to diagnosis shown in fig: 2

Fig: 2
Approach to Diagnosis of Leptospirosis (27)



COMMENTS

1) ELISA / MSAT are adequate for diagnosis of current infection. This can be done in smaller laboratories in both rural and urban areas. If positive, confirm diagnosis with MAT, which would be available in larger specialized laboratories.
2) MAT—Seroconversion / 4 fold rise in the titer is necessary for diagnosis. (2nd sample essential). Single high titer in MAT combined with positive ELISA/MSAT confirms the diagnosis of leptospirosis.
3) Blood culture—not sensitive. Should be done in critically ill patient. (As they may not survive to produce antibodies).

Table - 16

Interpretation of serological tests (27)

ELISA/ SAT	**MAT**	**Interpretation**
+ve	Single high titer	**Current infection**
+ve	-ve	**Current infection**
-ve	Single high titer	**Past infection**
± ve	Sero conversion/ 4 fold rise in titer	**Current infection**

MANAGEMENT

Chemotherapy: The aims of chemotherapy are to eradicate leptospirosis and to prevent complications. Leptospirosis is sensitive to most antibiotics.

Penicillin is the most effective antibiotic when given early. In severe illness large doses (6—8million units per day) of benzyl penicillin may be given is in divided doses, preferably by IV route, for 5-7days. Fever subsides in 24 to 36hours.

Ampicillin 1g IV qid in severe illness or 500-700mg qid in mild illness.

Doxycycline 200mg/day, **Amoxicillin** 500mg qid & **Erythromycin** 250mg qid are effective**. Quinolones** and **Cefotaxime** are also effective against leptospira.

Antibiotics are very effective only in the early stage (<5days). Recently there is evidence to suggest that antibiotics are useful even in the late stages of illness

Symptomatic and supportive treatment: The primary importance is the meticulous attention to fluid and electrolyte balance. Hypovolemia and hypotension need prompt and specific treatment with intravenous fluids. In patients with oliguria, if pre renal azotemia is suspected, prompt diuresis should be attempted with fluid therapy. Patients who have no response to therapy should be managed as established renal failure. Headache and myalgia are treated with analgesics. Fever is treated with antipyretics, restlessness and anxiety with sedatives and anemia with blood transfusion.

Peritoneal dialysis has been found to be safe, simple and effective procedure for management of leptospiral renal failure. If there is contraindication to peritoneal dialysis then hemodialysis can be done.

PROGNOSIS

Most patients recover. Overall mortality used to be about 15-40% and has been reduced to about 5% with better management. Death is usually due to renal failure but it can also occur due to massive bleeding or cardiac & pulmonary complications.

GUIDELINES FOR DIAGNOSIS

Faine has evolved criteria for diagnosis of leptospirosis on the basis of clinical, epidemiological and laboratory data (WHO guidelines). [8] Certain necessary modifications have been made by us to make the diagnosis more practical in Indian institutions.[28, 29] the modifications have been made in the epidemiological and laboratory criteria (Table- 17). The reasons for the modifications are:

1. Laboratory tests are essential for diagnosis: In the original Faine criteria only MAT has been utilized for diagnosis. In the modified criteria, ELISA & SAT have been included with appropriate scores, as they are adequate for the diagnosis of current infection. In addition, low titers in MAT and titers based on endemicity have been eliminated. Rising titers or high titer of MAT has been retained.

2. Epidemiological factors such as rainfall and contact with contaminated environment are important for diagnosis. Most of the cases of leptospirosis are reported in the monsoon or post monsoon season.
3. Clinical features if combined with epidemiological and laboratory data confirm the diagnosis of leptospirosis.

Presumptive diagnosis of leptospirosis is made of:

Part A or part A & part B score: 26 or more

Part A, B, C (Total): 25 or more

In the laboratory tests, only one test should be scored

A score between 20 and 25 suggests leptospirosis as possible but unconfirmed diagnosis.

Table – 17

Guidelines for diagnosis of leptospirosis- original & modified (28, 29)

Faine criteria		**Modified Faine criteria**	
Part A- Clinical features	**Score**	**Part A- Clinical features**	**Score**
Fever	**2**	Fever	**2**
Headache	**2**	Headache	**2**
Temperature > 39 deg.C	**2**	Temperature > 39 deg.C	**2**
Conjunctival suffusion	**4**	Conjunctival suffusion	**4**
Myalgia	**4** **10**	Myalgia	**4** **10**
Meningism	**4**	Meningism	**4**
Jaundice	**1**	Jaundice	**1**
Albuminuria/ elevated BUN	**2**	Albuminuria/ elevated BUN	**2**
Part B:Epidemiological factors		**Part B:Epidemiological factor**	
Contact with animals or contact With known contaminated water	**10**	Rain fall Contaminated environment Animal contact	**5** **4** **1**
Part C: Laboratory criteria		**Part C: Laboratory criteria**	
Culture – diagnosis certain		Culture – diagnosis certain	
Serological tests		**Serological tests**	
MAT			
Leptospirosis- **endemic**		ELISA IgM positive	**15**
Single positive – low titer	**2**	SAT	**15**
Single positive – high titer	**10**	MAT-single +ve high titer	**15**
Leptospirosis- **non endemic**		MAT- rising titer (paired sera)	**25**
Single positive – low titer	**5**		
Single positive - high titer	**15**		
Rising titer (paired sera)	**25**		
Total		Total	

Materials and methods

Patients admitted to the medical wards of Govt.Stanley hospital with fever due to infectious disease of duration of more than 5 days who were positive by slide agglutination test were taken up for the study. Patients aged 15 -60 years were taken up for the study. The period of study was from May 2004 to December 2005.

Diagnostic criteria

Leptospirosis was diagnosed utilizing Modified Faine's criteria -- Clinical, Epidemiological, Lab data (score >25).

Exclusion criteria

Malaria, viral hepatitis, UTI, enteric fever, TB and pediatric cases were excluded from the study.

The following data was noted

1) Age, sex, occupation and address was noted
2) Clinical features – fever, headache, myalgia, jaundice, Oliguria, vomiting, Diarrhoea, dehydration, hypotension, conjunctival suffusion, meningeal signs & hepatosplenomegaly

3) Investigaton – urea, creatinine, liver function test, Hemogram, chest x ray, EKG, ultrasound abdomen, MSAT, MAT

(All details in proforma in annexure)

MSAT (Macroscopic agglutination test)- This test is simple ,sensitive , genus specific test done using dense suspension of killed leptospires which is mixed with a drop of serum on a slide and rotated on a rotator (120rpm) for 4 minutes. It was then examined by naked eye for presence of agglutination. A 2+ agglutination titer was considered significant. All cases were confirmed by MAT.

MAT (Microscopic agglutination test) - MAT was done by standard technique and a titer of >1:80 taken as significant.

Table -18

Modified Faine's criteria

Clinical features (A)	**Score**	
Fever	**2**	
Headache	**2**	
Temperature > 39 deg.C	**2**	
Myalgia	**4**	
Conjunctival suffusion	**4**	**10**
Meningism	**4**	
Jaundice	**1**	
Albuminuria/ elevated BUN	**2**	
Epidemiological factors (B)		
Rainfall	**5**	
Contaminated environment	**4**	
Animal contact	**1**	
Laboratory criteria (C)		
Culture	**Diagnosis certain**	
ELISA IgM	**15**	
MSAT	**15**	
MAT- single positive high titer	**15**	
MAT- rising titer (paired sera)	**25**	

Each feature is given appropriate scoring. Presumptive diagnosis of leptospirosis is made of

Part A or part A+B with a score of 26 or more

Part A+B+C = 25 or more and in serological tests, only one test should be scored.

Management

Mild cases were treated with oral doxycyline and severe cases treated with IV penicillin.

Results

A total of 106 patients diagnosed of leptospirosis were analyzed. There were 69 males & 37 females (table- 19). The mean age was 31.2 years. The age/sex group data shows that maximum number of cases were seen in age group 21 to 30 years (Table- 20)

Table -19
Total number of cases 106

Total	Male	Female
106	69	37

Mean age – 31.2

Table -20
Age /sex group data

Age in years	Male	Female
15 – 20	19	9
21 – 30	22	14
31 – 40	15	4
41 – 50	11	4
51 – 60	1	2
>60	1	4

Table -21
Occupation

Occupation	**n =106 %**
Outdoor manual	39.4%
Outdoor non- manual	10.3%
Indoor manual	12.2%
Indoor non- manual	9.4%
Manual	51.6%
Non –manual	19.7%
Outdoor work	49.7%
Indoor work	21.6%
House wife	17.8%
Students	10.3%

Table -21 shows the occupation of the patients in which maximum percentage of cases seen outdoor manual work of about 39.4% and in North Chennai areas surrounding the hospital has the maximum number of cases. (Table- 22)

Table-22
Area wise distribution of cases – North Chennai

Place of work/ residence	**No. of cases**
Royapuram	10
Tondiarpet	9
Seven wells	8
Vysarpadi	8
Mint	5
Padi	5
Parrys	5
Ayanvaram	5
Other areas	51

(Chennai city map enclosed in annexure)

Table -23
Epidemiological factors

Contaminated environment	95.2%
Rainfall	50.7%
Animal contact	94%

Table – 24
Month wise distribution of cases 2004 - 05

Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
6	2	3	4	5	8	4	14	13	20	17	10

Table-23 shows that contaminated environment & animal contact was about 95% & 94% respectively. Rainfall was seen in 50% of cases. Table -24 shows the seasonal distribution of cases. Cases occurred throughout the year with maximum number of cases during September to December.

Table – 25
Clinical features

Signs & symptoms	**n=106 %**
Fever	100%
Headache	95.2%
Myalgia	90.2%
Conjunctival suffusion	18.8%
Meningism	6.5%
Vomiting	52.6%
Diarrhea	7.5%
Anicteric presentation	82.2%
Hepatomegaly	24.4%
Splenomegaly	16.9%
Hypotension / volume depletion	26.3%
Abdominal pain	4.7%
Cough	8.4%

Table – 26
Faine scoring

Score	**n=106 No. of cases**
25 -30	51
31 -35	48
36 – 40	6
>40	1

Table-25 shows the clinical features in which fever 100%, headache-95%, and myalgia- 90% with conjunctival suffusion about 18%. Hypotension and hypovolemia constituted about 26%. Anicteric presentation was about 82%. Table-26 shows the faine scoring 48 % of the cases had a score between 25-30 and another 45 % had score between 31- 35.

Laboratory data

Renal function test
Table – 27

Renal failure	**11 (10.3%)**
Creatinine (mg%)	
1.5 – 2.9	6 (5.6%)
3 – 4.9	2 (1.8%)
> 5	3(2.8%)

Mean creatinine 3.5

Table- 28

Blood Urea (mg%)	
10 – 40	92
41 – 100	8
101 – 150	3
> 150	1

Mean urea 85.9

Liver function tests

Table-29

Jaundice	**19 (17.8%)**
Bilirubin (mg%)	
1.5 – 2.9	13 (12.2%)
3 – 4.9	4 (3.7%)
>5	2 (1.8%)
SGOT	
0-40	58
41 – 60	21
>60	27
SGPT	
0 – 40	60
41 -60	21
>60	25

Mean Bilirubin 2.8, Mean SGOT 88.3, Mean SGPT 105.7

Table -30
Hemogram

Total count (cells/ mcl)	<4000	0
	4000 - 11000	104
	> 11000	2
Platelet (lacs/ mcl)	<100000	4
	10000 –150000	96
	> 150000	6
Hemoglobin (gms%)	5 – 6.9	0
	7 – 8.9	17
	9 - 11	61
	>11	28

Table 27, 28 shows renal function data, about 10.3% had renal failure (mean creatinine 3.5 mg%)) and table 29 shows liver function data, about 17.8% had jaundice (mean Bilirubin 2.8 mg%). Table-30 shows the Hemogram details with total count, platelet and hemoglobin almost within normal range.

All mild cases were treated with oral Doxycyline

Severely ill patients (organ dysfunction) treated with IV penicillin

2 patients dialyzed

All patients recovered (mortality nil)

Discussion

Leptospirosis is the most common underreported and under diagnosed zoonoses all over the world. In India leptospirosis is commonly reported from kerala, Andaman's, Tamilnadu, Gujarat and Maharashtra. It is not reported from other areas due to lack of diagnostic facilities.

In Chennai, leptospirosis has been reported since 1980's. In one study of 584 sanitation workers who lived in slums & worked in 4 corporation circles in Chennai 33% were found to be positive for agglutinins to leptospira interrrogans. Seropositivity increased with age, but similar in males & females except in youngest age group where male predominated. Prevalence in four study areas ranged from 17.8 % and 40.5%. serovar autmanlis was the most commonly recorded (33.6%), followed by icterohemmorhagiae (15.1%), panama (15.1%), sejroe (14.5%) and others (21.7%). The titer range was 1:50 – 1:3200. among another group of 46 male automobile industry workers who lived in middle class housing, the seroprevalence was 17.4%, was approximately half that of sanitation workers. Titer range was lower (1:50 – 1:200). so we can conclude sanitation workers are the urban group probably at highest risk.[7]

The problem of under diagnosis is because of complicated diagnostic tests. In the 1st week of illness blood culture or PCR is diagnostic but the culture reports may

take weeks or months to become positive and PCR is expensive. Hence serological tests are used for diagnosis. MAT is the gold standard test but it is complicated, less sensitive requires 2 samples for diagnosis. Simple genus specific test such as SAT & ELISA have become available, which have made diagnosis easy.

Since the clinical features of leptospirosis are non- specific (fever, headache, myalgia). Serodiagnosis is necessary for confirmation of diagnosis. A simple scoring criterion

(Modified Faine's criteria [28, 29]) is recommended for diagnosis in Indian setup. This has been modified from the original Faine criteria (WHO guidelines [8]) to make the diagnosis simple. These criteria take into account of clinical (part A), epidemiological (part B), laboratory (part C) parameters with appropriate scores. The modification has been made in epidemiological & laboratory criteria. A score of 26 or more when using part A&B (Or) 25 or more using Part A+B+C can be considered as current leptospirosis. The reason for modifications is

1, Most cases of leptospirosis are reported in the monsoon and post monsoon season. Factors such as rainfall & contact with contaminated environment have been incorporated with appropriate scores.

2, Laboratory tests are very essential for diagnosis of leptospirosis. ELISA IgM & slide agglutination tests (SAT) are simple, sensitive test, can be utilized to diagnose current leptospirosis. They have been included with appropriate scores.

MAT (microscopic agglutination test is the gold standard test, but it is complicated & less sensitive compared to ELISA or SAT.

In this study modified Faine's criteria was utilized for diagnosis of leptospirosis along with SAT (All these samples were confirmed by MAT)

The slide agglutination test is a simple macroscopic test in which a drop of the dense suspension of leptospira is mixed with drop of serum on a slide and is examined by the naked eye for agglutination. A 2+ agglutination titer is considered significant.[25]

In one study form Brazil by Angelo Brendo et al noted that SAT seems to be a convenient test for the initial diagnosis of leptospirosis. It detected 65% of the cases of illness with admission sample & 94% with 2nd serum sample collected on about 17th day of symptom. Whereas, MAT showed only 40% positive rate by 1st sample. This shows SAT both sensitive & specific test.[23]

In another study from Chennai medical college, out of 592 samples received 317 samples was positive by IgM ELISA. MSAT was positive in 310 samples (Sensitivity 97.8%). 303 samples had MAT titers of >1: 80. in all these patients, the MSAT was positive. Autumnalis was the most common serogroups (59.9%). 275 samples which were negative by IgM ELISA were also negative by MSAT (table-15). The MSAT has shown good correlation with both IgM ELISA & MAT. [25]

A total of 106 cases were taken up for the study, there were 69 males, 37 females, mean age was 31.2. This study was under taken in our hospital which caters to the population of North Chennai. Maximum age group which was affected was between 21 – 30 (33.8%) years. This was consistent with a study from Barbados in which 235 patients were studied. Males -173, females- 62 and 93 patients of both sex aged between 15 -34 years was maximum affected of about 39.5% cases. In this study men are more commonly affected than female this was also consistent with our study.[11]

Occupation plays an important role in infection. Leptospirosis is common in high risk groups which include agricultural workers, outdoor manual work, abattoirs, mining, veterinarians and also any one venturing outside in an environment which has water, infected soil and infected animal. In our study most of the patients are outdoor manual workers which constituted about 39.4% and 49.7% of cases associated with outdoor work. This was consistent with previous Chennai study in which outdoor manual work was associated with 49% of cases & 61.3% cases associated with outdoor work. (Table-31)

Out door manual workers are more vulnerable they come in contact with contaminated environment. Leptospirosis is zoonoses and infected animals (rodents & domestic) are an important source of infection. Contaminated environment is due to the urine of the infected animals contaminating the soil & water and contact with this leads to human infection.

Table -31

Occupation- comparison

Work category	**Chennai, 1990 n=57 (1) %**	**Our study n=106 %**
Outdoor manual	49%	**39.4%**
Outdoor non- manual	12.3%	**10.3%**
Indoor manual	8.8%	**12.2%**
Indoor non- manual	10.5%	**9.4%**
Manual	57.8%	**51.6%**
Non –manual	22.8%	**19.7%**
Outdoor work	61.3%	**49.7%**
Indoor work	19.3%	**21.6%**
House wife	12.3%	**17.8%**
Students		**10.3%**
Unemployed/ retired/ unknown	7.1%	

In India, serovar autumnalis has been isolated from bandicoots (Ratnam et al, 1987). This large rodent is very common throughout south India. Adinaryanan and James (1980) isolated strains of serogroups javanica, hebdomadis and autumnalis from bandicoots in kerala during 1970 -71. It is likely that in Chennai, R.norvegicus is the major source of infections caused by icterohemmorhagiae serovars, while bandicoots are the source of several others, including autumnalis. Sejroe is well known for its presence in cattle, and these animals are probably its source.[7] Contaminated environment is due to poor environmental hygiene which is contributed by the following factors

1) Inadequate garbage disposal which can attract rodents

2) Inefficient sanitation facilities which lead to stagnant water

3) Both the above factors can attract cattle, pigs, rodents & stray dogs which are potential source for infection.

4) With all the above factors walking bare foot poses a potential risk, when coming in contact with stagnant water or infected soil.

Contaminated environment is most important epidemiological risk factor. In our study it contributed about 94% of the cases which was aggravated by rainfall (50%). This contrasts with the study done during 1987-93 where 90% cases reported during monsoon months [4] (Table-32). This suggests that leptospirosis in Chennai can occur throughout the year with contaminated environment being the most important risk factor. Everard & Everard pointed out that where leptospirosis a widespread in the environment and where the disease is endemic, infection will be related to a way of life as well as to specific occupation. Thus when there are large number of rodents, stray dogs and wild animals, where people drink or bathe in untreated water, when sewerage & drainage are inadequate and where open shoes or none at all worn, leptospiral infection can be common. In such places occupational risk factors are so vertically linked with life style risk factors that investigation of sources of infection in individuals are inappropriate. That in Chennai the general truth applies that maleness, high rainfall and outdoor manual occupation encourage higher incidence rate of leptospirosis & that more specific sources cannot be pinpointed with certainty.[1]

In our study contaminated environment contributed about 95% of cases. This very fact was evident from cases occurring throughout the year & maximum number of cases occurred during August – December which covers both monsoon & non-monsoon months.

Table -32
Monsoon - monthly incidence comparison

Months	**Leptospirosis in Chennai 1987-93, n=176 (4) %**	**Our study n=106 %**
January	2.8%	**5.6%**
February	0.5%	**1.8%**
March	-	**2.8%**
April	-	**3.7%**
May	-	**4.7%**
June	-	**7.5%**
July	0.5%	**3.7%**
August	-	**13.1%**
September	2.2%	**12.2%**
October	-	**18.8%**
November	56%	**15.9%**
December	36.4%	**9.4%**

Animal contact is also an important epidemiological risk factor. In our study animal contact was 94%. The most probable reason we could attribute is most of them had environment which has rats, rodents and dogs.

Of the 106 patients, fever (100%), headache (95.2%), myalgia (90.2%) was the common presentation. This when compared to Vietnam study[14] (anicteric presentation) which is clearly consistent (Table-33) showing myalgia 90.2%, fever

97% & headache 98%. Anicteric presentation in our study was 82.2% which was also consistent with Vietnam study of about 98%. When comparing with another study from Hawaii [12] where fever was 99%, headache 89% & myalgia 91% which was also consistent with our study but in contrast anicteric presentation was only 61%.

Conjunctival suffusion in our study was 18.8%, when this was compared to Vietnam study where it was 42% which was not consistent with our study. Meningitis was only 6.5% in our study showing almost consistent with Vietnam study where it was 12%

Table -33
Clinical features comparison

Clinical features	**South Vietnam n=150 (14) %**	**Hawaii study n=353 (12) %**	**Our study n=106 %**
Fever	97	99	**100**
Headache	98	89	**95.2**
Myalgia	79	91	**90.2**
Conjunctival suffusion	42	28	**18.8**
Meningism	12	27	**6.5**
Vomiting	33	73	**52.6**
Diarrhea	29	53	**7.5**
Anicteric presentation	98	61	**82.2**
Hypotension	-	-	**26.3**
Abdominal pain	28	51	**4.7**
Cough	20		**8.4**
Hepatomegaly	15	16	**24.4**
Splenomegaly	22	9	**16.9**
Jaundice	2	39	**17.8**
Renal failure	4.6	26	**10.3**

Table –34

Indian studies-Clinical features comparison

Clinical features	**Mumbai 2000 n=74 (20) %**	**Kerala (kottayam) n=900 (10) %**	**Gujarat (surat) 1997, n=80 (21) %**	**Our study n=106 %**
Fever	100	95	100	**100**
Headache	91.8	53	-	**95.2**
Myalgia	67.5	85	-	**90.2**
Conjunctival suffusion	35.1	65	58	**18.8**
Cough	35.1	-	13	**8.4**
Jaundice	33.7	80	-	**17.8**
Oliguria	28.3	59	46	**10.3**
Meningitis	-	15	3.1	**6.5**
Bleeding diathesis	-	-	34	**-**
Cardiac	-	-	4	-

Further when comparing with previous Indian studies (Table- 34) from Mumbai [20], Kerala [10], Gujarat [21] and Chennai [1]. Fever was consistent with our study of 100%, but headache was 91.8% from Mumbai which was consistent whereas it was only 26% in previous Chennai study (Table- 35). Myalgia was 82% from previous Chennai study which was consistent with our study.

Conjunctival suffusion was 58% in previous Chennai study, kerala 65%, Gujarat was 58% which was not consistent with our study about 18.8%. Meningitis was 42% in previous Chennai study which was not consistent with our study of about 6.5%

Jaundice is an important complication indicating severity of illness which occurs between 4^{th} to 6^{th} days, but may occur as early as 2^{nd} day. In our study jaundice

was 17.8%. Mild jaundice occurred in 12.2%, moderate 3.7% & severe jaundice 1.8% (mean Bilirubin was 2.8mg%). When comparing with Vietnam study which was only 2% but compared with Hawaii study it was 39%, Barbados- 95%, United States- 43%, Chennai (1990)- 84% which was high (Table-33,35). When compared with Indian studies in Mumbai it was 33% which was nearly consistent with our study, whereas kerala- 80% & Chennai (1990)- 84% which was also not consistent (Table- 34, 35). The probable explanation we can attribute for this shift could be due to improved diagnostic facility in diagnosing leptospirosis & investigating all fever patients with fever >5 days.

Table -35
International studies comparison

Clinical features	**Barbados (Edwards et al) n=88 (18) %**	**United states (Heath et al) n=345 (9) %**	**Korea (Park et al) n=93 (19) %**	**Chennai (1990) (MSP et al) n=57 (1) %**	**Our study n=106 %**
Fever	85	100	97	100	**100**
Renal failure	49	26	15	72	**10.3**
Jaundice	95	43	16	84	**17.8**
Conj.suffusion	54	68	88	58	**18.8**
Myalgia	49	68	88	72	**90.2**
Bleeding diath	2	4	40	9	**-**
Cns compl	2	21	6	12	**6.5**
Anicteric presentation	5	57	84	16	**81.3**

Renal failure is another important life threatening complication of leptospirosis. It is the commonest cause for death in leptospirosis. In our study renal failure was 10.3%. Mild renal failure occurred in 5.6%, moderate 1.8% & severe renal failure in 2.8% (mean creatinine 3.5mg%).This when compared to Vietnam study (Table- 33) were it was 4.6% which was almost consistent with our study. In contrast with studies from Barbados- 49%, Chennai (1990) - 72%, Mumbai- 28.3%, kerala- 59% & Gujarat was 58%, which was higher (Table- 34, 35). This was possible because of diagnosing early infection utilizing modified Faine's criteria with slide agglutination test.

Other complications which was noted in our study was vomiting 52.6%, Diarrhoea 7.5%, hypotension 26.3%, abdominal pain 4.7%, cough 8.4%, hepatomegaly 24.4%, Splenomegaly 16.9%. All were not very consistent with other studies. Hemoptysis was common presentation with Andaman study [21] from 1988 to 93 of about 310 cases with case fatality rate of 22.9 %.

Anicteric leptospirosis was the most common presentation in this study of about 82%. Thus when compared to previous study leptospirosis reported in Chennai where jaundice occurred in 84% patients & renal failure occurred in 72%.

In this study complicated leptospirosis is significantly less compared to previous studies from Chennai. Our study highlights the fact that anicteric leptospirosis is

the common presentation in Chennai due to screening of all fever patients utilizing modified Faine's criteria.

We conclude that anicteric leptospirosis is the most common presentation. Contaminated environment, worsened by rain fall is the most important epidemiological risk factor; outdoor manual workers are the most vulnerable group. Thus, we recommend that all patients with fever (> 5 days) should be investigated for leptospirosis

Summary

1) A total of 106 patients with leptospirosis was analyzed, males-69, females - 37 & mean age was 31.2.
2) Out door manual workers were the group at highest risk to develop leptospirosis
3) Contaminated environment (95%), animal contact (94%) were important epidemiological factors. Rainfall was important risk factor in 50% of patients.
4) Most of the cases occurred between August to December.
5) Anicteric leptospirosis (82%) along with fever, headache, and myalgia were common clinical presentation. Conjunctival suffusion & Meningism was rare.
6) Jaundice occurred in 17.8% (Mean Bilirubin 2.8 mg %)
7) Renal failure occurred in 10.3% (mild 5.6%, moderate 1.8%, severe 2.8%), 2 patients were dialyzed.
8) All patients recovered , mortality- nil
9) Modified Faine's criteria was valuable for diagnosis of leptospirosis (especially anicteric)

Conclusion

1, Anicteric leptospirosis is the common presentation (82%) in north Chennai.

2, Lower incidence of jaundice and renal failure

3, It also occurs in non-monsoon months

4, Contaminated environment is an important risk factor/ outdoor manual workers are the vulnerable risk group.

5, Role of modified Faine's criteria with single diagnostic test MSAT makes diagnosis easy

6, Recommended that all fever patients be evaluated for leptospirosis

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PROFORMA

NAME	DOA
AGE	DOD
SEX	IP NO.
ADDRESS	WARD
OCCUPATION	

CLINICAL HISTORY:

Fever	Jaundice
Headache	Oliguria
Myalgia	Altered sensorium
Vomiting	Bleeding diathesis
Diarrhoea	High colored urine
Cough	Abdominal pain

EPIDEMIOLOGICAL DATA

Rainfall
Contaminated environment
Animal contact

CLINICAL EXAMINATION

Vitals : Pulse rate
Temperature
BP
RR

Conjunctival suffusion	Bleeding diathesis
Muscle tenderness	Hepato/splenomegaly
Hypovolemia/ dehydration	Anemia
Jaundice	

CVS
RS
ABD
CNS

Modified Faine's criteria

Clinical features (A)	**Score**	
Fever	**2**	
Headache	**2**	
Temperature > 39 deg.C	**2**	
Myalgia	**4**	
Conjunctival suffusion	**4**	**10**
Meningism	**4**	
Jaundice	**1**	
Albuminuria/ elevated BUN	**2**	
Epidemiological factors (B)		
Rainfall	**5**	
Contaminated environment	**4**	
Animal contact	**1**	
Laboratory criteria (C)		
Culture	**Diagnosis certain**	
ELISA IgM	**15**	
MSAT	**15**	
MAT- single positive high titer	**15**	
MAT- rising titer (paired sera)	**25**	

Each feature is given appropriate scoring. Presumptive diagnosis of leptospirosis is made of

Part A or part A+B with a score of 26 or more

Part A+B+C = 25 or more and in serological tests, only one test should be scored

INVESTIGATION

Hemogram- TC, Hb
Platelet count
Renal function test- Bl.Urea
S.creatinine
Liver function test- Bilirubin – Total & direct
SGOT, SGPT
Chest X-ray
ECG
USG-Abdomen

MSAT- Macroscopic slide agglutination test
MAT – Microscopic agglutination test

Urine – albumin/ sugar/ deposit

DIAGNOSIS

MANAGEMENT

Cap .Doxycyline
IV Penicillin
IV Fluids
Antipyretics
Supportive treatment- dialysis

OUTCOME

KEY TO FILES

FILE – 1: Title, certificate, declaration, acknowledgement, contents

FILE – 2: Introduction
- **Review of literature**
- **Materials and methods**
- **Results**
- **Discussion**
- **Summary**
- **Conclusion**

FILE – 3: Bibliography

FILE – 4: Proforma

FILE – 5: Master chart

FILE – 6: Chennai city map

Master chart

S.no	Name	Age	sex	Occupation	Fever	headache	Myalgia	Conjunctival suffusion	Meningism	Jaundice	Oliguria	vomiting	Diarrhoea	Abdominal pain	Cough	Hypotension/ hypovolemia	Hepatomgaly	Splenomgaly
1.	Arun	26	M	Courier boy	+	+	+	+	-	-	-	-	-	-	-	+	-	-
2.	Pitchai	33	M	Laborer	+	+	+	-	-	-	-	-	-	-	-	+	+	+
3.	Kulandairaj	28	M	Sweeper	+	+	+	+	-	-	-	-	-	-	-	-	-	-
4.	Vijay	19	M	Glass fitter	+	+	+	-	-	-	-	-	-	+	-	-	-	+
5.	Vasanthi	33	F	House wife	+	+	+	+	-	+	-	-	-	-	-	-	-	-
6.	Panchali	35	F	House wife	+	+	+	-	-	-	-	+	-	-	-	-	+	-
7.	Punithavathy	65	F	House wife	+	+	+	-	-	-	-	-	-	-	-	-	-	-
8.	Rajesh	18	M	Plumber	+	+	+	-	-	-	-	-	-	-	-	-	-	-
9.	Narayan	30	M	farmer	+	+	+	-	-	-	-	-	-	-	+	-	-	-
10.	Siva	19	M	Electrician	+	+	+	-	+	-	-	+	-	-	-	+	-	-
11.	Sasikala	15	F	Student	+	+	+	-	-	-	-	+	-	-	-	-	+	-
12.	Charumathi	15	F	Coolie	+	+	+	-	-	-	-	-	-	-	-	-	-	-
13	Ethiraj	28	M	Coolie	+	+	-	-	+	-	-	-	-	-	-	-	-	+
14.	Varadhan	34	M	Farmer	+	+	+	-	-	+	-	+	-	-	-	-	-	-
15.	Kuttiammal	30	F	Sweeper	+	-	+	+	-	-	-	-	-	-	-	-	-	-
16.	Malaythri	38	M	Laborer	+	+	+	+	-	-	-	-	-	-	-	-	-	-
17.	Suresh	35	M	Barber	+	+	+	-	-	+	-	-	-	-	-	-	+	+
18.	Shankar	37	M	Electrician	+	+	+	-	-	-	-	-	-	-	-	-	+	+
19.	Rajkumar	20	M	TV mechanic	+	+	+	-	-	+	-	+	+	-	-	+	-	-
20.	Soosai	25	M	Painter	+	+	+	+	-	-	-	+	-	-	-	+	+	+
21.	Vasanthi	25	F	House wife	+	+	+	-	-	-	-	-	-	-	-	-	-	-
22.	Saraswathi	24	F	Servant maid	+	+	+	-	-	-	-	+	-	-	-	-	-	-

S.no	Name	Address	Months	Rainfall	Contaminated environment	Animal contact	Urea (mg %)	Creatinine (mg %)	Bilirubin (mg %)	SGOT (IU/L)	SGPT (IU/L)	Hb (gms%)	Platelet (lacs/ mcl)	TC (cells/ mcl)	MSAT	MAT	Faine score
1.	Arun	Tondiarpet	Nov	+	-	+	88	0.9	1.1	28	21	11.6	1.6	9200	+	+	33
2.	Pitchai	Vilivakkam	Jan	+	+	+	24	0.8	1	52	24	10	1.2	8400	+	+	29
3.	Kulandairaj	Parrys	Dec	+	-	+	28	0.7	1.2	24	20	12	1.1	9000	+	+	33
4.	Vijay	Tondiarpet	Dec	+	+	+	22	1.0	0.9	22	28	11	1.2	9100	+	+	29
5.	Vasanthi	Vysarpadi	Jan	+	+	+	19	0.9	2.1	36	56	11	1.2	7800	+	+	38
6.	Panchali	Wasermanpet	Nov	-	+	+	20	1.2	1.1	22	24	11	1.3	9000	+	+	28
7.	Punithavathy	Pulianthope	Aug	+	+	+	22	0.8	0.9	22	26	10	1.1	6000	+	+	29
8.	Rajesh	Tondiarpet	Nov	-	+	+	18	1.1	0.8	22	28	12	1.2	10000	+	+	29
9.	Narayan	Gumdipoondi	Nov	-	+	+	26	1	0.9	20	18	11.5	1.1	9200	+	+	26
10.	Siva	Mint	Sep	-	+	+	28	0.9	1	42	48	11	1.2	9000	+	+	29
11.	Sasikala	Parrys	Aug	+	+	+	20	1.1	1	62	44	9.9	1.2	9000	+	+	28
12.	Charumathi	Parrys	Sep	-	+	+	22	1	1.1	44	42	11	1.4	8000	+	+	26
13.	Ethiraj	Wasermanpet	Nov	-	+	+	49	1.2	1	42	68	12	1.1	11101	+	+	28
14.	Varadhan	Gumdipoondi	may	+	+	+	26	1.3	2.3	48	62	12	1.2	8100	+	+	30
15.	Kuttiammal	Vysarpadi	Apr	+	+	+	26	1.1	1	48	68	11	1.3	9100	+	+	31
16	Malaythri	Moolakotram	Nov	+	-	+	17	1.1	1.2	22	24	9.8	1.4	9800	+	+	34
17.	Suresh	varadapalyam	Nov	+	+	+	23	1.3	2.8	116	68	8	1.2	9900	+	+	33
18.	Shankar	Ernavoor	Oct	+	+	+	24	1.1	1	64	24	11	1.3	8000	+	+	33
19.	Rajkumar	Tv Nagar	Nov	+	+	+	30	1.2	3	180	200	10.2	1.1	7800	+	+	30
20.	Soosai	Mannadi	Nov	+	+	+	41	1.1	1.1	14	23	10	1.2	10000	+	+	34
21.	Vasanthi	Tiruvallur	Oct	+	+	+	16	1	0.9	20	22	10.4	1.1	9000	+	+	31
22.	Saraswathi	Chindaripet	Oct	+	+	+	12	0.9	1.0	40	42	8	1.1	8100	+	+	30

S.no	Name	Age	sex	Occupation	Fever	headache	Myalgia	Conjunctival suffusion	Meningism	Jaundice	Oliguria	Vomiting	Diarrhoea	Abdominal pain	Cough	Hypotension/ hypovolemia	Hepatomgaly	Splenomgaly
23.	Vasu	38	M	Farmer	+	+	+	-	-	-	-	-	-	-	-	-	-	-
24.	Srinivasan	25	M	Laborer	+	+	+	-	-	-	-	-	-	-	-	-	+	-
25.	Mary	16	F	Student	+	+	+	-	-	-	-	-	-	-	+	-	-	-
26	Alamelu	38	F	House wife	+	+	+	-	-	-	-	-	-	-	+	-	+	+
27.	Esther	29	F	House wife	+	+	+	-	-	-	-	+	-	-	-	-	-	-
28.	Annapoorni	30	F	Coolie	+	+	+	-	-	-	-	-	-	-	-	-	-	-
29.	Ramakrishan	54	M	Mechanic	+	+	+	+	+	+	+	-	+	-	-	+	-	-
30.	Rajan	25	M	Laborer	+	+	+	+	-	+	-	+	-	-	-	+	-	+
31.	Baradan	40	M	Laborer	+	+	+	+	-	+	-	-	-	-	+	+	+	+
32.	Krishnan	20	M	Fitter	+	+	+	-	-	+	-	-	-	-	-	-	+	+
33.	Parthiban	33	M	Laborer	+	+	+	-	-	-	-	+	-	-	-	-	-	+
34.	Kailasam	34	M	Sweeper	+	+	+	-	-	-	+	+	-	-	-	+	-	-
35.	Chengalvaryn	40	M	Farmer	+	+	+	+	-	+	+	+	-	-	-	+	-	-
36.	Manikandan	16	M	Student	+	+	+	-	-	-	-	-	-	-	-	-	-	-
37.	Danalakshmi	22	F	Sweeper	+	+	+	-	-	-	-	-	-	-	-	+	+	-
38.	Sathish kumar	16	M	Student	+	+	+	-	-	-	-	-	-	-	-	-	-	-
39.	Kanimoli	22	F	Attender	+	+	+	-	-	-	-	+	-	-	+	-	-	-
40.	Rajam	62	F	House wife	+	+	+	-	-	-	-	+	-	-	-	-	-	-
41.	Devadoss	48	M	Mason	+	+	+	-	-	-	-	+	-	-	-	-	+	-
42.	Sankariah	41	M	Farmer	+	+	+	-	-	+	-	+	-	-	-	-	-	+
43.	Ponnuswamy	40	M	Farmer	+	+	+	-	-	-	-	-	-	-	-	-	-	-
44.	Kannayan	45	M	Driver	+	+	+	-	-	-		+	-	-	-	-	+	-

S.no	Name	Address	Months	Rainfall	Contaminated environment	Animal contact	Urea (mg %)	Creatinine (mg %)	Bilirubin (mg %)	SGOT (IU/L)	SGPT (IU/L)	Hb (gms%)	Platelet (lacs/ mcl)	TC (cells/ mcl)	MSAT	MAT	Faine score
23.	Vasu	Ponneri	Oct	+	+	+	28	0.8	1.2	28	21	10.4	1.1	9200	+	+	33
24.	Srinivasan	Vysarpadi	Oct	+	+	+	17	0.8	1	20	22	10	1.2	8100	+	+	32
25.	Mary	Tondiarpet	Oct	+	+	+	18	0.7	1.2	42	40	8.4	1.5	9000	+	+	31
26	Alamelu	Mandaveli	Oct	-	+	+	28	1.0	0.9	22	28	9	1.2	8000	+	+	30
27.	Esther	korkupet	Oct	-	+	+	19	0.9	1.2	16	12	10.2	1.1	9000	+	+	32
28.	Annapoorni	Wasermanpet	Aug	+	+	+	18	1.2	1.1	42	40	8	1.3	10,100	+	+	31
29.	Ramakrishan	Mylapore	Sep	-	+	+	106	3.8	2.9	22	26	10	1.1	8800	+	+	34
30.	Rajan	perambur	March	-	+	+	28	2.8	1.8	22	48	12	1.2	10000	+	+	32
31.	Baradan	Padi	Apr	-	+	+	18	1	2.6	42	43	11.5	1.1	9200	+	+	32
32.	Krishnan	Ambattur	May	-	+	+	28	0.9	2.8	42	48	11	1.2	9000	+	+	32
33.	Parthiban	Valuvarkotam	Aug	-	+	+	20	1.1	1	22	24	9.9	1.2	9000	+	+	28
34.	Kailasam	Vysarpadi	Aug	-	+	+	42	5.5	1.4	56	78	11	1.2	8700	+	+	32
35.	Chengalvaryn	Gumdipoondi	Apr	-	+	+	156	5.4	4.1	42	68	12	1.1	8000	+	+	34
36.	Manikandan	Saidapet	Jun	-	+	+	26	1.3	1.3	22	18	11	1.2	12600	+	+	30
37.	Danalakshmi	Mandaveli	May	-	+	+	26	1.1	1	30	32	12	1.3	10600	+	+	28
38.	Sathish kumar	Parrys	May	-	+	+	20	1.1	1.2	22	24	11	1.2	4400	+	+	28
39.	Kanimoli	Perambur	Jun	+	+	+	20	1.3	1.1	40	42	10.6	1.1	5100	+	+	29
40.	Rajam	Vysarpadi	July	-	+	+	24	1.1	1	40	26	9	1.1	4800	+	+	30
41.	Devadoss	Padi	June	+	+	+	30	1.2	1	60	40	10	1.1	5200	+	+	31
42.	Sankariah	Utukottai	Jan	+	+	+	26	1.1	3.2	138	146	11	1.2	10400	+	+	29
43.	Ponnuswamy	Tiruvallur	Feb	-	+	+	22	1	0.9	20	22	12	1.1	6000	+	+	33
44.	Kannayan	Allinagaram	Oct	-	+	+	18	0.9	1.0	40	42	10	1.1	5100	+	+	30

S.no	Name	Age	sex	Occupation	Fever	headache	Myalgia	Conjunctival suffusion	Meningism	Jaundice	Oliguria	Vomiting	Diarrhoea	Abdominal pain	Cough	Hypotension/ hypovolemia	Hepatomgaly	Splenomgaly
45.	Ansaribeevi	20	F	House wife	+	+	+	+	-	-	-	+	-	-	-	-	-	-
46.	Anand	19	M	Student	+	+	+	+	-	-	+	-	-	-	-	-	+	-
47.	Raja	29	M	Cleaner	+	+	+	+	-	-	+	+	-	-	-	-	-	-
48	Bibiyan	65	F	Sweeper	+	-	+	-	-	-	-	+	-	-	-	+	-	-
49.	Hamanbee	50	F	House wife	+	+	-	-	-	-	-	+	-	-	-	-	-	-
50.	Sekar	25	M	Coolie	+	+	+	-	-	-	-	-	-	-	-	-	+	-
51.	Sulurnathan	47	M	Fitter	+	+	+	-	-	-	-	+	-	-	-	-	-	-
52.	Manju	28	F	House wife	+	+	+	-	-	-	-	-	-	-	-	-	+	-
53.	Ponnuswamy	45	M	Mason	+	+	+	-	-	-	+	+	-	-	-	-	-	-
54.	Pavithra	16	F	Fitter	+	+	+	-	-	-	-	+	-	-	-	-	-	+
55.	Shankar	40	M	Electrician	+	+	+	-	-	+	-	+	-	-	-	-	-	+
56.	Pachali	60	F	Sweeper	+	+	+	-	-	-	-	+	-	-	-	+	-	-
57.	Sivaprakash	43	M	Laborer	+	+	+	-	-	-	-	-	-	-	-	+	-	-
58.	Nagabooshnm	20	F	Teacher	+	+	+	-	-	-	-	-	-	-	-	-	+	-
59.	Angamuthu	30	M	Coolie	+	+	+	-	-	-	-	+	-	-	-	-	-	-
60.	Roopavathi	20	F	Ayah	+	+	+	-	-	-	-	+	-	-	-	-	-	-
61.	Perumal	43	M	Driver	+	+	+	-	-	-	-	+	-	-	-	-	-	-
62.	Anbalagan	15	M	Student	+	+	+	-	-	-	-	+	-	-	-	-	-	-
63.	Govindan	23	M	Farmer	+	+	+	-	-	+	-	-	+	+	-	-	+	-
64.	Dharmaraj	40	M	Painter	+	+	+	-	-	-	-	+	-	-	-	+	-	-
65.	Venkatesh	28	M	Fitter	+	+	+	-	-	+	-	+	-	-	-	-	-	+
66.	Dayanidhi	15	M	Student	+	-	+	-	-	-		-	-	-	+	-	+	+

S.no	Name	Address	Months	Rainfall	Contaminated environment	Animal contact	Urea (mg %)	Creatinine (mg %)	Bilirubin (mg %)	SGOT (IU/L)	SGPT (IU/L)	Hb (gms%)	Platelet (lacs/ mcl)	TC (cells/ mcl)	MSAT	MAT	Faine score
45.	Ansaribeevi	Sowcarpet	June	-	+	+	12	0.9	1.1	30	32	11	1.1	4200	+	+	31
46.	Anand	Aynavaram	Mar	+	+	+	18	2.1	1.1	32	40	12	1.2	5800	+	+	32
47.	Raja	Mandaveli	Mar	-	+	-	16	2.4	1.2	40	42	11	1.1	5300	+	+	30
48	Bibiyan	Pammal	Jan	-	+	+	28	1.0	0.9	60	48	10	1	5200	+	+	27
49.	Hamanbee	Royapuram	Dec	-	+	+	18	0.9	1.2	28	28	11	1.1	5000	+	+	26
50.	Sekar	Mint	Dec	-	+	+	20	1.2	1.1	62	60	12	1.1	4900	+	+	28
51.	Sulurnathan	Seven wells	Dec	-	+	+	22	1.2	0.9	22	26	10	1.1	5200	+	+	30
52.	Manju	Aynavaram	July	-	+	+	20	1.1	1.2	68	60	11	1.2	5100	+	+	31
53.	Ponnuswamy	Seven wells	June	-	+	+	22	2.8	1.1	68	72	12	1.4	5600	+	+	32
54.	Pavithra	Ajax	Aug	-	+	+	24	0.9	0.8	72	68	11	1.1	4200	+	+	29
55.	Shankar	Kasimedu	Aug	-	+	+	28	1.1	2.7	74	64	11	1.1	4800	+	+	30
56.	Pachali	Pudupet	Aug	-	+	+	32	1	0.8	70	72	10	1.1	4200	+	+	31
57.	Sivaprakash	Royapuram	Apr	-	+	+	24	0.9	0.7	42	68	12	1.1	7200	+	+	30
58.	Nagabooshnm	Royapuram	Jun	-	+	+	32	1.1	0.9	40	42	12	1.1	4800	+	+	31
59.	Angamuthu	Central	Sep	-	+	+	18	1.1	1	42	40	10	1.1	4300	+	+	31
60.	Roopavathi	Mint	Oct	-	+	+	18	1.1	1.2	62	60	10	1.1	4200	+	+	27
61.	Perumal	Tondiarpet	Jun	+	+	+	20	1.3	1.1	38	32	11	1	4800	+	+	30
62.	Anbalagan	Seven wells	June	-	+	+	28	1.1	1	20	28	12	1.1	4200	+	+	29
63.	Govindan	Villupuram	July	+	+	+	30	1.2	5.2	263	403	11	1	8200	+	+	32
64.	Dharmaraj	Triplicane	Oct	+	+	+	39	1.1	1	22	24	11	1.6	6200	+	+	33
65.	Venkatesh	Parrys	Oct	+	+	+	12	1	2.5	62	78	12.4	1.1	5200	+	+	34
66.	Dayanidhi	Korrukupet	Sep	+	+	+	24	0.9	1.0	40	42	11.2	1.2	6700	+	+	31

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67.	Ramya	15	F	Student	+	+	+	-	-	-	-	+	-	-	-	+	-	-
68.	Devika	23	F	House wife	+	+	+	-	-	-	-	+	-	-	-	-	-	-
69.	Venkatesh	38	M	Factory work	+	+	+	-	-	+	-	+	-	-	-	-	-	+
70.	Dhanraj	16	M	Coolie	+	+	+	-	-	-	-	+	-	-	-	+	-	+
71.	Ramraj	16	M	Welder	+	+	+	-	-	-	-	-	+	-	-	+	-	-
72.	Suresh kumar	29	M	Mechanic	+	-	+	-	-	-	-	+	-	-	-	-	-	+
73.	Sirajudeen	27	M	Electrician	+	+	+	-	-	-	-	+	-	-	-	-	-	-
74.	Nizamudeen	18	M	Plumber	+	+	+	-	-	-	-	+	-	-	-	-	-	-
75.	Prabhu	18	M	Painter	+	+	+	-	-	-	-	+	-	-	-	+	-	-
76.	Nagoor basha	18	M	Business	+	+	-	-	-	-	-	+	-	-	-	+	+	-
77.	Gowri	29	F	House wife	+	+	+	-	-	-	-	+	-	+	-	-	-	-
78.	Sriram	50	M	Conductor	+	+	+	+	-	+	-	+	+	+	-	+	-	-
79.	Saritha	24	F	House wife	+	+	+	+	-	-	-	+	-	-	-	-	-	-
80.	Prasad	23	M	Coolie	+	+	+	-	-	-	-	-	-	-	-	-	+	-
81.	Shankar	30	M	Painter	+	+	+	-	-	+	-	+	-	-	-	-	-	-
82.	Amudhavalli	28	F	House wife	+	+	-	-	-	-	-	+	-	-	-	+	-	-
83.	Lawrence	23	M	Coolie	+	+	-	+	-	-	-	-	-	+	-	-	+	-
84.	Babu	30	M	Painter	+	+	+	+	-	-	+	-	+	-	+	-	-	+
85.	Nagappan	37	M	Driver	+	+	+	+	+	-	-	+	-	-	-	+	-	-
86.	Manikandan	19	M	Welder	+	+	+	+	-	+	+	+	-	-	-	-	-	+
87.	Surya	18	M	Student	+	+	+	-	-	-	-	-	+	-	-	-	+	-
88.	Dilshad	24	F	House wife	+	+	+	-	-	-	-	+	-	-	-	-	-	-

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67.	Ramya	Manali	sep	+	+	+	93	0.9	0.8	40	42	10.4	1.4	6100	+	+	32
68.	Devika	Royapuram	Oct	+	+	-	20	1	0.9	36	48	9.6	1.6	7200	+	+	29
69.	Venkatesh	Kasimedu	Oct	+	+	+	12	1.1	2.4	78	66	12.6	1.1	5200	+	+	34
70.	Dhanraj	Mint	Oct	+	+	+	39	1.0	0.9	21	22	10	1.1	6200	+	+	33
71.	Ramraj	Moolakothrm	Aug	-	+	+	39	0.9	1.2	28	22	12	1	4300	+	+	30
72.	Suresh kumar	Pulianthope	Oct	+	+	+	19	1.2	1.1	79	34	10	1.1	6000	+	+	31
73.	Sirajudeen	Avadi	Oct	+	+	+	16	0.9	1	73	106	10.6	1.2	5100	+	+	32
74.	Nizamudeen	Royapuram	Oct	+	+	-	20	1.1	1.3	16	22	11	1	6100	+	+	30
75.	Prabhu	Ambattur	Aug	-	+	+	32	0.8	1.1	40	28	11	1	6000	+	+	28
76.	Nagoor basha	Ayanavaram	Jan	+	+	+	38	1	0.8	72	26	12	1.2	4800	+	+	31
77.	Gowri	Royapuram	Aug	+	+	+	14	1.1	1	26	41	10	1.4	5400	+	+	28
78.	Sriram	Tondiarpet	Sep	+	+	+	53	1.2	3.2	142	140	9.8	1.8	7700	+	+	33
79.	Saritha	Ajax	Aug	-	+	+	20	0.9	0.7	34	32	8.2	1	4900	+	+	31
80.	Prasad	Tondiarpet	Aug	+	+	+	32	1.1	0.9	22	40	11.8	1.1	4700	+	+	31
81.	Shankar	Mint	Sep	+	+	+	18	1.1	2.1	42	40	10	1.1	4300	+	+	30
82.	Amudhavalli	Tondiarpet	Oct	-	+	+	18	1.2	1	62	50	10	1.1	4100	+	+	29
83.	Lawrence	Vysarpadi	Dec	+	+	+	20	1.3	1.1	38	32	11	1	4800	+	+	33
84.	Babu	Royapuram	Jan	+	+	+	38	2.1	1	20	28	12	1.1	4200	+	+	38
85.	Nagappan	Korukuppet	Nov	+	+	+	30	1	1.2	26	40	11	1	8200	+	+	37
86.	Manidkandan	Paadi	Oct	-	+	+	39	6.1	3	98	88	11	1.6	6200	+	+	32
87.	Surya	Aynavaram	Oct	-	+	+	12	1	0.9	62	78	12.4	1.1	5200	+	+	35
88.	Dilshad	Ajax	Sep	-	+	+	14	0.8	1	43	65	10	1.1	6900	+	+	28

S.no	Name	Age	sex	Occupation	Fever	headache	Myalgia	Conjunctival suffusion	Meningism	Jaundice	Oliguria	Vomiting	Diarrhoea	Abdominal pain	Cough	Hypotension/ hypovolemia	Hepatomgaly	Splenomgaly
89.	Rekha	20	F	House wife	+	+	+	-	-	-	-	+	-	-	-	+	-	-
90.	Mani	22	M	Coolie	+	+	-	+	-	-	-	-	+	-	-	-	+	-
91.	Karthik	20	M	Student	+	+	+	-	+	-	+	+	+	-	-	+	-	+
92.	Velmurugan	30	M	Coolie	+	+	+	-	+	-	-	+	-	-	-	-	-	-
93.	Satish	25	M	Driver	+	+	-	-	-	-	-	-	+	-	-	+	-	-
94.	Mangalaksmi	60	F	House wife	+	+	-	-	-	-	-	-	-	-	+	-	+	-
95.	Mamadevi	42	F	Sweeper	+	+	+	-	-	-	-	+	-	-	+	-	-	-
96.	Maheswari	28	F	House wife	+	+	+	-	-	-	-	+	-	-	+	-	-	-
97.	Patchiamma	65	F	House wife	+	+	+	-	-	+	-	+	-	-	-	+	+	-
98.	Mala	28	F	Sweeper	+	+	-	-	-	-	-	-	+	-	-	-	-	-
99.	Rani	45	M	House wife	+	+	+	-	-	-	-	+	-	-	-	+	-	-
100.	Anbalagan	19	M	Electrician	+	+	+	-	-	-	-	-	-	-	-	-	-	+
101.	Devadoss	48	M	Farmer	+	+	+	-	-	-	-	-	+	-	+	-	-	+
102.	Priyan	21	M	Coolie	+	-	+	-	-	-	-	+	-	+	-	-	-	-
103.	Ramu	39	M	Welder	+	+	-	-	-	-	-	-	-	-	-	-	-	-
104.	Thulukanam	42	M	Coolie	+	+	+	+	-	+	+	-	-	-	-	+	+	-
105.	Kanniappan	24	M	Painter	+	+	-	-	-	+	-	-	-	+	-	-	-	-
106.	Subramani	50	M	Cleaner	+	+	+	+	+	+	+	+	-	-	-	+	+	-

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89.	Rekha	Red hills	June	-	+	+	12	0.9	1.1	30	32	11	1.1	4200	+	+	28
90.	Mani	Royapuram	Mar	+	+	+	18	2.1	1.1	32	40	12	1.2	5800	+	+	27
91.	Karthik	Tondiarpet	Oct	+	+	+	74	1.9	1.2	201	400	11	1.1	5200	+	+	37
92.	Velmurugan	Kasimedu	Dec	+	+	+	26	1.0	0.9	47	30	10.8	1	5100	+	+	36
93.	Satish	Paadi	Nov	-	+	+	18	0.9	1.2	32	30	11	1.1	5000	+	+	28
94.	Mangalaksmi	Aynavaram	Nov	-	+	+	16	1.2	1.1	26	22	11	1.2	4900	+	+	29
95.	Mamadevi	Perambur	Sep	+	+	+	22	1.2	0.9	51	32	10	1	6000	+	+	33
96.	Maheswari	Central	Nov	+	+	+	20	1.1	1.2	28	22	10.8	1.3	5100	+	+	33
97.	Patchiamma	Vysarpadi	Nov	+	+	+	116	1.3	3.8	173	56	9.8	1	4800	+	+	34
98.	Mala	Kasimedu	Aug	+	+	+	24	0.9	0.8	72	68	11	1.1	4200	+	+	33
99.	Rani	Vysarpadi	Nov	+	+	+	18	1.1	0.9	29	22	11.2	1.4	4800	+	+	33
100.	Anbalagan	Royapuram	June	-	+	+	22	1	0.8	16	12	12	1.2	3780	+	+	28
101.	Devadoss	Poondi	June	-	+	+	19	0.9	0.7	26	23	11	1.5	9000	+	+	28
102.	Priyan	Royapuram	Aug	-	+	+	18	1.1	0.9	80	65	9.5	1	4700	+	+	26
103.	Ramu	Korukkepet	Oct	+	+	+	32	1.1	1	60	68	12	2	4300	+	+	29
104.	Thulukanam	Aminjikarai	Nov	+	+	+	140	2.7	3	68	72	11.4	1.2	6100	+	+	40
105.	Kanniappan	Tondiarpet	Feb	+	+	+	38	1.3	2.6	40	42	9	1	5100	+	+	29
106.	Subramani	Seven wells	Nov	+	+	+	60	4.1	5.4	123	66	11.4	1.2	6000	+	+	41