ejpmr, 2017,4(12), 173-188

SJIF Impact Factor 4.161

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN 2394-3211

EJPMR

A CRITICAL REVIEW ON DIABETES IN PERSPECTIVE OF ANCIENT AND MODERN TOXICOLOGY

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Article Received on 10/10/2017 **Article Revised on 30/10/2017** **Article Accepted on 20/11/2017**

ABSRACT

The term diabetes is commonly referred for Diabetes mellitus which is the group of metabolic disorders in which there is high blood sugar level over the prolonged period. Frequent urination, increased thirst and increased hunger are the commonly occurred symptoms of Diabetes. If it left untreated or due to the negligence of doctor or patient or both, it may causes many complications or even the death of the Individual. Many time diabetes is caused due to toxic environmental factors like heavy metals, pesticides, pollution etc. Contamination of drinking water, food, air are main sources of such environmental toxicities and the person who exposes to these factors for a certain period of time are susceptible for diabetes and its complications. Many times the Ayurvedic poisonous plants which listed in schedule E of drugs and cosmetic Act. 1940 and rule 1945 and herbal or herbo-mineral compounds containing the poisonous herbs and metals used for the treatment of Diabetes after the proper detoxifying processes called as *Shodhana*. In the given study treatment protocol of Diabetes by Ayurvedic poisonous herbal and metallic preparations is established and also the modern point of view of various autopsy studies that shows the association between diabetes and its complication along with the its medico-legal aspect are elaborated.

KEYWORDS: Diabetes, complications, Ayurvedic poisonous plants, autopsy, medico-legal aspect.

INRODUCTION

Now a days Diabetes is becoming the fastest considerable disease in the world. No longer is a disease of predominantly rich nations, its prevalence steadily increasing everywhere, most markedly in the world's middle income countries. Diabetes leads to cause of death of 1.5 million peoples in 2012. In 2014, 422 million peoples in the world had diabetes. The prevalence is 8.5% among the adult population. Such a way it has gigantic disgrace in recent times and becomes the world's largest silent killer. As per WHO, India has been projected as fastest growing population of Diabetic patients. It is estimated that between 1995 to 2005 diabetic patients in India will increase by 195%. It is the medical condition in which there is an accumulation of glucose in urine and blood of the individual. It is caused due to the malfunctioning of the pancreas, which is responsible of production of insulin. In ayurveda, it is explained as a term called *Madhumeha* which is a type of *Pameha*. The commonly occurred symptoms are frequent urination, increased thirst and increased hunger. If it left untreated or due to the negligence of doctor or patient or both, it may causes many complications or even the death of the Individual. Many time diabetes is caused due to toxic environmental factors like heavy metals, pesticides, pollution etc. Contamination of drinking water, food, air are main sources of such environmental toxicities and the person who exposes to these factors for a certain period of time are susceptible for diabetes and its complications.

OBJECTIVES

1. To discuss the toxic environmental factors and metal toxicities that causes diabetes.
2. To explore the treatment protocol of Diabetes by using medicines that contains toxic herbs and metals used in Ayurveda.
3. To explain their detoxification processes and compounds manufactured after detoxification.
4. To discuss various autopsy studies of complications and associated diseases in diabetic mellitus.
5. To discuss the Medico-legal aspect regarding to diabetes and laws regarding to malpractices and negligence

TOXIC METALS ASSOCIATED WITH DIABETES

Ayurveda perspective

Many of Ayurveda formulations contains the metals or minerals etc. as their integral component. If these are not used by following Ayurveda principles leads to symptoms of toxicity. Our ancient *Acharyas* were versed about this fact and toxic effects due to these metals or

minerals documented in their respective classics. Following metal if taken without the proper detoxifying process like *Shodhana* or *marana* leads to diabetes.

Metals causes Diabetes	Antidotes
Haratal[1]	*Jiraka* with *Sharkara* or *Kushmanda, Duralabha*[2]
Vanga[3]	*Meshsringi* with *Sita*[4]
Naaga[5]	*Haritaki* with *Sita*[6]
Yashada[7]	*Bala* and *Abhaya* with *Sita*[8]

Modern perspective

Inspite of Ayurveda preparations some metals found in our surrounding that leads to diabetes. The sources and mechanism that responsible for diabetes are given bellow.

Toxic metals	Sources	Mechanism[13]
Arsenic	Drinking water (largest source), food, cigarettes, occupational environment, air etc.[9]	Causes insulin resistance
Copper	Inorganic copper from drinking water and taking supplement pills, along with high fat diet.[10]	Haemochromatosis from chronic Cu-absorption (Bronzed Diabetes), Alzhemer's disease, cognition loss
Mercury	Outgressing of mercury from dental amalgam, ingestion of contaminated fish or occupational exposer[11]	Increases urine glucose level, induce oxidative stress, causes pancreatic cell dysfunction, impedes production of insulin
Cadmium	Cigarette smoke, welding and contaminated food and beverages[12]	Inhibits insulin release, leads to increased activation of gluconeogenic enzymes & impaired insulin receptors.

ENVIRONMENTAL TOXIC FACTORS ASSOCIATED WITH DIABETES

Exposure to Pesticides as a cause of Diabetes[14]

- Exposure to pesticides may result in abnormal glucose metabolism, increasing risk of Diabetes
- Dioxin exposure are also suggestive of increased risk for type 2 diabetes, hyper-glycaemia and hyper-insulinemia.
- There have been several case reports of glysuria and transient hyperglycemia associated with herbicides and insecticide poisoning.
- Gestational DM- Exposer to agriculture pesticides during the first trimester of pregnancy may increase risk of GDM.
- Glucose metabolism disturbances have been observed with exposure to organochlorine and organophosphate insecticides. These disturbances include an increase in insulin and blood glucose concentrations, as well as change in activity of glucose metabolism enzyme.[15]

Pollution and Diabetes[16]

- Persistent organic pollutants (POPs) (includes dioxins, DDT, chlordane etc.) and Arsenic are chemicals most strongly linked with diabetes. They may do damage by disrupting hormone_function or altering gene expression which further responsible for diabetes.
- Air pollutants like Nitrogen dioxide and particulate matter had increased insulin resistance_is thought to involve oxidative stress from free radicles in the pollution.

Chemicals and Diabetes[17]

- Phthalates are chemicals used in plastic manufacturing, cosmetics, perfumes, industrial paints and solvents. They may cause diabetes, obesity and insulin resistance in human studies.
- Selenium- It is vital trace mineral, but too much selenium has been associated with Type II diabetes. The mechanism is thought to be oxidative stress leading insulin resistance.

TOXIC HERBAL DRUGS (VISHA-VANASPATI) USE IN DIABETES

1) *Bhallataka (Semecarpus anacardium)*

- The cardinal symptom of Diabetes is frequent micturition. So the drug which regulate on this pathology will certainly use for treatment of Diabetes. According to Acharya Charaka. It is included in 'Mutrasamgrahaniya mahakashaya'. These drugs use to restore normal quantity of urine due to Kashaya rasa which absorb water contents (Jaliyansh).[18]
- It also stated as 'Mehanashanam' means Anti-diabetic in Rajnighantu.
- As per modern concept of diabetes, hyperglycemia is mainly produced by gluconeogenesis and glycogenolysis. Also the impaired energy production due to the altered mitochondrial function. Some animal experiments are done to evaluate efficacy of Semecarpus anacardium on diabetes. On the basis of these studies it was concluded that, Glycolysis and TCA cycle enzymes level increased and it was decreased in gluconeogenesis cycle. Also P13K and AKT increased in skeletal muscles. It shows the hypoglycemic and the antioxidant activity of

Semecarpus anacardium. As per this study Semecarpus anacardium is able to restore the altered activities of enzymes that are involved in carbohydrate metabolism and production of energy.[19]

- As per another study, it stimulates or regenerates the beta cells of Langerhans for secretion of insulin and are most effective for controlling diabetes by improvement of carbohydrate metabolizing enzymes towards the establishment of normal blood glucose level. Due to presence of hypoglycemic components saponins, tannins, triterpine and flavonoids - glucose level significantly reduced.[20]

2) *Vatsanabha (Aconitum ferox)*

- It is useful in neurogenic disorders associated with Diabetes. It is indicated in symptoms like polyuria, nocturnal enuresis. It also decreases urine glucose level so useful in Glycosuria (Alimentary or renal) named as *Ikshumeha* in ayurveda texts.[21]
- It also named as '*Madhumehahara*' in *rasaratnasamucchaya*.*[22]*
- As per Animal trial it was concluded that Aconitum ferox with alpha-glucoside inhibitors could be used in treatment of type2 diabetes. It produced a significant decrease of plasma glucose level. It also shows the strong inhibitory activity against alpha-glucosidase in vitro and in vivo.[23]

TOXIC METALS (*DHATUVISHA*) USED IN DIABETES

Any drug can be panacea or poison. When the drug fulfils the criterion of standard drug then it always becomes the panacea provided, if used in the proper way. While the poorly prepared drug however used skillfully, it always shows the poisonous effects.[24]

Classical Ayurveda texts do mention the hazards of such drugs, which not manufactured properly. Such references clearly shows that our ancient *acharyas* fully aware of hazards of heavy metals and other substances. On the basis of this knowledge, they were prescribed some specific processing techniques like *Shodhana, Marana,* etc. that will removes the hazardous properties of such drugs. These Acharyas also prescribe the testing methods like *Bhasma pariksha* that will tell us whether the drug has attained a form, which doesn't have hazardous properties. These processed metals known as *Bhasma* and utilized in therapeutics.

The properly processed metals which are used in Diabetes are as follows:

Metals used in treatment Diabetes	**Detoxification processes**
Tamra[25] (Copper)	Milk of *Snuhi* (Euphorbia neripholia) mixed with *lavana* and make layer of coating on *Tamrapatra* (sheet of copper). Then after it heated on fire and then it emerge into *swarasa* of *Nirgundi* (Vitex negundo) for three times. Another method of detoxification of *Tamra* is emerge into the milk of *Snuhi* (Euphorbia neripholia) and *Madar* (Calatropis gigantean)[26] Make the very small pieces of sheet of *Tamra*. It heated on the fire and then emerged into fresh juice extract of *Changeri* (Oxalis corniculata) and make its *bhasma*[27]
Naag[28] (Lead)	Lead is taken into the Iron pot and heated on fire. When lead is melted, it emerged into into another pot containing fresh juice extract of roots of *Nirgundi* (Vitex negundo) or *Churnodaka* (lime water). This process is repeated for 7 times to obtained pure lead and used after making its *bhasma*.[29]
Vanga[30] (Tin)	Lead is taken into the Iron pot and heated on fire. When lead is melted, it emerged into another pot containing fresh juice extract of roots of *Nirgundi* (Vitex negundo). After cooling it is taken out and again melted and then emerged into *Churnodaka* (lime water). This process is repeated for 7 times to obtained pure lead and used after making its *bhasma*. It also detoxified when it melted and emerged into milk of *Arka* (Calatropis gigantean) repeatedly for 7 times[31]
Yashada[32] (Zinc)	Zinc is taken into the Iron pot and heated on fire. When lead is melted, it emerged into another pot containing *Churnodaka* (lime water). This process is repeated for 7 times to obtained pure *Yashada* and it used after making its *bhasma*. It also be detoxified by emerging melted *Yashada* into Cow's milk or Milk of *Arka* (Calatropis gigantean)[33]

Many Ayurveda preparations contains the Metals or minerals or herbo-minerals constituent as the one of important component. These have to undergo the proper detoxifying procedures to eliminate their toxic effects and increase their efficacy. The compounds contains these components which are use for diabetes.

1) Ayurveda compounds that containing Toxic herbal component *(Visha-vanaspati)* used for Diabetes

Some of the Ayurvedic poisonous plants are listed in schedule E of drugs and cosmetic Act. 1940 and rule 1945 are also used for manufacture of herbal or herbo-mineral compounds used for treatment of Diabetes. These plants are given as follows along with their compounds are as follows:

Toxic herbal components (Visha-vanaspati)	**Detoxifying process**	**Compounds**
Vatsanabha (Aconitum ferox)	Small pieces taken into pot of clay or stone. Then add fresh Cow's urine into it and this pot put into strong sun light. This process repeat for 3 days by changing Cow's milk daily. Now top portion is removed by knife and kept the inner pure inner portion in sunlight for drying and pure *Vatsanabha* obtained.[34]	*Jaya vati*[35] *Amruta-rasayanam*[36] *Anandbhairav rasa*[37] *Shwasakuthar rasa*[38]
Bhallataka (Semecarpous anacardium)	The seed of *Bhallataka* soaked into the water and rubbed over the piece of bricks till the outer covering is removed. Now the top portion is should remove with knife and the seeds should be washed with warm water and cooked in *Dola yantra* by adding cow's milk for 3 hours, then it again washed with warm water and dried.[39]	*Sarivadi loham*[40] *Ashwagandha-paak*[41] *Nyagrodhadi choornam*[42] *Trikantakadi sneha*[43] *Dhanvantar ghrita*[44] *Nyagrodhadi kwatha*[45] *Shuran vataka*[46] *Dhanvantam ghritam*[47] *Bhallatakasawa*[48]
Chitraka (Plumbago zeylanica)	Usually purification is not followed but some author mentioned about *shodhana* of *Rakta Chitraka*. Here it cuts into small pieces and immerged into lime water for 3 hours. Then it is taken out and again immerged into another fresh lime water for another 3 hours. This process is repeated for three times. Some have mentioned to keep it immerged for 3 days, each day changing the lime water.[49]	*Chandraprabha vati*[50] *Dhanvantar Ghritam*[51] *Sarivadi leham*[52] *Chandraprabha Guti*[53] *Kumaryasava*[54] *Simhamrutam ghritam*[55] *Lodhrasava*[56] *Nyagrodhadi churnam*[57]
Kupilu (Strychnous nuxvomica)	3 Detoxification processes of *Kupilu*[58] (1) Seed should be tied in a piece of cloth and made into *pottali*. It soaked into *Dola yantra* for 3 days by adding kanji (fermented product of brown rice, water, ginger, etc.). Kept in sunlight for drying. Then make the fine powder by smashing in *Kharal* of Iron and make the fine powder by smashing in *Kharal*. OR (2) Seed should fried in Cow's milk ghee. After *colour* becomes slightly red, the outer covering is removed by scraping with knife. OR (3) Seed should be tied in a piece of cloth and made into *pottali* It soaked into *Dola yantra* for 3 hours by adding Cow's milk and after removing make the fine powder in *Kharala.*	*Kupilubeejadi kwatha*[59]
Danti (Baliospermum montanum)	*Danti* root is coated with paste made with *Pippali* (long pepper) and *madhuka* (Madhuka longifolia). This mass is wrapped in grass and tied. Then wrapped in mud covering. This is heated by fire and sunlight. By this method, the toxicity of *Danti* is reduced.[60]	*Dhanvantam ghritam*[61]

Snuhi (Euphorbia Nerifolia)	*Snuhi* milk is mixed with extract fresh juice of leaves of *Chincha* (Termarindus indica). This mixture kept in sunlight for drying. The milk remained after drying used for medicinal purpose.[62]	*Dhanvantam ghritam*[63]
Dhattura (Datura metal)	Seed should be tied in a piece of cloth and made into *pottali* It soaked into *Dola yantra* for 3 hours by adding Cow's milk or *ghee* and after removing, wash it by warm water[64]	*Mahavangeshwara rasa*[65]
Bhanga (Cannabis sativa)	Dry leaves are kept in water wash them though out. Now these leaves kept into sunlight for drying and then fried in Cow's ghee. OR Dry leaves boiled in decoction of bark of *Babbul* (Acasia arabica) for 25 minutes. Then take these *Bhanga* leaves out and remain for drying[66]	*Bruhannayika churnam*[67]
Jayapala (Croton tinglium)	Take the new seeds of *Jayapala* and separate the outer covering. Now separate the greenish Tounge like structure within the seed and remaining portion is considered as *Jayapal*a *beej-majja*. Seed should be tied in a piece of cloth and made into *pottali*. This *pottali* soaked into *Dola yantra* for 3 hours by adding Cow's milk. This procedure repeated for 3 times to obtained pure *Jayapala*[68]	*Praanavallabha rasa*[69]

2) Ayurveda compounds that contains Metallic/Mineral component use in diabetes:

Metallic/ Mineral	**Detoxifying process**	**Compound**
Parada (Mercury)	(1) Mercury and same amount of lime taken into *kharala* and *mardana* process is done for 3 days. It is distilled out from 2 layer cloth. Now this mercury taken into *kharala* along with same quantity of Garlic and half salt and repeat the *mardana* process upto blackish coloration of garlic. Now this mercury is washed by cold water or kanji to obtained pure mercury. OR *(2) Mardana* of mercury is done along with aloe-vera, bark of *Chitraka* (Plumbago zeylanica), Sarshapa (Brassica juncea), *Bruhati* (Solanum indicum), *Kantakari* (Solanum xanthocarpum) and *triphala* for three days. Then wash it by cold water to obtained pure mercury[70]	*Harishankar rasa*[71] *Meghanada rasa*[72] *Mehari rasa*[73] *Chandrakala vati*[74] *Vangeshwar rasa*[75] *Vasanta-kusumakara rasa*[76] *Mrugavati rasa*[77] *Vijaybhairav rasa*[78] *Laxmivilas rasa*[79] *Nityodaya rasa*[80] *Shulavamini rasa*[81] *Chintamani rasa*[82] *Shankaravati rasa*[83] *Sangrahani-kapat rasa*[84] *Piyushavalli rasa*[85] *Sarvanagasundara rasa*[86] *Maharaja vati*[87] *Vishamajwarantaka vati*[88] *Apurvamalini-vasanta rasa*[89]
Vanga (Tin)	(1) Small pieces of *Vanga* obtained by crushing method. Then these pieces are taken into *Loha darvi* (Iron ladle) and melted by heating in low flame. This melted metal is poured in the *pitrhar-yantra* which containing *choornodaka*. Sound heard during the process noted. The purified cooled *Vanga dhatu* washed with lukewarm water. This same process is repeated for six times in different *pitharyantra* and fresh *churnodaka* OR (2) *Shodhana* of *Vanga* carried out in *Kumari swarasa* (freash juice extract of Aloe vera) for seven times. OR (3) By using *haridra (*Curcuma longa*)* and fresh juice extract of *nirgundi* (Vitex negundo) with constant stirring[90]	*Mehakunja-keshari rasa*[91] *Mehantaka rasa*[92] *Mehari rasa*[93] *Chanrakala vati*[94] *Vangeshvar rasa*[95] *Jalajamruta*[96] *Vasantakusumakara rasa*[97]
Naaga (Lead)	*Naaga* is taken into the Iron pot and heated on fire. When lead is melted, it emerged into into another pot containing *swarasa* of roots of *Nirgundi* (Vitex negundo) or *Churnodaka* (lime water). This process is repeated for 7	*Mehantaka rasa*[99] *Vasantakusumakara rasa*[100]

	times to obtained pure lead and used after making its *bhasma*[98]	*Mehakunjakeshari*[101]
Tamra (Copper)	(1) Milk of *Snuhi* (Euphorbia neripholia) mixed with l*avana* and make layer of coating on *Tamrapatra* (sheet of copper). Then after it heated on fire and then it emerge into *swarasa* of *Nirgundi* (Vitex negundo) for three times. Another method of detoxification of *Tamra* is emerge into the milk of *Snuhi* (Euphorbia neripholia) and *Madar* (Calatropis gigantean)[102] OR (2) Make the very small pieces of sheet of *Tamra*. It heated on the fire and then emerged into *swarasa* of *Changeri* (Oxalis corniculata) and make its *bhasma*[103]	*Apurvamalini-vasanta rasa*[103] *Maharajanrupati-vallabha rasa*[104]
Manahshila (Realgar)	(1) Powder of *Manahshila* is emerged into lime-water for 2 days OR (2) *Manahshila* tied in a piece of cloth along with the juice extract of *Bhringaraj*a (Eclipta alba) or *Jayanti* (Sesbania seban) and made into *pottali.* It soaked into *Dola yantra* for 12 hours. OR (3) *Manahshila* has given the *Bhavana* of Lemon juice or juice extract of leaves of *Agasthya* (Sesbania grandiflora) for seven times. Then dry it to detoxify it[105]	*Meghanaada rasa*[10]6 *Jalajamruta rasa*[107]

***VISHANGHNA MAHAKASHAYA*[108]**

This is the group of ten drug explained by Acharya *Charaka* in *Shadavirechanashatashraya-ahyaya.* These drugs have antitoxic properties in various types of poisons. But the drugs belongs to this group have very efficient action on Diabetes and it is proved on various types of scientific studies conducted on these drugs. These are explained as follows**:**

1) Haridra (Curcuma longa)

- It is explained as the best drug (*agrya*) in diabetes.[109] It is taken along with combination of *Dhatri (Embelica officinalis)* for better result.[110] It is very useful herbal drug for diabetes, toxicities, skin disorders etc.
- Curcumin reduce blood glucose and HbA1c level by reduction in hepatic glucose production and glycogen synthesis and stimulation of glucose uptake.
- It also suppress hypoglycemia induced inflammatory state, stimulation of insulin secretion from pancreatic tissue, improvement of pancreatic cell function and reduction of insulin resistance.
- In human clinical trials conducted on diabetic and pre-diabetic patients, glucose lowering effects of turmeric in curcumin have been observed. However no effects are seen in patients with normal baseline levels of blood sugar[111]

2) Manjishta (Rubia cordifolia)

- It is used along with *Chandana (Santalum album)* in diabetes *Manjishtameha* (Haemoglobinuria or haematuria)[112]

3) Suvaha *(Pluchea lanceolata)*

- It is very effective herb for Peripheral neuropathy in which nerve damage occurs.
- It provide relief from diabetic nerve pain[113]

4) *Palindi (Operculina terpethum)*

- *Operculina terpethum* root extract shows better results in treating diabetes and its complications. The possible mechanism by which this extract brigs about its hypoglycemic and Anti-hyperglycemic activity due to elevated plasma insulin level[114]

5) *Chandana (Santalum album)*

- Santalum album can effectively improve lipid profile in diabetes.
- The improvement in atherogenic index is even better than Metformin.
- It lowers the risk of cardiovascular damage in diabetes.
- Although the result from studies did not demonstrate immediate lowering of blood glucose, as in the case of secretagogue or insulin action, prolonged treatment appears to alleviate diabetes though lowering of blood glucose and improved glycated Hemoglobin level.
- It is likely that this effect could be due to its lipid lowering action that could prevent development of insulin resistance and allow better glycemic control through existing insulin content and preventing further damage to beta cells[115]

6) *Kataka (Strychnos potatorum)*

- Rippened fruit of *Strychnos potatorum* use in diabetes[116]
- Phytochemical analysis of *S. potatorum* revealed the presence of alkaloids mainly diaboline and four triterpenes from seed and leaves. It improves glycemic response, along with proven minimal toxicity indicates that it has been promising anti diabetic activity[117]

7) *Shirisha (Albezzia lebbeck)*

- Plant extract decrease the blood glucose level by potentiation of insulin effect due to increase in

pancreatic secretion of insulin from beta cells of Islets of Langerhans or by increase peripheral glucose uptake.

- In diabetes mellitus, beside hyperglycemia, cardiovascular disease is mainly due to Atherosclerosis. Abnormal blood lipids are risk factors for it.
- So, prevention of cardiovascular disease in diabetic patients is necessary. Here the Bark extract of *Albezzia lebbeck* is useful[118]

8) *Sindhuwar (Vitex nigundo)*

- Idopyranose component of Extract of *Vitex negundo* helps in regeneration of damaged pancreas and protect pancreatic beta cells[119]

9) *Shleshmantaka (Cordia dichotoma)*

- Methanolic Fruit extract decrease blood sugar level by potentiating the insulin effect of plasma by increasing either the pancreatic secretion of insulin from beta cells of Islets of Langerhans or its release from bound form.
- Methanolic extract of fruit pulp of *Cordia dichotoma* was proved in vivo a potent hypo-glycemic or anti-hyperglycemic agent and so useful in management of Type-1 and Type-2 Diabetes mellitus[120]

DIABETES AND ALCOHOLISM

Drinking Alcohol to excess can be the factor causing diabetes mainly following ways -

1. Heavy drinking can reduce the body's sensitivity to insulin, which can trigger type 2 diabetes[121]
2. Diabetes is a common side effect of chronic pancreatitis, which is overwhelming caused by heavy drinking.[122]
3. Alcohol contains a huge amount of calories. So drinking can also increase your chance of becoming overweight and risk of developing type 2 diabetes[123]
4. Low to moderate levels of alcohol actually make the body more sensitive to insulin[124]
5. According to American Diabetes Association the latest study on Alcohol Consumption and the Incidence of Type 2 Diabetes concluded that moderate alcohol consumption may reduce the risk of type 2 diabetes. On the other hand, bridge drinking and high alcohol consumption may increase the risk of type 2 diabetes in women[125]
6. Also the study on Alcoholism and Diabetes Mellitus concluded that chronic heavy consumption deteriorates glucose tolerance and insulin resistance, and this may well be ones of the mechanisms involved in the malignant effect of alcohol, with regard to development of diabetes.

AUTOPSY STUDY OF COMPLICATIONS AND ASSOCIATED DISEASES IN DIABETIC MELLITUS

'Autopsy is a highly specialized surgical procedure that consists of a thorough examination of course by dissection to determine the cause and manner of death and to evaluate any disease or injury that may be present'.

Clinical records & Autopsy records it is reviewed to verify the diabetes, its complications and associated diseases with diabetes.

Some autopsy studies are carried out which shows the association diabetes and its complication that causes death are as follows:

1) Autopsy Study 1[127]

In this study 13,215 autopsy reports were scanned where Diabetes mellitus was found in 820 subjects (426 men and 394 women), Out of all autopsies.

- Here it was found that DM was present along with other complications. Two most Dangerous Complications that causes of death in diabetic patients were cardiovascular diseases (69%) and infection (31%).
- Bacterial infection' were common in diabetics but among this Tuberculosis was the most serious type of infection. In addition with this other Disease which found to be fetal were Urinary tract disease were noted in 48%,
- Hepato-biliary tract lesions = 42%,
- Tumors were found in 29% of the diabetic patients. Malignant tumors' were more often seen than benign tumors.

2) Autopsy Study 2.[128]

'Diabetic nephropathy' was found Subjects under dialysis.

- Here Infection was the first direct causes of death in diabetic subjects on Dialysis

1) Peritoneal Dialysis (12.6%)
2) Hemodialysis (7.8%)

- Bleeding was the second direct Cause of death in Diabetic Subjects on Dialysis

1) Peritoneal Dialysis (6.8%)
2) Hemodialysis (18.4%)

- Other causes of death in diabetic patients on dialysis was Myocardial infraction, Liver cirrhosis, Pulmonary edema and uremia

3) Autopsy Study 3[129]

In this study 1144 subjects with diabetes mellitus and 5674 subjects without diabetes mellitus. Here principle cause of death were found to be Circulatory diseases, Neoplasm, Renal diseases etc

- 1. Circulatory System Diseases: Mainly patients above 50 years death due to Coronary disease. Generalized Atherosclerosis, cerebral thrombosis, Frequency of Pulmonary embolism are higher in

DM while chances of cerebral embolism were same in both i.e. with and without diabetes.

- 2. Renal diseases: Microscopic legions were seen in kidney. In these subject Nephrosclerosis, acute pyelonephritis, glomerulonephritis, diabetic kidney nephropathies were seen in subjects. Among the younger patients with diabetes and disease developed before 20 years of age, renal disease accounts 1/3rd of deaths.
- 3. Neoplasm contributes 18 % of total deaths. Death due to cancer were less common cancer of Pancreas was common Neoplasm. Also common neoplastic lesions were carcinomas of the lung, pancreas, liver, large intestine, stomach, and esophagus.

These Autopsy Study help us to understand Complications and Diseases associated with DM

- Diabetic's complications and associated diseases are common problems in these populations.
- Attention of health care resources were needed. These complications are the main threats
- To prevent diabetic Complications and associated diseases is the principal objective of treatment and to provide normal life to Subjects.

MEDICO LEGAL ASPECT REGARDING TO DIABETES

Medical Malpractice and negligence

- It is professional negligence in which act or omission conducted by any health provider in which the treatment provided that falls below the accepted standards in the medical community and causes injury or death of the patient, with the medical cases involving error.[130] It includes unethical acts i.e. the medical practice, which is not fair or is a wrong practice.[131]
- Diabetes becomes a serous malpractice issue whenever the serious preventable injury has occurred in the diabetic patient because the doctor is not following accepted standards of care. These includes:

1) Diabetes and Amputation.
2) Diabetes and blindness.
3) Diabetes and Kidney disorders.

1) Diabetes and Amputation

In diabetes patient limb amputation have to be done in following cases of negligence

- Poorly controlled blood sugar in diabetes patient due to the lack of proper follow up by the general practitioner. It is the duty of practitioner that he taught the patient for daily monitoring the sugar level and how to make frequent adjustments of insulin to maintain proper control of diabetes.
- Poor attention toward the foot injury until the tissues are damage at that extant that they becomes gangrenous and amputation becomes must for them.
- Failure of practitioner to diagnose the patient as need of arterial graft to keep healthy blood-supply toward the foot.

Globally per 30 seconds a lower limb is lost due to diabetes while in India, about 1 lakh legs are amputed every year due to the diabetes related problems.[132]

2) Diabetes and Blindness[133]

- Blindness that occurs from poorly controlled diabetes also called as diabetic retinopathy. High level of blood sugar leads to weakness of blood vessels of eye. It causes bulge in blood vessels wall. If it remain untreated by negligence, these bulges (called micro-aneurysms) can causes leak of blood and fluid. As this damage to retina which is very important part of eye that receive light and sent images to the brain so may be eventually turns into the finally consequence as blindness.
- If diabetic retinopathy is still remain untreated, the condition of patient will almost certainly gets worse. The damage to the retina will become increasingly severe. It results into following complications:
  1) Glaucoma: due to pressure of fluid on nerves at back of the eye
  2) Diabetic maculopathy: due to leaking of blood and fluid onto the macula in the centre of the eye.
  3) Retinal detachment: due to excess of fluid causes the retina to pull away from the blood vessels.

3) Diabetes and Kidney

- Any diabetes patient who has protein in his urine that means the Kidneys are not filtering properly. It should be treated by High blood pressure drug from family ACE (Angiotensin receptor enzyme) inhibitors include enalapril, captopril, ramapril, etc. or ARB drugs (angiotensin receptor blockers) because these drugs can ceases the progression of loss of kidney[134]
- If any doctor fails to follow this standard guidelines which leads to loses of kidney function of patient then it included in medical negligence. If Kidney disease untreated for very long time then it leads to end stage renal disease or ESRD which finally leads to kidney failure. This is very dangerous and patient need to have kidney transplantation or dialysis.

Diet and regular exercise are also the major components for self-care. If these things are properly explained to patient by doctor but patient fail to follow the proper routine diet and exercise plan then it comes in patient negligence. Anyone treated with diabetes should monitor his own blood glucose on a daily basis along with It is duty of doctor to measure glysosylated haemoglobin regularly gives the tools needed to make the small adjustment in insulin timing, dose and mix of short acting and long acting insulin that can bring most diabetics blood sugar under control. If both patient and doctor are fail to do these can also be contribute for diabetes so called as contributory negligence.

Misdiagnosis

Either delayed diagnosis or mismanagement of diagnostic testings may be as result of

- Failure to screen patient for diabetes
- Failure to refer a patient to a specialist
- Mis-interpretation of lab test results
- Failure in proper consult with patient for signs & symptoms
- Failure in Proper follow-up & investigate potential causes of symptoms that are reported.
- Rarely a physician diagnoses a patient with a condition or illness that the patient doesn't have then it may prove to be harmful for patient in the form of anxiety, stress, medical problems & expenses due to unnecessary treatment.
- Misdiagnosis or Delayed diagnosis may harm to the patient in variety of ways including- Exposing patient to more aggressive treatment than would have been required; if diabetes had been diagnosed earlier or Unnecessarily exposing patient to harmful courses of treatment increased likelihood of complications which may leads to death also.
- Health complications due to negligent or inadequate diabetic treatment are Kidney failure, blindness, stroke, gangrene, diabetic foot ulcers, cardio-vascular diseases and death.

Risks to a fetus from negligent or inadequate gestational diabetic treatment

It usually starts midway through the pregnancy and means that a women has high blood sugar level. In this condition doctor must know if their patient have gestational diabetes in order to protect the unborn baby. Unless the woman has risk factor, doctor should screen for gestational diabetes with a glucose loading test (GLT) around 24-29 weeks. The duty of patient is that she should screen early at first prenatal visit and early in the third trimester if the first screening was negative which associated with risk factors like age more than 25 years, BMI more than 30, had gestational diabetes in a prior pregnancy, pre-eclampsia, excessive amniotic fluid or previously delivered a baby over 9 pounds[135]

- Fetal macrosomia (fat baby) means excessive fetal weight and size which make more prone to them for shoulder dystocia injuries like Eab's palsy or developmental delay caused by negligent forceps of vacuum deliveries
- High birth weight
- Skeletal muscle malformations
- RDS (Respiratory Distress Syndrome)
- Hyper-bilirubinemia
- Congenital cardiac anomalies
- Congenital CNS anomalies

LAWS REGARDING TO MALPRACTICES AND NEGLIGENCE IN INDIA

If a physician fails to accurately diagnose, that lead to worsening of patient's medical condition and he may be liable in medical malpractice lawsuits-(in India) under IPCs for Medical negligence Consumer Protection Act & Medical Profession IPC 1860 under Sections 52, 80, 81, 83, 88, 90, 91, 92, 304-A, 337, 338.

DIABETES AND LAW IN AMERICA

1) Federal laws –protect children with Diabetes include- Sec.504 of the Rehabilitation Act 1973(5)
2) The Individuals with Disabilities Education Act (IDEA)
3) The Americans with Disabilities Act (ADA)

Under these laws diabetes is consider as disability and it is illegal for schools & or day care centers to discriminate against children with disabilities[136]

School Bill of Rights for Children with Diabetes.[137]

- Children with Diabetes require medical care to remain healthy. The need of medical care doesn't end while the child is at school. Thus, while at school, each child must be allowed to-

1. Do blood sugar checks when and where they want.
2. Treat hypoglycemia with emergency sugar.
3. Inject Insulin when necessary.
4. Eat snacks when necessary.
5. Eat lunch at an appropriate time and have enough time to finish the meal.
6. Have free and unrestricted access to water & bathroom.
7. Participate fully in Physical Education (gym class) and extracurricular activities, including field trips.

Action against Discrimination[138]

If school doesn't comply with School Bill of Rights for Children with Diabetes,

1. Educate school administration, make sure they understand laws & your child's needs.

2. If still refuse- advise- You are requesting preparation of Individualized Education Program (IEP) & Section 504 Accommodation for child.

3. If still refuse- a complaint could be filed with state's department of Education

Each child has a right to care for his or her Diabetes at school. Scientific data on glycemic control should be clear. Since, there is no break from Diabetes even at time spent at school- there can be no break from the need to care for it.

Driver Fitness Guidelines[139]

Produced in cooperation with American Association of Motor Vehicle Administration

- DMV – Driver should not resume driving unless the treating clinician has certified that the diabetes is under control.
- Individuals with Diabetes who have driver license must have

1) Regular check-ups by physician (complications & BSL control)

2) A good understanding of disease and follow the recommendations by health care professional.

3) Precautions-people at risk of hypoglycemia or being treated with Insulin.

Driver must

- Measure BSL before wheels, then every 4hrs thereafter on long trips BSL should be- more than 4mmol/L – driving car/motorcycles and more than 6mmol/L – others vehicles
- Health care professionals should aware that drivers with diabetes – group at increased risk of having road crashes. (major risk associated with hypoglycemia)
- Councelling of patient should be done on importance of frequent stops & snacks,
  1) Easy availability of glucose supplement,
  2) Early recognition of signs of impending hypoglycemia.
- Insulin- treated diabetes, a justification for disqualification from driving.

DISCUSSION

Now a days, Diabetes becomes the World's largest silent killer affecting millions of peoples worldwide. Many times it is associated exposer of toxic environmental factors like heavy metals, pesticides, pollutions due to the contamination of drinking water, food, air etc. *Agadtantra* is the branch of *Ayurveda* that includes the study of toxic components may belongs to mineral, plant or animal kingdom as well as artificial poisons prepared from poisonous drugs and their treatment. So in the present study, these concepts of *Agadtantra* are used to treat the diabetes by using such toxic plants and minerals after their detoxification. Also the drugs belongs to *Vishaghna mahakashaya* are proved to be very efficient in various study conducted worldwide. Diabetes increases the risk of many serious complications due to the negligence of doctor or patient or both. The health complications includes kidney failure, blindness, stroke, gangrene or even death of the individual. So any medical practitioner should aware about the proper treatment protocol, preventive measures and legal perspective to avoid these complications.

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