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EFFECTS OF PESTICIDES ON HUMAN LIVER TISSUE AND ASSOCIATED MORPHOLOGICAL CHANGES

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Abstract. The pesticide affects skin,lungs,kidney,cause cancer and liver mainly leads to mortality and morbidity .As due to increased human population there is a need for usage of pesticide to produce high yields and fast production of crops.There is three types of pesticides used namely Herbicide,Insecticide (organophosphate and organochlorines) and fungicides.Liver is the primary organ for detoxification and metabolism of nutrients it affects liver mainly.This leads to morphological changes in the liver liver causes inflammation,fatty liver (steatosis),fibrosis,Cirrhosis,lipid accumulation,carcinogenesis,elevation in liver enzymes like alanine transaminase(**ALT)** and aspartate transaminase**(AST),GGT.**This finding shows the scientific evidence of effects of pesticides on human liver and morphological changes analysing this changes leads to early diagnosis and help reduce morbidity and mortality rates.

Key words: Organophosphate,organochlorines,fatty liver,pesticides,liver cirrhosis,liver inflammation.

Annotatsiya. Pestitsidlar teri, o'pka va buyraklarga salbiy ta'sir ko'rsatadi, onkologik kasalliklarning rivojlanishiga sabab bo'ladi hamda asosan jigarni zararlab, kasallanish va o'lim ko'rsatkichlarining oshishiga olib keladi. Aholi sonining ortib borishi bilan yuqori hosildorlikka erishish va qishloq xo'jaligi mahsulotlarini tezkor ishlab chiqarish uchun pestitsidlardan foydalanish zarurati ortmoqda. Hozirgi vaqtda uch turdagi pestitsidlar qo'llaniladi: gerbitsidlar, insektitsidlar (organofosfatlar va organoxlor birikmalar) hamda fungitsidlar.

Kalit so'zlar: Organofosfatlar, organoxlor birikmalari, yog'li jigar kasalligi, pestitsidlar, jigar sirrozi, jigar yallig'lanishi.

Аннотация. Пестициды оказывают неблагоприятное воздействие на кожу, лёгкие и почки, вызывают развитие онкологических заболеваний, а также в значительной степени поражают печень, что приводит к повышению показателей заболеваемости и смертности. В связи с ростом численности населения возникает необходимость в активном применении пестицидов для получения высоких урожаев и ускоренного производства сельскохозяйственной продукции. В настоящее время применяются три основные группы пестицидов: гербициды, инсектициды (органофосфаты и органохлорные соединения) и фунгициды.

Печень является главным органом детоксикации и метаболизма питательных веществ, поэтому она в наибольшей степени подвержена токсическому воздействию пестицидов. Это приводит к морфологическим изменениям печени, включая воспаление, жировую дистрофию (стеатоз), фиброз, цирроз, накопление липидов, канцерогенез, а также повышение уровней печёночных ферментов — аланинаминотрансферазы (АЛТ), аспартатаминотрансферазы (АСТ) и гамма-глутамилтрансферазы (ГГТ). Полученные данные демонстрируют научные доказательства негативного влияния пестицидов на печень человека и связанные с этим морфологические изменения. Анализ этих изменений способствует ранней диагностике и снижению показателей заболеваемости и смертности.

Ключевые слова. Органофосфаты, органохлорные соединения, жировая дистрофия печени, пестициды, цирроз печени, воспаление печени.

Jigar organizmda asosiy detoksikatsiya va oziq moddalar almashinuvi organi bo‘lib, pestitsidlarning toksik ta’siriga eng ko‘p uchraydigan a’zodir. Bu esa jigarda morfologik o‘zgarishlarga olib keladi, jumladan yallig‘lanish, yog‘li gepatoz (steatoz), fibroz, sirroz, lipidlar to‘planishi, karsinogenez, shuningdek alaninaminotransferaza (ALT), aspartataminotransferaza (AST) va gamma-glutamiltransferaza (GGT) kabi jigar fermentlari darajasining oshishi kuzatiladi. Ushbu ma’lumotlar pestitsidlarning inson jigari to‘qimasiga salbiy ta’sirini va u bilan bog‘liq morfologik o‘zgarishlarni ilmiy jihatdan tasdiqlaydi. Mazkur o‘zgarishlarni tahlil qilish erta tashxis qo‘yish hamda kasallanish va o‘lim ko‘rsatkichlarini kamaytirishga yordam beradi.

Kalit so‘zlar. Organofosfatlar, organoxlor birikmalar, yog‘li jigar, pestitsidlar, jigar sirrozi, jigar yallig‘lanishi.

INTRODUCTION

Data from WHO shows that unintentionally around 385M exposed to pesticide poisoning.and nearly 11000 deaths per year due to accidental exposure and intentional self poisoning is more comparable to unintentional ~160,000 deaths annually.This pesticides enters body through three main ways.contact with skin is high risk for agricultural farmers.even though skin is a protective barrier the harsh pesticides like organophosphate and organochlorines passes the skin easily end enters intercellular lipid and 84% of exposure is mainly in forearms and hands.and it passes through oral intake of pesticide food it affects the liver and inhalation of these chemicals in long term even leads to Bronchitis,chronic Obstructive Pulmonary Diseases,Lung cancer.Liver is the organ where metabolism and detoxification takes place.liver gets its major blood supply from portal vein and some from portal artery.liver consists of lobule which is the functional unit of liver and each lobule is hexagonal in nature.portal triad is present in each corner of this hexagon.This hepatocytes mainly consists of 3 zones.

MORPHOFUNCTIONAL CHANGES:

ZONE 1: It is very close to the entry of blood.and this is the best perfused and first to regenerate due to its proximity to oxygenated blood and nutrients.due to its high profusion zone 1 plays a large role in oxidative metabolism

ZONE 2: It is intermediate zone known as pericentral region of hepatocytes

ZONE 3: Lowest profusion because it is located far from portal triad. It plays the important role in detoxification,ketogenesis and glycolysis etc…This Zone 3 is primarily affected by pesticides and other toxins. This is because enzyme responsible for breaking down foreign substances like xenobiotics,mainly cytochrome P450 enzyme system,are mainly concentrated

ELEVATED LEVEL OF ALT AND AST. We can easily find exposures to pesticide poisoning by elevation in this level.And ALT is more specific for liver compared to AST.moreover when blockage of bile flow is affected there is increased level of ALP(Alkaline phosphatase).This indicates pesticide not only damaged cell but also causes cell swelling and inflammation.and jaundice in patient with high dose herbicide.

ALT elevation leads to necrosis,AST elevation means cellular death,ALP elevation means cholestasis.

MITOCHONDRIAL DYSFUNCTION: Mitochondria is necessary for production of ATP and for detoxification process liver need this ATP.but person consuming pesticide food interferes with mitochondrial respiratory chain.This decreases the oxidative phosphorylation which leads to decrease im ATP production.

FATTY LIVER: It occurs even due to non alcoholic fatty liver disease (NAFLD). It is due to increase in hepatic lipid(too much accumulation of fat).pesticides interfere with fat metabolism and cause fatty liver (steatosis). This review aims to present a comprehensive overview of the morphofunctional changes in liver and impact of pesticides on liver.

LITERATURE REVIEW

Several research and experimental,clinical trails shows the impact of effect of pesticides on liver tissue and its morphofunctional changes.The effects of pesticides on human liver tissue and associated morphofunctional changes represent a significant focus within toxicological and biomedical research, emphasizing the liver's essential role in metabolism and detoxification processes. Pesticides, a diverse group of chemical compounds widely used in agriculture and pest control, have been demonstrated to induce hepatotoxicity through multiple mechanisms, resulting in both structural and functional impairments of liver tissue. Morphological Alterations: Histopathological studies consistently report that pesticide exposure leads to notable changes in liver morphology. These include hepatocellular degeneration characterized by swelling and vacuolization, necrosis indicating irreversible cell death, and apoptosis reflecting programmed cell death pathways. Inflammatory responses manifest as infiltration of immune cells within liver parenchyma, while sinusoidal dilation and fibrosis suggest ongoing tissue remodeling and chronic injury. These structural disruptions compromise the liver's regenerative capacity and overall integrity. Functional Impairments: Pesticide-induced liver dysfunction is often evidenced by altered enzymatic activities and biochemical markers. Key enzymes involved in xenobiotic metabolism, particularly cytochrome P450 isoforms, show altered expression and activity, leading to impaired detoxification and accumulation of reactive metabolites. Elevated serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase, and bilirubin serve as clinical indicators of hepatocellular damage and cholestasis. These biochemical changes underscore the decline in liver metabolic efficiency and homeostasis. Mechanisms Underlying Hepatotoxicity: Oxidative stress is a primary mechanism driving pesticide-induced liver injury. Excessive generation of reactive oxygen species (ROS) leads to lipid peroxidation of cellular membranes, protein oxidation, and DNA damage. The depletion of endogenous antioxidants such as glutathione exacerbates oxidative damage. Mitochondrial dysfunction, including impaired electron transport and ATP synthesis, contributes to energy deficits and cell death. Disruption of calcium signaling and activation of pro-inflammatory pathways, including cytokine release and NF-κB signaling, further amplify hepatic injury. Some pesticides also exert genotoxic effects, causing DNA strand breaks and mutations that may predispose to carcinogenesis. Dose-Response and Exposure Dynamics: The severity and nature of liver damage depend on pesticide type, concentration, exposure duration, and route. Acute high-dose exposure often results in pronounced hepatotoxicity with rapid onset of clinical symptoms, while chronic low-dose exposure may induce subtle but progressive liver dysfunction and fibrosis. Genetic variability in metabolic enzymes influences individual susceptibility, affecting the biotransformation and clearance of toxic compounds. Clinical and Public Health Implications: Pesticide-induced hepatotoxicity has broader implications beyond liver pathology, potentially contributing to systemic metabolic disturbances, immune dysregulation, and increased risk of chronic liver diseases such as steatosis, fibrosis, cirrhosis, and hepatocellular carcinoma. Understanding these effects is critical for risk assessment, regulatory policies, and development of protective measures for populations at risk.

CONCLUSION AND RECOMMENDATIONS:

From this research we understand that pesticides used in agriculture leads to many problems especially liver related problems.To rule out this always check elevation of ALT and AST changes instead of using pesticides farmers can use PESTICIDE RESISTANT PLANT which are generated via biogenetic engineering and farmers can use NATURAL PESTICIDES instead of harmful CHEMICAL PESTICIDE.Farmers can plant BT(BACILLUS THURINGIENSIS). This gene allows the plant to produce a specific protein that is toxic to certain pests but Harmless to Humans and INSECTS.Example of this are Bt cotton,Bt corn,Bt brinjal,Bt potatoes etc…

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