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Review Article

Some parasites that might be related to the occurrence of cancer

MANAL I. KHALEEL[1] , ASMAA A.Z.S. AL-EDANY[2]
[1,2]Biology Department–College of Education for Pure Sciences–University of Basrah
Email: manal.khaleel@uobasrah.edu.iq[1],Asmaa.sabaa@uobasrah.edu.iq[2]
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ABSTRACT:
Cancer is a major global cause of death, particularly in developing countries, and which occurs by the uncontrolled division of normal cells to form abnormal growths or tumours. The occurrence of cancer has a direct or indirect linkage to gene expression patterns, and may affected by different physiological and environmental conditions. Parasites are one such infective agent that might have a certain relationship with the occurrence of cancer. It has been found that some protozoan parasites, for instance, Cryptosporidium sp., Toxoplasma gondii, Trichomonas vaginalis, Blastocystis hominis and Plasmodium falciparum, as well as certain helminths, for instance, Schistosoma, Opisthorchis or Chlonorchis sp. Seem to have high incidence in cancer patients and have been related to cancer in infected individuals. Some of these parasites further hinder the efficacy of chemotherapy in cancer patients and make their health worse, whilst cancer itself can have effects on patients' immunity in such a way as to place them at risk from opportunistic parasitic infections and their associated pathogenic consequences.

Keywords: cancer; tumour; parasites; opportunistic; immunocompromised

INTRODUCTION

Globally, cancer is a major cause of death, being responsible for about 7.6 million deaths (that is, 13% of all deaths) in 2008 (1, 2). More than 70% of all cancer deaths occur in less developed countries. It is expected that deaths from cancer worldwide will continue increasing to around 11 million deaths in 2030 (3). The most significant causes of cancer are direct or indirect changes in gene expression patterns. Cancer occurs when normal cells divide in an uncontrolled manner to grow out of control and invade other tissues, and may grow to form a mass called a tumour (4). Tumours can be divided into two categories: 1- cancerous or malignant, which has the ability to grow and extend to other parts of the body, 2- benign, which can grow also but do not extend and spread. Some types of cancer, such as leukaemia, myeloma, and most types of lymphoma, do not form tumours, however (5). Cancer as a disease can be divided into four main categories based on where it begins: Carcinomas: The most common type of cancer forms in the skin or in the covering tissues of internal organs and glands. This kind of cancer usually produces solid tumours, such as colorectal cancer, lung cancer, breast cancer, and prostate cancer. Sarcomas: This develops in the connective tissues which provide required support for the body. It can grow in muscles, fat, nerves, joints, tendons, blood vessels, lymph vessels, bones or cartilage. Leukaemia: This is a blood cancer which is stimulated when a change and associated uncontrolled growth occurs in healthy blood cells. Lymphomas: These are cancers of the lymphatic system (6).

Cancer may be enhanced by various physiological and environmental conditions. Some forms of human carcinogenicity are thought to be associated with infection by viruses, bacteria, and parasites (7). Many parasites may cause chronic health issues, and might also to the formation of cancer, and some parasites, such as schistosoma, are already recognized to be causative of cancer. Globally, there are public health concerns because there are billions infected people with various parasites, particularly in cancer patients, which has become a major problem in recent years. Most infections have no symptoms, but these infections may kill patients when they undergo chemotherapy (8,9,10,11). This study will consider parasites that are thought to accompany the formation of cancer.

1- Cryptosporidium sp.

The Cryptosporidium genus, which causes cryptosporidiosis, contain intracellular parasites that can infect mammalian intestines. Cryptosporidiosis is considered a serious worldwide public health concern. Clinically, it has been reported as cause of chronic diarrhoea (12). Immunocompromised patients, particularly those who have had neoplasms, are at risk of symptomatic invasion which may lead to such

diarrhoea, and that can threaten the lives of HIV-infected individuals. The prevalence of Cryptosporidium sp. in colorectal cancer patients was reported to be comparable to that for patients with immune disorders (12,13).

2- Toxoplasma gondii

Toxoplasma gondii is an opportunistic intracellular protozoan parasite that can cause toxoplasmosis disease, particularly in immunocompromised patients and cancer patients (14). Toxoplasmosis can result in a wide range of pathogenicity, such as miscarriage and pneumonia, and it is recognised to be related to certain forms of cancers that include primary eye tumours, meningioma, leukaemia, and lymphoma (15). An association between lung cancer and T. gondii infection that occurs with high frequency has been reported in the literature (16, 17). Also, there are two known cases of pituitary adenoma that have been related to T. gondii which have been described in the literature, and it is believed that overstimulation of the pituitary gland against parasites may lead to the formation of adenoma (18). On the other hand, both cancer and chemotherapy themselves weaken the immune system, making people with cancer vulnerable to infection by various opportunistic pathogens, including toxoplasma (19).

3- Trichomonas vaginalis

Trichomoniasis disease that caused by Trichomonas vaginalis is one of the possible sources among a number of factors that are thought to be linked to the risk of developing prostate cancer. Trichomonas vaginalis is a non-viral sexually transmitted infection with an estimated worldwide number of new cases in the region of 276 million infections annually (20). Chronic infection with T. vaginalis may lead to an inflammatory response that may lead to prostate cancer (21, 22). There are many studies that have examined the relationship between infection with T. vaginalis and cervical neoplasia, where most such studies have demonstrated a significant positive association between them (23). Serological and histopathological studies provide additional evidence for the link between cervical cancer and trichomoniasis, as it has been found that a large number of women with cancer have trichomoniasis (24, 25). Individuals with Trichomonas vaginalis, especially those with papilloma virus, are at greater risk of developing cervical cancer than others (26).

4- Blastocystis hominis

Blastocystis is an intestinal parasite commonly found in the stool swabs in people with diarrhoea, especially immunocompromised individuals and those with colorectal cancer (CRC) (27, 28). Some studies have indicated that intestinal parasites, particularly B. hominis and microsporidia, may reduce the effectiveness of chemotherapy in infected cancer patients (29, 30).

5- Plasmodium falciparum

It has been recorded that infection with Plasmodium falciparum is linked to Endemic Burkitt lymphoma (31,32). Burkitt, during his studies in the 1960s, found that there was a relationship between the incidence of sarcomatous lymphoma and its geographical distribution in East and Southern Africa, and further recognized that this kind of lymphoma was correlated with the same infectious conditions as malaria. It is believed that the endemic Burkitt lymphoma, which accounted for about 70% of cancers among equatorial African children, is connected to infection with Plasmodium falciparum (33, 34). Another study conducted in 2010, depending on data on malaria outbreaks collected from the US Disease Control and Prevention Centres in 2004, illustrated that there was indeed a relationship between malaria and brain tumour incidence (35). It is thought that the ability of Plasmodium spp. to stimulate immune system inhibition leads to a predisposition to secondary infections, which may explain the relationship between malaria and cancer mortality (36).

6- Schistosoma

This comes immediately after malaria in terms of its prevalence (37, 38). Infection with schistosomiasis occurs when people are exposed to the larval stage of the genus Schistosoma during their routine activities in infested water (39). Its lifecycle requires two hosts: a definitive mammalian and an intermediate invertebrate, usually a freshwater snail. After the cercaria grow inside the infected snails, they are released into the water from where they can penetrate the skin of the definitive host when it enters water containing infected snails. (39,40).

There are five species that infect humans which are S. haematobium, S. mansoni, S. japonicum, S. intercalatum, and S. mekongi. The adult worm of S. japonicum lives in the superior and inferior mesenteric vein, S. mansoni lives in the inferior mesenteric vein, and S. haematobium in the pelvic plexus and terminal veins in the wall of the bladder and urogenital system. It was found that schistosomiasis leads to cancer, as it was reported that hematoma causes hypersensitivity due to the formation of granulomas around the eggs deposited in the tissues, leading to serious complications, the most significant of which is cancer (41).

7- Opisthorchis or Chlonorchis sp.

O. viverrini, O. felineus, and of the phylum platyhelminths infect the human liver (42). It is considered a serious public health problem in endemic areas. It causes biliary liver disease and is linked to bile duct cancer, which is one of the most prevalent complications due to infection with these parasites. It has also been noted that O. felineus causes liver cancer in infected individuals. Other studies have found that there is a certain relationship between infection with Clonorchis sinensis and bile duct cancer (43). It is believed that the cause of cancer may be due to the occurrence of glandular changes and hyperplasia in the epithelium of the bile ducts resulting from inflammation and chronic irritation caused by infection with the flukes, resulting in DNA damage during the active cell proliferation process (44). It is also believed that inflammatory cells produce nitric oxide in the chronic inflammation area around the bile ducts, which causes the formation of N-nitroso compounds, and then tumours as a result of exposure of epithelial cells in the ducts due to the continuous exposure to high concentrations of these compounds (45).

Infection with other parasitic types may be associated with the occurrence of cancer, but confirmation of this relationship needs more intensive studies.

CONCLUSIONS:

Cancer is a worldwide concern for which there is no active treatment to date, as is the case with parasites which remain a major health issue worldwide. There is a certain relationship between infection with certain parasites such as Cryptosporidium sp., Toxoplasma gondii, Trichomonas vaginalis, Blastocystis hominis, Plasmodium falciparum, Schistosoma, Opisthorchis and Chlonorchis sp., and the occurrence of cancer, It is believed that infection with these parasites induces or develops into cancer in most cases; some of these species are opportunistic parasites affecting immunosuppressed patients, especially cancer patients, resulting in major problems, and which can consequently reduce the efficiency of chemotherapy in cancer patients so infected.

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