LITERATURE REVIEW

The identification of Candida albicans in the past was controversy. The fungus has many synonyms such as, Oidium albicans (Robin, 1853), Monilia albicans (Zopf, 1890) and Endomyces albicans (Vuillemin, 1898). In 1923 Berkhout made a new combination and created the correct name Candida albicans with the description :- as an asporogenous yeast in the form-family Cryptococcaceae in the form-class Deuteromycetes. The genus Candida contained 8 species one of which is commonly pathogenic species, C. albicans, that can cause any of the clinical type of candidosis.

Lodder (1952) summarized the descriptions which concerned in particular fresh isolates of C. albicans as follows:

Concerning the morphology pseudomycelium is formed, usually on the solid medium. The blastospore, ball-like clusters, are formed along pseudomycelium. **Chlamydospores** are very often formed at terminal of the hyphae. The growth of white or creamy colony on agar culture is smooth and pasty.

Physiological study, glucose and maltose are fermented. The reaction is varied on sucrose fermentation. Some strains of C. albicans may show a very slight or high fermentation of sucrose. Galactose is occasionally fermented. They can use

glucose, galactose, sucrose and maltose as a carbon source, only lactose is excepted.

There are also same study on other seven species by different workers, C. parapsilosis (Ashford) Langeron and Talice, 1959; C. guilliermondii (Castellani) Langeron & Guerra, 1938; C. krusei (Castellani) Berkhout, 1923; C. stellatoidea (Jones and Martin) Langeron & Guerra, 1939; C. tropicalis (Castellani) Berkhout, 1923; C. pseudotropicalis (Castellani) Basgal, 1931; C. viswanathii (Sandhu and Randhawa, 1959). Rippon (1974) has presented the summary of differential characteristic on sugar fermentation and sugar assimilation of Candida species as in figure 1.

Historical review

Hippocrates in his "Epidemics" described aphthae (white patches) in debilitating patients, and the presence of his clinical condition had been recognized for centuries. Berg (1840) considered that it could be transmitted by unhygienic conditions and communal feeding bottles. It was also known to occur in patients with debilitating diseases. Debilitation was proposed by Robin in 1853 and Bennett in 1944, as the most important predisposing factor to candidal infection.

By 1853 Robin, who had great influence on later generations of physicians recognized that the thrush fungus

Figure 1. Differential characteristics of Candida species encountered in human disease.

	RB	Pellicle formation	Chlamydospore	Fermentation				Assimilation							Utilization	
				Gl.	M.	S.	L.	Gl.	Gal.	L.	M.	R.	S.	C.	Ar.	Et.
C. albicans	+	O	+	AG	AG	AorO	O	+	+	O	+	O	+	O	O	V
C. guilliermondii	O	O	O	A/AG	O	A/AG	O	+	+	O	+	+	+	+	+	+
C. krusei	O	Wide film	O	AG	O	O	O	+	O	O	O	O	O	O	O	+
C. parapsilosis	O	O	O	A/AG	O	O	O	+	+	O	+	O	+	O	O	O
C. stellatoidea	O	O	Rare	AG	AG	O	O	+	+	O	+	O	O	O	O	+
C. tropicalis	O	Narrow film Bubbles	O	AG	AG	AG	O	+	+	O	+	O	+	+	V	V
C. pseudotropicalis	O	O	O	A/AG	O	AG	AG	+	+	+	O	+	+	+	+	V
C. viswanathii	O	-	O	A	A	O	O	+	+	O	+	O	V	+	+	+

Abbreviations:

Gl. = glucose; Gal. = galactose; Et. = ethanol; RB = Reynolds-Braude phenomenon;

M. = maltose; R. = raffinose; A. = acid;

S. = sucrose; C. = cellobiose; G. = gas ; + = assimilation

L. = lactose; Ar. = arbutin-split; V. = variable; O = no assimilation

could become systemic as a terminal event of the other illness.

The first description of vaginal candidosis was by Wilkinson in 1849, when 77-year-old female had a profuse vaginal discharge. Previous to that time vaginal discharge as well as thrush were defined as the result of morbid secretions.

A revival of interest in systemic candidosis and candidal endocarditis were found after the year 1940. The occurence of candidosis from after effects of the use of antibacterial antibiotics, steroid therapy, immunosuppressive drugs, cytotoxic agents and immune defects become apparence.

The classification of the organism Candida albicans had been the subject of controversy since it association with human disease. The term "Monilia" often confused when similar fungus was also isolated from rotting vegetation. The genus Monilia was erected by Persoon in 1797 to encompass certain species of fungi isolated from rotting fruits which were now known to be the imperfect stage of certain genus of ascomycetes.

In 1853 Robin named the fungus Oidium albicans and 70 years later Berkhout made a new combination and created the genus Candida to encompass asporogenous yeasts that had pseudomycelium and propagated by budding.

Geographical distribution review

Candidosis is a disease of world-wild distribution.

Gupta and Shome (1958) reported 8% of superficial cases of candidosis in India.

Mahgoub (1968) found that about 44% of pregnant woman in Sudan showed the incidence of candidal vaginitis and about 15.8% in nonpregnant woman. Kozinn (1958) studied in U.S.A, Bret and Coupe (1958) in France, Harris et. al. (1958) in Canada, Dawkins et. al. (1958) in England, Mckenzie (1961) in Scottland and Somerville (1964) in New Zealand showed the variation of the incidence of candidal vaginitis to be varied from 15.5% to 39.4%.

Gupta (1966) also showed the incidence of candidosis in sputum as high as 79% of the collected specimens in Canada.

There was a report presented by Taylor et. al. (1968) about 31% superficial infection caused by C. albicans in Thailand.

Pathological review

C. albicans can cause two types of candidosis either systemic or superficial infections. There were papers reported that both mycelial and yeast phases could infect the human and animal tissues.

Maibach (1962) reported cutaneous infection of C. albicans that this species was the most pathogenic and virulent strains than any other species in the same genus. The rest species could cause infection only in special circumstance which tend to lower resistance in the organism.

Taschdjian et. al. (1969) concluded that the yeast phase of Candida species was more pathogenic phase than mycelial phase.

Montes and Wilborn (1968) studied host-parasite relationship in oral candidosis. They found that the yeast stage was necessary for initiation of a lesion and later on the mycelium was formed upon the exposure to environmental factors which promoted cells elongation to form pseudomycelium.

Nickerson (1954) and Sherr (1953) presented that the pathogenicity of organism depended on the dimorphism phenomena and enzymatic participating in cellular division of the yeast. They found that the yeast-mycelial transition of Candida in vitro depended on nutritional and environmental factors. There were some certain enzymes which were directly involved in both pathogenic phases.

Louria and Brayton (1964) also concluded that the yeast could sprout to form mycelium for escaping from macrophage ingestion.

Hurley and Stanley (1969) studied the relationship of pathogenicity and the growth rate of C. albicans on cultured mouse epithelial cells. They suggested that the yeast phase of C. albicans may initiate infection, in vivo, and the mycelial phase was associated with extension of the lesion.

Immunological and Serological Reviews

The serology of candidosis is recently interesting subject of serologist. Two types of immune responses had been found both humoral and cellular types. The response reaction was similar to Tuberculosis.

Hasenclever and Mitchell (1961) spent most of their times on the study of structure of C. albicans. They reported that the species Candida albicans could be divided into two antigenic groups, A and B, by based on the agglutination reaction. The group A strains possessed an antigen or antigens that were not presented in the group B strains. Further investigation (Hasenclever et. al., 1961) indicated that C. albicans group A was closely related antigenically to C. tropicalis, whereas, C. albicans group B was quite similar to C. stellatoidea.

Hasenclever et. al. (1961) studied on morphology, pathogenicity and physiology of both groups A and B of C. albicans. The results conformed the classical taxonomic description of the organism. They also studied on immunochemical

polysaccharide of C. albicans group A and B, and recommended that the polysaccharide of A group was highly branched than B group. Group A contained short chains of α-1, 2 linkages of mannose units and joined together by α-1, 6 linkages and group B contained only α-1, 3 linkages.

Chilgren et. al. (1968) studied the interaction of human serum and fungal growth of C. albicans. They found that there was a factor in sera of the patients that could inhibit clumping effect of C. albicans. This factor was the immunoglobulin G. antibody. Neither patient nor normal sera can inhibited growth of C. albicans, in vitro, eventhough the presence of high titer of antibody was detected. In contrast, human serum directly promoted formation of germ tubes and mycelia in vitro. They also showed the result of glucose utilization by C. albicans during the incubation time in serum.

Sole et. al. (1967) demonstrated that there was specific immunity produced in candidosis. The immunity may be depended largely on cellular resistance rather than the presence of circulating antibody. The experiment had been done on transferring of the active immunized rabbits sera that did not passively protect normal animals.

Recently, there was a firm support that the presence of immunodiffusion bands and complement fixation titers are good

diagnostic and prognosis values of the organism. Patients with dissiminated candidosis as well as some with candida granuloma and chronic mucocutaneous candidosis showed antigen antibody reaction of precipitin bands in immunodiffusion test.

In accordance with identifying species of Candida by serologic tests had become useful. Tsuchiya et. al.(1955) supported that the classification of the genus Candida on the basis of antigenicity by slide agglutination, could be used to differentiate C. albicans from C. parapsilosis and C. krusei.

Gordon et. al. (1967) had been developed fluorescent antibody techniques for using to identify Candida species in culture and in tissue. It was possible to differentiate C. tropicalis from C. albicans and C. stellatoidea.

According to Tsuchiya's experiment which showed an evidence that the cell wall of C. albicans had at least one more polysaccharide antigen than that of C. tropicalis. There was a difference in protein antigens which also supported by Gordon's experiment.

Fukasawa et. al. (1968) concluded that immunological specificity of soluble polysaccharides of C. albicans was serologically highly specific. It consisted of phosphomannan chains with specific linkages. The most specific antibody of Candida species differentiation against soluble polysaccharides was recommended to be the immunoglobulin G.