Studies on renal lesions and the pathogenesis in chicks infected with infectious bronchitis virus

Bing Yue Chen

Laboratory of Comparative Pathology,
Department of Veterinary Clinical Sciences,
Graduate School of Veterinary Medicine,
Hokkaido University, Sapporo 060, Japan

The objective of the present study is to clarify the morphological features and pathogenesis of renal lesions by histological, immunohistochemical and ultrastructural examination using chicks experimentally infected with a nephropathic infectious bronchitis virus (IBV).

Firstly, two-day-old specific-pathogen-free (SPF) chicks were inoculated intranasally with the MA-87 strain of IBV. The trachea and kidney lesions were studied histologically and immunohistochemically from 2 to 20 days postinoculation (PI).

The histologic lesions and the IBV antigen were first found in the trachea and severe lesions were subsequently observed in the kidney. The renal lesions consisted of ducto-tubular damage and interstitial inflammatory changes in the medulla and cortex, but the medullary regions were more markedly affected. The IBV antigen appeared prior to the development of renal histologic lesions. The epithelial cells of the collecting ducts (CD), collecting tubules (CT) and distal convoluted tubules (DCT) were severely affected, followed by the Henle's loops (HL), whereas the proximal convoluted tubules (PCT) were only minimally affected. The epithelial cells of the affected ducts and tubules were degenerated, necrotic and desquamated. They concurrently presented the IBV antigen in their cytoplasm as early as 4 days PI. The severe epithelial cell changes resulted in the infiltration of heterophils and macrophages in the interstitium, ducts and tubules. The detectable IBV antigen was consistent with the distribution of histologic lesions at 6 to 8 days PI. At a later stage, antigen-positive cells disappeared and reparative changes of affected epithelial cells were recognized. The repair of the damaged epithelium was accompanied with interstitial lympho-plasmacytic infiltration and lymphoid follicle formation.

The renal lesions due to IBV initially, was found to be nephrosis and then changed to nephrosis-nephritis and lastly to interstitial nephritis. Thus, the IBV induced renal lesions can be considered to be ducto-tubular interstitial nephritis.

Subsequently, two-day-old SPF chicks were inoculated intranasally with the same strain of IBV previously described, and the cytopathic alterations in the host renal epithelial cells were examined ultrastructurally from 2 to 20 days PI.

Infected epithelial cells containing viral particles were observed from 4 to 13 days PI. These epithelial cells were more numerous in the CD, CT, DCT and HL than in the PCT. The viral particles invaded host cells through endocytotic vesicles. The cytopathic changes were manifested by a variety of organelle alterations including swelling of mitochondria, dilation of Golgi vesicles and development of rough endoplasmic reticulum (RER). Viral particles were replicated by budding into RER and rarely toward the perinuclear space. As virus replication progressed, viral particles were enclosed mainly in the dilated RER or cytoplasmic vesicles. The viral particles were also found in the vesicles of Golgi complex, the dilated perinuclear space,

some autophagic vacuoles or free in the cytoplasm. In addition, virus-containing electron-dense bodies were found in the cytoplasm, which contained varying numbers of viral particles within fine electron-dense granular matrix and were surrounded by a single limiting membrane. Viral particles were released by exocytosis through cytoplasmic vesicles or appeared to be discharged through disrupted cell membranes.

It is concluded that epithelial cells of the lower nephron and ducts are the primary target cells in IBV-infected kidneys.

Lastly, in order to study the effect of infectious bursal disease virus (IBDV) on the pathogenesis of renal lesions caused by IBV infection, the MA-87 strain of IBV was inoculated intra-tracheally into 14-day-old SPF chicks or ones previously inoculated with highly virulent IBDV at 7 days of age. The renal lesions were examined histopathologically and immunohistochemically at intervals up to 30 days PI.

At the early stage of infection, the histopathological changes in the kidneys were similar in both groups, but the ducto-tubular changes were more severe in the dually infected chicks. At the late stage of infection, the renal lesions were characterized by chronic interstitial nephritis with formation of lympho-plasmacytic follicles in IBV-inoculated chicks and by chronic active nephritis which consisted of tubular degeneration, lymphoid cell reaction and interstitial fibrosis in IBDV+IBV-inoculated ones.

The IBV antigen-positive cells were first detected in the trachea. Subsequently, these were seen in the kidneys, particularly in the CD, CT and DCT. The IBV antigen were of greater numbers and persisted longer in the kidneys of dually infected chicks than in those of IBV-inoculated ones. The antigen was also detected in the renal epithelial cells in chronic active renal lesions of IBDV+IBV-inoculated chicks.

These findings suggest that the pathogenicity of nephropathic strains of IBV is increased in chicks previously infected with IBDV.

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Radiation-induced DNA damage : Analysis of the "quasi-direct" effect by evaluating the generation of 8-hydroxyguanine, alkali-labile sites and DNA strand breaks in γ-irradiated frozen aqueous solutions of DNA at 77 K.

Hideki Ohshima

Laboratory of Radiation Biology,
Department of Environmental Veterinary Sciences,
Graduate School of Veterinary Medicine,
Hokkaido University, Sapporo 060, Japan

Ionizing radiation induces DNA damage generally through two types of pathways ; one is called the "direct" and the other the "indirect" effect. In the direct effect, ionizing radiation induces both electron-loss centers on DNA through the ejection of electrons at purine bases and electron-gain centers through the capture of the electrons ejected by pyrimidine bases. The indirect effect is caused by the reactions of DNA with hydroxyl radicals (.OH), hydrated electrons (e^-_{aq}) and, to a small extent, atomic hydrogens (.H) formed by the radiolysis of water surround-