THE IMPACT OF CHICKEN ASTROVIRUS TOWARDS POULTRY INDUSTRY

3rd WPSA-WVPA (Malaysia Branch) Scientific Conference 2018
Kuala Lumpur Convention Centre (KLCC), MALAYSIA
19th April 2018

Jessica LEE TM, DVM
Asia Veterinary Services Manager
Ceva Animal Health Asia

Star-like appearance
(Madeley & Cosgrove) from Greek word astron
- Small, **non-enveloped** ~ 25-30 nm round virus with star-like appearance (not all)

- Non-segmented, ss(+)RNA genome

- ~7-8 Kb - 3 open reading frames (ORF) genes

- **EXTREMELY stable and resistant to inactivation** by phenolics, acidic pH, chloroform, detergents, heat, ambient temperature, quarternary ammonia, most alcohols, and lipid solvents.

- Formaldehyde, b-propriolactone, 90% methanol, and a potassium peroxymonosulfate-containing disinfectant have been shown to eliminate AstV infectivity.
DAstV-1 only recognized as an astrovirus in the mid-1980s
CAstV was known as “Enterovirus-like virus” (ELV)
### Avian Astrovirus Species and Associated Diseases

<table>
<thead>
<tr>
<th>Virus</th>
<th>Disease</th>
<th>Major target tissues</th>
<th>Bird species infected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Avian Nephritis virus (ANV)</strong></td>
<td>nephritis, baby chick nephropathy, growth retardation</td>
<td>kidney, intestine</td>
<td>chickens, turkeys, ducks, pigeons</td>
</tr>
<tr>
<td><strong>Chicken Astrovirus (CAstV)</strong></td>
<td>growth retardation, kidney disease</td>
<td>intestine, kidney, liver, pancreas, spleen</td>
<td>chickens, turkeys</td>
</tr>
<tr>
<td><strong>Turkey Astrovirus Type 1 (TAstV-1)</strong></td>
<td>enteritis, growth retardation</td>
<td>intestine</td>
<td>turkeys</td>
</tr>
<tr>
<td><strong>Turkey Astrovirus Type 2 (TAstV-2)</strong></td>
<td>enteritis, growth retardation (PEMS), Intestine, bursa of Fabricius, thymus</td>
<td>Intestine, bursa of Fabricius, thymus</td>
<td>turkeys, guinea fowl, ducks</td>
</tr>
<tr>
<td><strong>Duck Astrovirus Type 1 (DAstV-1)</strong></td>
<td>duck hepatitis</td>
<td>liver, kidney, spleen</td>
<td>ducks</td>
</tr>
<tr>
<td><strong>Duck Astrovirus Type 2 (DAstV-2)</strong></td>
<td>duck hepatitis</td>
<td>liver, kidney, spleen</td>
<td>ducks</td>
</tr>
</tbody>
</table>

*According to International Committee on Taxonomy of Viruses (ICTV)*
Phylogenetic Tree

**Mamastrovirus**

**Avastrovirus**

**ANVs**

**CAstVs**

based on amino acid sequence of polymerase region

“enterovirus-like virus” (ELV)
First isolated in **Japan** in 1979, from faeces of normal, 1 wk old broilers (Yamaguchi et al., 1979)

- Antibody **widespread** in commercial poultry
  - most infections thought to be subclinical

- Detected in field cases **of gout, nephritis, baby chick nephropathy and stunting**

- Differences in antigenicity

- Differences in pathogenicity & tissue tropism
  - differences in mortality, degrees of growth retardation and nephritis
Avian Nephritis Virus
First isolated in 2004 from broiler flocks with growth problems in Netherlands

- infect early age within the first week of life
  - Hypothesis: Birds receiving a substantial virus challenge at very early ages (eg., <3 days) are likely to perform less well than birds challenged at later ages (eg., >10 days)

- Almost all broiler flocks infected with CAstV

Transmission:
- horizontally by the fecal–oral route
- vertically transmitted (some CAstV strain) from naive in-lay parent
  - have capacity to introduce infections and result in worse outcome.
Darkling beetles can act as vectors for CAstV (Rosenberger, 2010)

Ineffective cleaning/disinfection & poor biosecurity will expose flocks to horizontally-acquired infections

Pathogenicity could vary widely, depending on:
- Strain
- Viral load (dose) during infection
- Presence of maternal derived antibodies (MDA) against CAstV
- Other enteric pathogens (e.g., ANV or ubiquitous enteric viruses, fowl adenoviruses and avian orthoreoviruses)
- A flock can be infected with more than one strain of CAstV concurrently.
A. **Runting and Stunting Syndrome:**

- Enteritis, growth problems, diarrhoea, leg weakness and irregular feathering in chicken flocks

- CAstV has *yet to be the only etiological agent.*

- CAstV could also be present in underperforming and in *good performing* flocks.

- It is still complex and unclear the factors that could lead to poor performance
Chicken Astrovirus

Runting-stunting in 1980s *(same age)*
B. **Kidney disease and visceral gout:**

- **severe kidney** disease of young broiler chicks with outbreaks of **visceral gout** and up to **40% mortality** in India (2012)

- Re-inoculation of **SPF chicks:**
  - extremely high mortality (**67.5% - 100%**) 5 and 10 dpi
  - severe kidney lesions and visceral gout.

- Also found in Middle East, Europe and USA.
C. **“White Chick” syndrome (WCS):**

- various Scandinavian countries, North America, Poland and Brazil
- “clubbed down” problem
- weak, runted and died at **early age**
- RSS like symptoms, kidney and liver lesions, poor development and abnormal feathering
- In Poland (2016)
  - 4%–5% hatchability decrease in breeder flock over a 4-week period when a maximum of 1% of chicks were pale and weak
- In Finland (2013)
  - average 29% of dead in shell embryos in CAstV affected flocks
In Canada (2017)
- Broiler breeder flocks had egg production drops up to 15% and hatchability drops from 1.8% to 49.1%.
- Affected hatching egg producers US$4,417 per 10,000 hens
- Hatcheries averaged US$1,287 per 10,000 hens

Source: Daniel Todd
Diagnosis

- **Virus isolation** of ANV and CAstV can be difficult
  - poor growth in cell culture
  - often contaminated with other better growing viruses
  - labour-intensive & time consuming

- **Histology** can be non-specific

- **Antigen-detecting** diagnostic tests eg.,
  - immunohistochemistry, cryostat FA not commonly available due to lack of virus specific antibodies

- **RT-PCR**
  - fast, convenient, sensitive, specific
  - real-time RT-PCR can be quantitative

**Great genetic heterogeneity of strains!**
- Detects virus RNA by amplifying target RNA to detectable levels
- Avian astroviruses exhibit substantial sequence diversity
- **Conserved regions** identified after comparing sequences from ranges of ANVs and CAstVs
- Separate tests developed for detecting all ANVs and all CAstVs
two sets of primers had to be used to amplify a broader range of strains.

Source: Palya V. et al. 8th International Congress of Veterinary Virology, ESVV 2009
Genetic Diversity

- Genetic diversity of ANV and CAstV

- 3 genetic groups among chicken astroviruses

- ANV is the most distinct group

- CAstV-1 and CAstV-2 are closer to each other

- isolated from HU, PH, MY, SA and etc

Source: Internal result from Ceva SSIU Phylaxia
Chicken astrovirus (CAstV) is a newly emerging virus

More cases been reported

The true impact from this virus is still uncertain due to many other factors.

no vaccines or other effective measures yet being reported

strict biosecurity, increase down time between flocks and use of effective disinfectants to reduce the impact from CAstV.