

CMS AND HSMI IN ATLANTIC SALMON (*Salmo salar* L.),

-PATHOGENESIS AND EPIDEMIOLOGY

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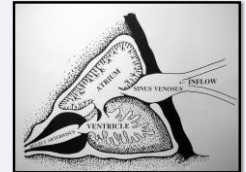
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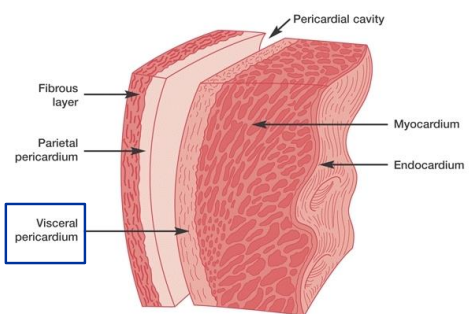
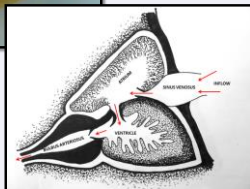
Two diseases primarily affecting the heart of farmed salmon:

Heart and skeletal muscle inflammation (HSMI)
Piscine reovirus (PRV)
Since 1999 (Norway)

Cardiomyopathy syndrome (CMS)
Piscine myocarditis virus (PMCV) (Totiviridae)
Since 1985 (Norway)



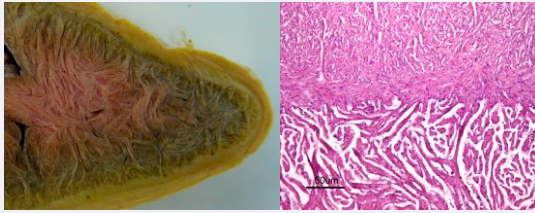
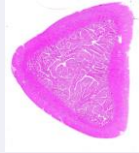
Anatomy of the salmonid heart



Visceral pericardium = Epicardium

The ventricular myocardium of salmonids has two distinct layers;

- The (outer) compact myocardium
- The (inner) spongy myocardium



Heart and skeletal muscle inflammation, HSMI:

First case diagnosed in Norway in 1999

Clinical disease with characteristic lesions also diagnosed in Scotland, Canada? Chile?

Diagnosed in 134 locations in Norway in 2013, including some smolt farms where no sea-water contact is known .

The virus is widespread in the farmed fish population and in wild salmonids, and has also been isolated from capelin, Atlantic herring and horse mackerel.

Heart and skeletal muscle inflammation

Clinical signs	Loss of appetite. Abnormal swimming behaviour. Lethargy
Gross external pathology	Few or none. Moderate-size fish (5 - 8 months in SW)
Gross internal pathology	Haemopericardium, pale heart, yellow-orange liver, ascites, splenomegaly and visceral petechiae.
Histopathology	In the heart early lesions in the ventricular compactum typically include coronary vessel perivasculitis, endocarditis and focal myocarditis. A highly cellular epicarditis can also be observed. Cardiac lesions may progress to pancarditis (epicarditis plus myocarditis in both layers plus endocarditis). Atrial lesions are similar to those seen in the spongy myocardium, but often milder. Red skeletal muscle is usually heavily affected with myocyte degeneration and infiltration of inflammatory cells. Lesions in other organs are few, but general congestion and multifocal liver necrosis may be seen. In addition, haemorrhage and accumulation of erythrocytes can be recorded in gills, kidney and spleen.

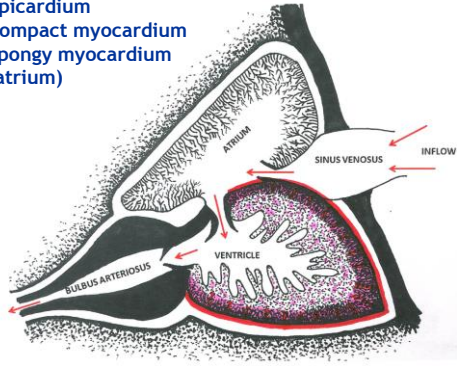
HSMI



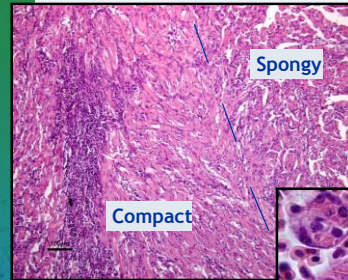
Gross pathological lesions are few and unspecific.
Fluid or blood in pericardial cavity, ascites.
Pale heart and pale or orange-coloured liver

HSMI; distribution of cardiac lesions:

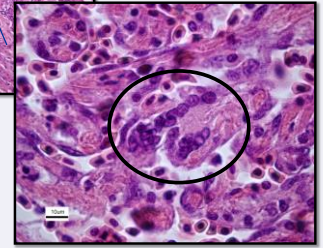
- Epicardium
- Compact myocardium
- Spongy myocardium (atrium)



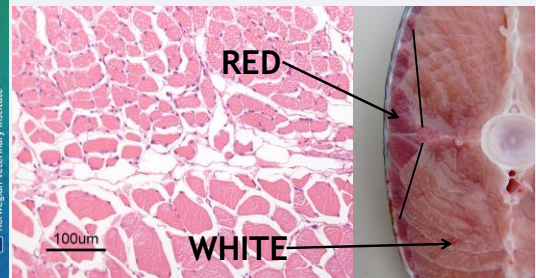
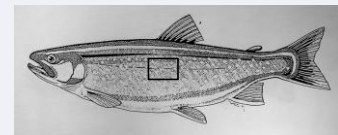
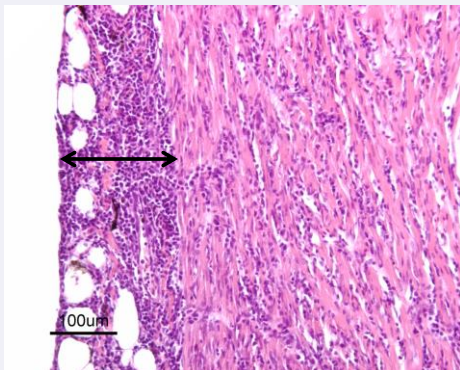
CARDIAC LESIONS

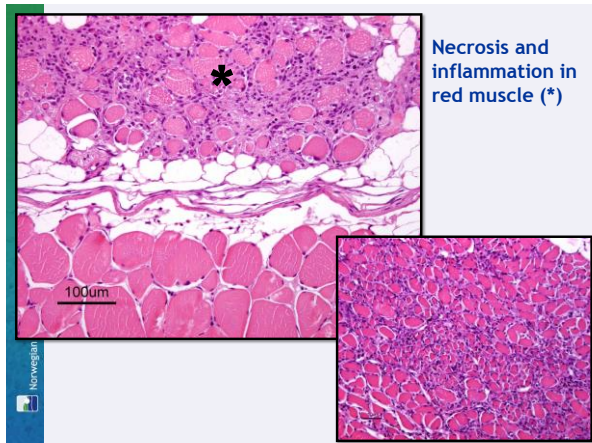


Nests of nuclei in spongy myocardium



HSMI; pronounced epicarditis and inflammation of compact myocardium





Cardiomyopathy syndrome (CMS)

First diagnosed in 1985 (Norway)

Also diagnosed in Scotland, The Faroe Islands and Canada (?).

Diagnosed in 100 locations in 2013

PMCV has been demonstrated in healthy farmed salmon more than 9 months prior to outbreak

PMCV has also been isolated in argentine (*Argentina silus*)

Cardiomyopathy syndrome (CMS)

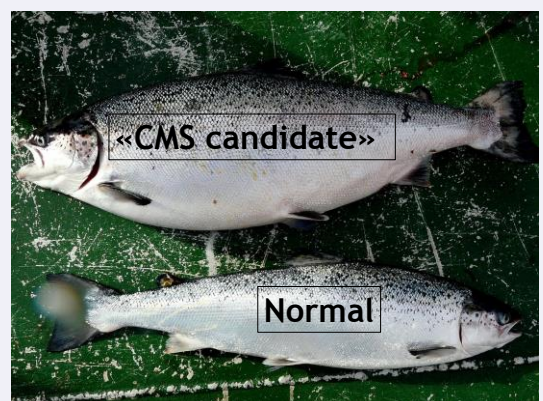
Clinical signs

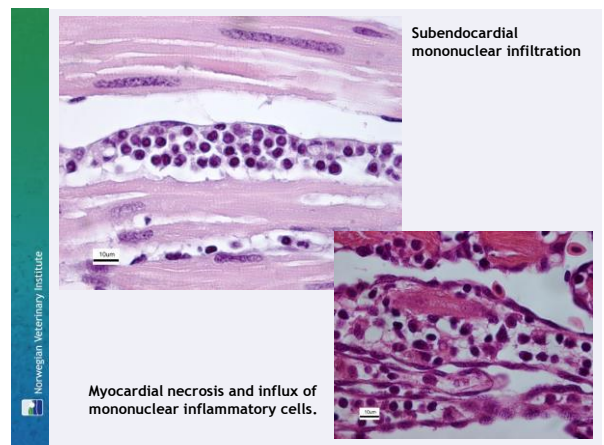
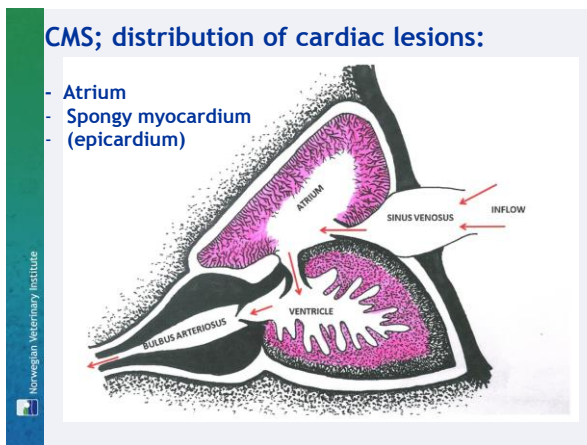
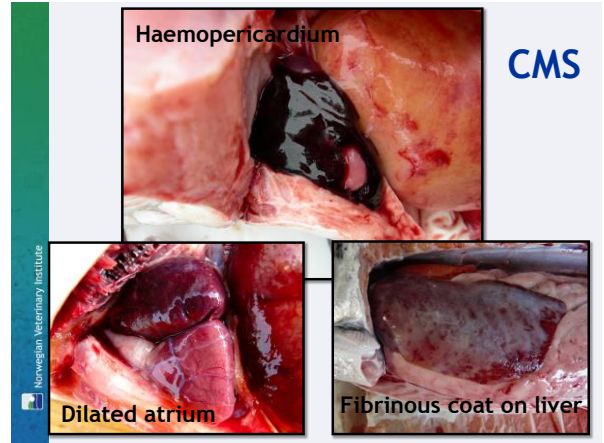
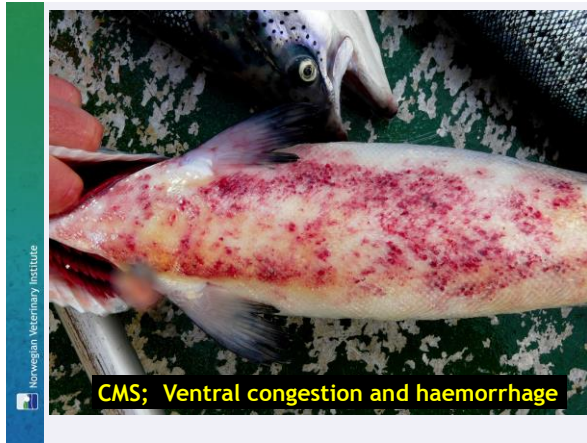
Few. Normal appetite and behaviour. Sudden death. Chronic progressive disease that develops over several months. Mortality typically affects harvest-size fish (15 - 18 mo. in SW)

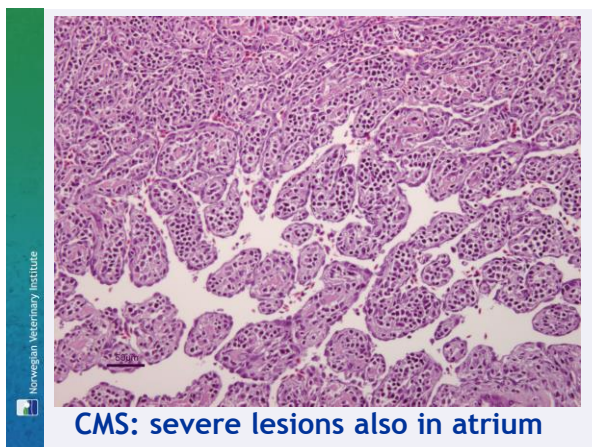
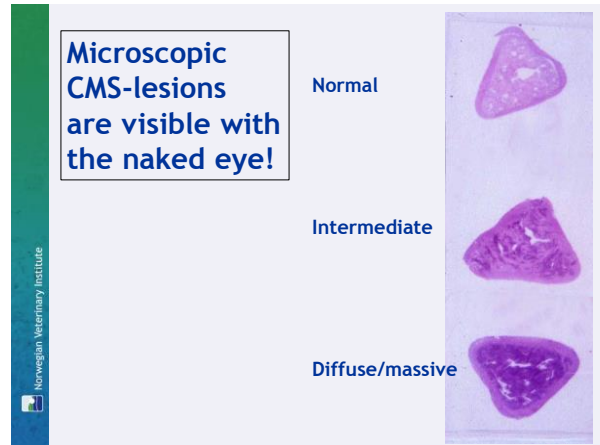
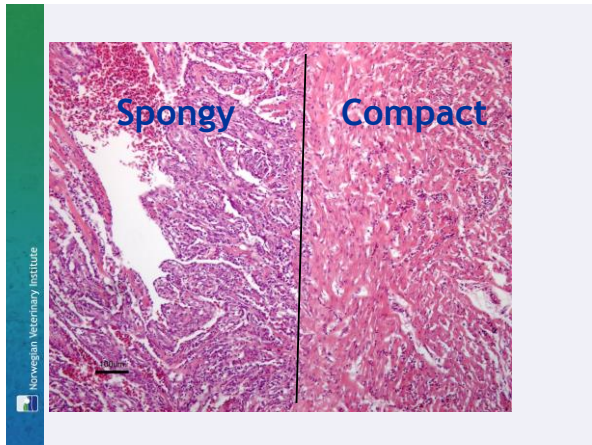
Gross external pathology Fish in normal to obese body condition. Sometimes ventral haemorrhage.

Gross internal pathology General congestion. Dilated atrium and/or haemopericardium. Fibrinous coat on liver. Ascites. Congested hind gut.

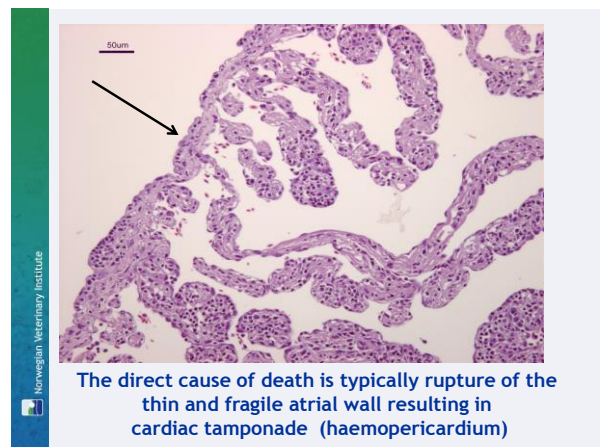
Histopathology Multifocal to diffuse and massive endo- and myocarditis (atrium and spongy myocardium). Epicarditis. Fibrinous coat on liver surface. Anastomosing (bridging) liver necrosis.



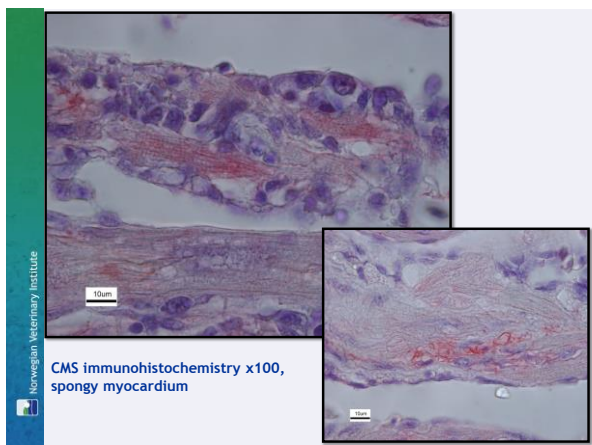
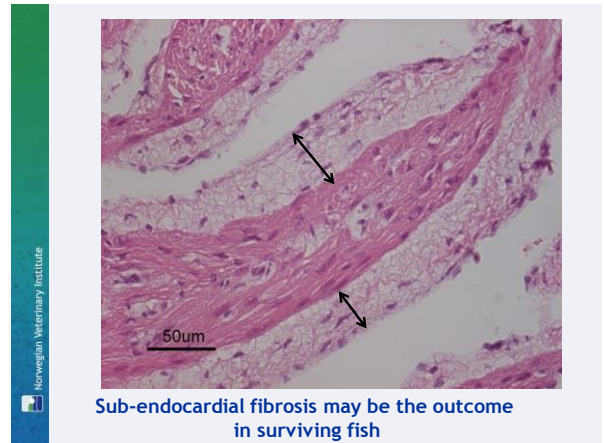
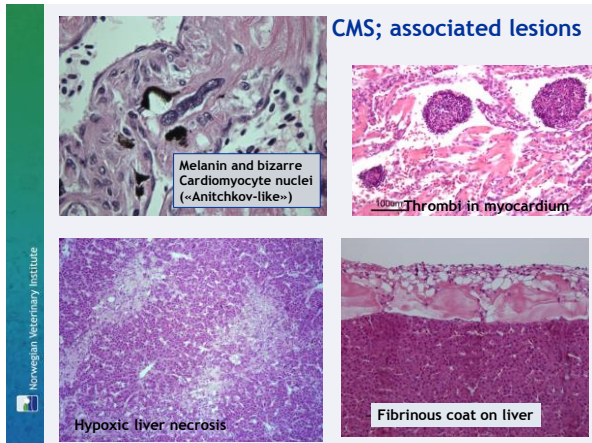




CMS: severe lesions also in atrium



The direct cause of death is typically rupture of the thin and fragile atrial wall resulting in cardiac tamponade (haemopericardium)



PD, CMS and HSMI are important differential diagnoses to each other (and may occur at the same time in the same area and in the same farm)

Disease	Agent	Heart	Pancreas	Muscle (red)
PD	SAV	+	+	+
CMS	PMCV	+	-	-
HSMI	PRV	+	-	+

