FIRE IN CARS – some medical aspects

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Car Crash Fatalities Associated With Fire in Sweden

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RESULTS

- During the 11-years 1998-2008 a total of 181 people died in post crash fires - 64% drivers
- 5 – 8 % of passenger car deaths

Dead by fire – 55 deaths without fatal traumatic injuries

- Drivers 25 (45%)
- Passengers 30 (55%)
Recent study 10 years later – 2009 - 2018

- 94 fatalities in a burning passenger car/10 year
- Autopsy:
  - 18 without traumatic fatal injuries
  - In 10 cases HCN (highly toxic) was detected

HCN produces when e.g. polyurethan is burning
E-vehicles – new problems?
Fire emissions in vehicle fires – three physical effects

- Reduces oxygen in human cells
- Poisonous effect
- Corroding effect - airways
Low $O_2$-level in a human cell may be caused by:

- 1. Low $O_2$ level in the air (closed spaces) – the fire has consumed the $O_2$
- 2. CO
- 3. HCN

The effect adds up – suffocation of cells
2. CO-"poisoning".

- CO attach 250 times easier than O₂ to the hemoglobin in the red blood cells, and thus the transport of O₂ to the cells are blocked

- **Symptoms:** Head ache, nausea, decreased level of consciousness/unconscious - and late neurologic and psychiatric symptoms < 14 days

The victim may have a "false" cherry red colour – easy to misinterpret as a well oxygenated person
3. HCN-"poisoning"

- HCN is a colourless, very toxic gas with lower density than air. Has been used in the gas chambers during WW II (Zyklon B)

- HCN is quickly taken up in the cells, where HCN blocks the function of the mitochondries (the cell’s power station) blocking the uptake of O₂ to the cell.
SOME SYMPTOMS HCN

- 180 ppm fatal within 10 minutes
- Taste/smell of bitter almond – taste of metal
- Confusion, vomiting, dyspné (shortness of breath)
- Convulsions
- Muscle paralysis
- Lung oedema
Hydrogen fluorid (HF) or (PF5)

Air condition liquid and maybe also the cooling liquid of traction batteries (?) (R1234yf), generate HF when burning
HF – (1) toxic, corrosive effect on airways/lungs

Medical effect:

- Irritating, pungent smell
- Causes corrosion in the airways because HF is a very strong acid – oedema and bleedings
HF – (2) toxic effect via changes in electrolytes in blood

- Reduction of the level of Ca++ (Calcium) in blood, which may induce heart arrythmia (VES/ventricular extra systolic heart rythm = dangerous)

- Increased level of K+ (potassium), irritates nerve ends, giving severe pain, often in the muscles
Treatment at incident site – vehicle fire

1. **Always** $O_2$ – 100% if impaired consciousness, CPAP
2. If oedema and swelling in airways – quick intubation
3. If breathing compromised – give bronchus dilating drugs and steroids (reduces swelling) via the airway.
Treatment if HCN is suspected

4. Impaired consciousness - administer without delay Cyanokit infusion during 15-30 min – it will reverse the HCN block of the mitochondrias
Treatment – e.g. fire in e-vehicle’s traction battery

5. Heart arrhythmia and/or severe muscle pain – administer tablet Ca 6 g – and to hospital

6. Low oxygenation - intensive care and/or pressure chamber
Thank you – two veterans – the youngest 50 yrs