

Molds and Mycotoxins

*The neglected disease:
evidence based lecture*

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Water Intrusion

- Variety construction defects:
- roof leaks
- HVAC condensation
- water intrusion from floods, hurricanes
- leaking appliances and plumbing
- poorly designed foundations, e.g. basement walls that allow water seepage from wet soils, slope of the building lot leading to water accumulation under concrete slabs
- cracked cement slabs, bent aluminum window framing, highly contaminated wall cavities, poorly installed roofing, improperly sealed fireplaces

Mold is an equal opportunity pollutant

- Affordable housing is often in an area likely to flood.
- Landlords fail to maintain buildings and make necessary repairs.
- 1994 Cleveland: major rain caused flooding in east Cleveland in an area with dilapidated buildings. 3 months later doctors noted parents were coming into ERs with limp, blue children, bleeding from their lungs.
- Dr. Dearborn of Rainbow Babies and Children's hospital found *Stachybotrys* in homes.

EPA, FEMA and CDC

Government agencies agree:

- Mold starts to grow and spread 24 - 48 hours after water damage.



Caution!

- The E.P.A. cautions that approximately 50% of the fungal growth can be hidden, i.e. hidden from view.
- The identification of airborne mold spores only reveals what is present at the time of testing, not 24/7.
- Airborne mold testing does not necessarily reveal hidden mold, e.g. wall cavities, attic, under carpeting, in ventilation ducts, behind molding.

Why is this happening now?

- Homes in the past were made with plaster walls.
- Windows, and later fans, no A/C.
- World War II ended and suburbia began with lots of inexpensive homes built quickly for returning soldiers and their brides: the baby boomers were a result.
- Then came the big oil embargo in the 1970's

Contributing factors to the problem

- Oil embargo in the 1970's created a fuel crisis.
- In the name of energy efficiency, since then buildings have been built "TIGHT": no air in, no air out.
- Walls are stuffed with thick and fluffy insulation.
- When you paint inside your office, home, or building, or lay down new floors, or put up wallpaper: all the VOC fumes recirculate.

What we use today

- Gypsum wallboard, aka: drywall.
- Comprised of compressed gypsum between 2 layers of durable paper.
- Gypsum readily absorbs water and dries s-l-o-w-l-y.
- Perfect recipe for mold growth, especially *Stachybotrys*, the famous black toxic mold.

Molds and Mycotoxins

- Molds multiply quickly.
- As they multiply, they release mycotoxins; mycotoxins are secondary metabolites of molds, and are very potent protein synthesis inhibitors.
- In addition, molds produce, 1,3-alpha D glucans, extracellular polysaccharides, and solvents.

Two Important Points: Mycotoxins

- A mold that produces mycotoxins usually produces a series of mycotoxins rather than just one mycotoxin.
- If a mold known to produce mycotoxins is present in a home or building, then the mycotoxins it produces are present as well.

Size matters

- Hair is 100 microns.
- Spores are 1-20 microns.
- **Mycotoxins are 0.1 microns.**
- Exposure to mycotoxins is by ingestion, inhalation, and dermal absorption.

Killing Mycotoxins

- Mycotoxins are toxins
- It takes heat at 500 degrees Fahrenheit (260 degrees Celsius) for 30 minutes, or
- 900 degrees Fahrenheit (482 degrees Celsius) for 10 minutes to destroy trichothecene mycotoxins.
- HEPA filters are ineffective in removing mycotoxins.
- Activated carbon filters can remove mycotoxins from the ambient air.

NEUROLOGICAL EFFECTS OF MYCOTOXINS

- Decrease in short and long memory in adults and children
- Autism Spectrum Disorder
- Chronic inflammatory demyelinating polyneuropathy
- Loss of balance, facial pain
- Glossopharyngeal neuralgia
- Head and neck myalgias
- Movement disorders
- Decreased visual acuity

Medical and Scientific Facts

“Trichothecene mycotoxins exhibit potent toxicity in man. The numerous target organ systems include the brain, the immune system, heart, lung, intestine, liver, kidney and skin.”

Trichothecenes-Chemical, Biological and Toxicological Aspects, 1983 by Drs. Jarvis et al.

Mycotoxins and Cancer

- Cancer of the kidney
- Cancer of the esophagus
- Cancer of the liver – some with a 10-year latency period
- Testicular Cancer
- And many others

Mycotoxins: Neurotoxicity

The study population consisted of 119 patients (79 females and 40 males). 20 were controls.

Data obtained from the NCV studies for motor nerves and sensory nerves. Patients with abnormal findings comprised of 3 groups:

1. Mixed sensory-motor polyneuropathy (55).
2. Motor neuropathy (17).
3. Sensory neuropathy (27).

Mycotoxins: Neurotoxicity

- Tremorgenic mycotoxins: can affect neuroreceptor sites.
- Other mycotoxins can cause the release of excitatory neurotransmitters.
- Contaminated corn tortillas were linked to an increase in neural tube defects, anencephaly, and fetal deaths in women along the Texas-Mexico border.

Mycotoxins and the Microbiome

- Studies have shown that the gut microbiota is capable of eliminating mycotoxin from the host naturally, provided that the host is healthy with a balanced gut microbiota.
- The reported effects of mycotoxins are negative in terms of intestinal health, where beneficial bacteria are eliminated followed by an increase of the gut pathogen.
- The interactions between gut microbiota and mycotoxins have a significant role in the development of mycotoxicosis.

Mycotoxins and the Gut

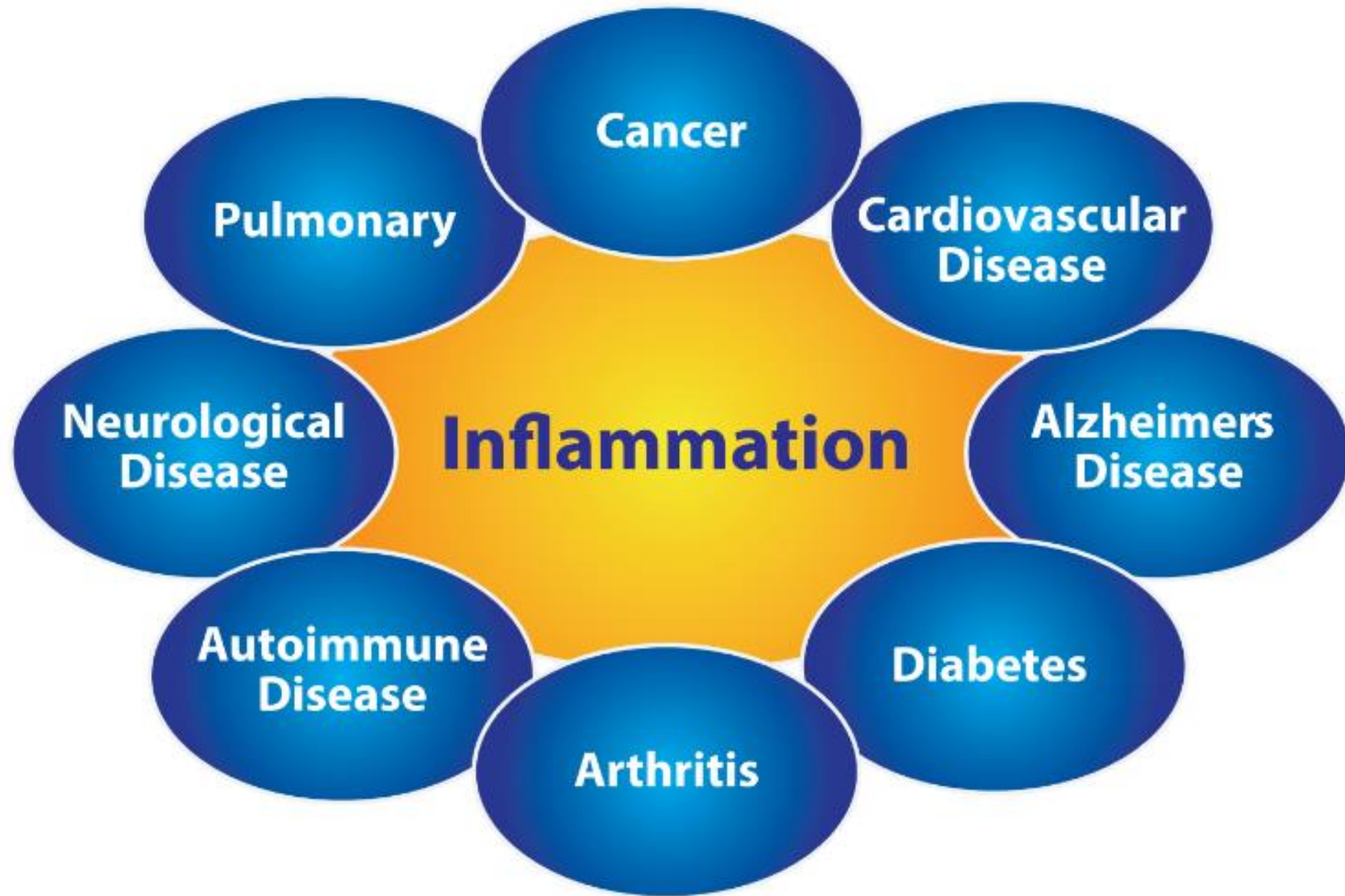
- Diseases and disorders have now been linked to dysbiosis of gut microbiota, including asthma, autism, colon cancer, Crohn's disease, IBS, obesity, diabetes, hepatic encephalopathy, eczema.
- Dysbiosis causes gut inflammation, which initiates mucosal immune responses resulting in intestinal permeability.
- Translocation of pathogens and harmful metabolites enter the intestinal epithelium.
- These, in turn, exacerbates the severity of diseases.

Mycotoxins and the Microbiome

- Mycotoxins can cause the intestinal inflammation and intestinal permeability through the opening of tight junctions.
- This allows the entry of luminal antigens and bacteria that are normally restricted to the gut lumen by the intestinal barrier function.
- As a consequence, this leads to tissue inflammation and invasion of commensal and pathogenic bacteria as observed in Crohn's disease.

Mycotoxins and the Microbiome

- T-2 toxin cause toxicosis due to consumption of contaminated foods.
- In China ingestion of moldy rice contaminated with T-2 toxin: 65% of patients developed food poisoning symptoms, including chills, fever, nausea, abdominal distention, dizziness, vomiting, thoracic stuffiness, abdominal pain, and diarrhea.
- Several outbreaks have been reported in China, India, and the U.S.



Mycotoxins

Mycotoxins can cause diverse and powerful toxic effects:

Carcinogenic

Mutagenic

Teratogenic

Estrogenic

Hemorrhagic

Immunotoxic

Hepatotoxic

Dermatotoxic

Neurotoxic

Hemorrhagic

Nephrotoxic

Mycotoxins in Food

- The United Nations Food and Agriculture Organization and the World Health Organization has estimated that 25% of the world's crops, such as nuts, grains, and rice are contaminated by mold.

Mycotoxins in Food then in Urine

- Low levels of mycotoxins are found in many foods: cereals, meat, fruits, wine, beer, coffee, etc. per the WHO and the United Nations Food and Agricultural Organization.
- For that reason, mycotoxins can be found in the urine in ppb in healthy people.

Ochratoxin: Major Targets

- Liver
- Kidney
- Brain
- Skeletal muscle
- Fat tissue
- Ochratoxin crosses the placenta.
- The highest Ochratoxin levels is found in breast milk.

Ochratoxin and Mitochondria

- Mitochondrial dysfunction is an early sign of toxicity
- Results in a overall decrease in protein synthesis
- Ochratoxin can penetrate into the mitochondria, binding to proteins involved in maintenance of the membrane potential and the oxidative phosphorylation.
- Interferes with phosphate transport
- Inhibits electron transport

Ochratoxin and Inflammation

Ochratoxin depletes zinc

- Even at nanomolecular concentrations it causes apoptosis
- Increases pro-inflammatory mediator levels: TNF-alpha and IL-6
- Induces cell cycle arrest on kidney cells and lung fibroblasts
- **IMPORTANT:** N-acetyl cysteine (NAC) supplementation abolishes Ochratoxin-induced cell cycle arrest.

Ochratoxin in Urine???

- Ochratoxin is absorbed from the stomach and jejunum.
- Studies have shown it alters intestinal barrier and absorption functions.
- Albumin binds Ochratoxin with unusual high affinity.
- 99.8% of Ochratoxin is albumin bound.
- Ochratoxin is reabsorbed from practically any part of the nephron by both active transport and by passive diffusion.
- Due to strong albumin binding of Ochratoxin, its elimination by glomerular filtration is negligible.

Koszegi T, Poor M. Ochratoxin A: Molecular Interactions, Mechanisms of Toxicity and Prevention at the Molecular Level. Toxins 2016, 8, 111.

Trichothecene Mycotoxins

- Produced by *Stachybotrys chartarum*, *Fusarium*, *Trichoderma*, and other molds.
- Extremely toxic and difficult to destroy
- There are about 60 known types of trichothecene mycotoxins, including:
 - **Satratoxin**
 - **Verrucarin**
 - **T-2 Toxin**
 - **Vomitoxin**

Symptoms: Mycotoxins? Lyme's? RMSF? Babesia? Chagas?

Fatigue

Numbness and Tingling

Short Term Memory Loss

Headaches

Joint Aches and Pains

Shortness of Breath, Cough

Anxiety and Depression

Mood Swings, Personality
Changes

Abdominal Pain and
Discomfort

Hair Loss

Tremors

Nosebleeds

Skin Rashes

Chronic sinusitis

Upper Respiratory
Symptoms

... Pets get sick too...

Test for 12 Mycotoxins: serum IgG & IgE

- The specificity and sensitivity of recent serology assays for the presence of IgG and IgE antibodies to mycotoxins in the blood are high.
- **Mycotoxins from** Stachybotrys, Penicillium, Alternaria, Aspergillus, Cladosporium, and Aspergillus auto-toxin.
- Aspergillus/Penicillium neurotoxic mycotoxin
- Ochratoxin
- Trichothecenes:
 - Satratoxin T-2 Toxin Vomitoxin
 - Verrucarin and verrucarol

Testing

- Serum Immunoglobulins, including IgG subclasses.
- Autoimmune panel.
- Neurological autoantibodies.
- Immune function tests: T and B cell, NK cell



Testing

- Pulmonary Function Test
- Brain SPECT scan.
- Gives more information than MRI.

Neurophysiological Tests

1. Nerve conduction velocities
2. Brainstem auditory evoked response: these pick up: cochlea and auditory pathways to the brain; neuronal activity of the auditory nerve, cochlear nucleus, superior olive, inferior colliculus of the brain.

Neurophysiological Tests

3. Visual evoked response: measure the functional integrity of: the visual pathways from the retina to the visual cortex via the optic nerves.

Optic neuritis due to demyelination.

Optic atrophy.

Myelin plaques common in multiple sclerosis.

These better quantify functional integrity of the optic pathways than scanning, i.e. MRI (even Tesla 3 magnets).

Treatment



First and foremost:

The first rule of toxicology: get the patient away from the toxin or the toxin away from the patient.

Second: simultaneously build back up the immune system while giving an antifungals.

Treatment

- Immunotherapy.
- Anti-fungal medication.
- Melatonin.
- Vitamin D₃, C, B complex
- For demyelination (CIDP): IVIG

What about adsorbents?

- Not selective: adsorbs good and bad alike, and can cause adverse effects, especially with long term use
- Cholestyramine can bind Ochratoxin in the gut, inhibiting its absorption
- Application of NaHCO_3 (sodium bicarbonate) ionizes Ochratoxin decreasing its absorption
- However, both can also cause nephrotoxicity.
- Best is to use NAC, glutathione, vitamin C, alpha-tocopherol (vitamin E), and retinol (vitamin A), quercetin, zinc supplementation, and lycopene instead.

Binders and Disorders

Avoid in patients with

- Patients with hypothyroidism
- Diabetes
- Nephrotic syndrome
- Liver disease
- Kidney disease
- Alcoholism
- Dysproteinemia

Binders and Medication

- Estrogens and progestins
- Oral diabetes drugs
- Penicillin G
- Phenobarbital
- Spironolactone
- Tetracycline
- Thiazide-type diuretic pills
- Thyroid medication
- Warfarin
- Leflunomide
- Digitalis

Treatment

- Glutathione
- Probiotic
- Diet
- A high-fat diet changes fungi in the gut and plays a role in the development of obesity.

80% of the immune system is in the gut, so this is a primary place to begin. The main components will be diet and probiotics. The question is: which probiotics?

Yogurt

- \$30 billion spent by consumers annually.
- All commercial yoghurts are made from pasteurized milk. Pasteurization kills off potential pathogens, as well as destroying all beneficial bacteria.
- Yoghurt is also pasteurized after it has been allowed to ferment, and bacteria are added back to the product after this last step.
- Many commercial yoghurts found in supermarket in the United States contain artificial coloring, chemical additives and sugars, including high fructose corn syrup and aspartame.

PROBIOTICS REVEALED

- A publication from Reading University with the Food Safety Authority of the United Kingdom, in essence the FDA in England, showed that less than 10% of the usual commercial strains of Lactobacilli and Bifidobacterium in probiotics are able to get to the colon.

THE KITCHEN SINK

- The vast majority of probiotics are trying to stand above the others by including more strains and more cfus.
- However, there is no scientific rationale for this. There are no studies that have shown that 200 billion CFU is more effective than 10 billion cfu and that 15 strains are more effective than 5 strains.
- Most probiotic studies are done on a single strain and at relatively low doses (2-3 billion+). There is no scientific reasoning for the kitchen sink cocktail products.
- Quality of the strain is far more important than quantity.
- In probiotics, the ones you want to recommend and use are strains that have undergone DNA sequencing.

Do you REALLY know what's in your probiotic?

A recent publication by UC Davis examined 16 probiotic products from local California stores to check if the strains claimed on the label matched those that were found in the product. **They found that only ONE out of 16 actually matched the label claim.** In some products there was pill-to-pill variation in the same bottle.

Benefits from Bacillus Spores

Studies in humans show the following benefits from Bacillus spores:

1. Immune modulation for childhood allergies
2. Immune stimulation of peripheral T-lymphocytes and B-lymphocytes
3. Decrease in frequency of urinary tract infections and positive cultures
4. Reduction in side effects related to anti-H. pylori antibiotic therapy
5. Effective treatment for small intestinal bacterial overgrowth (SIBO)
6. Diminished duration of diarrhea in children 3 to 36 months of age
7. Reduced incidence of irritable bowel syndrome diarrhea
8. Immune response to adenovirus and influenza-A in-vitro
9. Improvement in pain scale in Rheumatoid arthritis patients

There are other dangers lurking after
a flood...



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