Hypersensitivity reactions

Hypersensitivity refers to undesirable reactions produced by the normal immune system.

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Hypersensitivity reactions

- Type I
  - Allergy (immediate)
- Type II
  - Cytotoxic, antibody-dependent
- Type III
  - Immune complex diseases
- Type IV
  - Delayed type, cell mediated
MECHANISM
1. the allergen stimulates the induction of CD4+ T cells. These T cells secrete cytokines that cause IgE production by plasma cells.
2. The IgE molecule will bind to Fc receptor on mast cell and basophils which in turn causes vasodilation, increased vascular permeability and vascular spasm.
TYPE I hypersensitivity
(anaphylactic)

- this type may occur as systemic or local reaction:
  - A) systemic reactions: skin erythema, followed by respiratory difficulty due to bronchial constriction.
  - B) local reactions: generally on skin or mucosal surface at site of Ag exposure.
- Allergy to penicillin, Aspergillus spores, rupture of Echinococcus cyst...

TYPE II HYPERSENSITIVITY
(antibody dependent)

- in this type Ab are formed against target Ag that are cell membrane components.
TYPE II HYPERSENSITIVITY (antibody dependent)

- Not really hypersensitivity, but cytotoxic reactions:
- A) Complement-mediated:
  - ab reacts with cell surface Ag leading to fixation of complement system and then cell lysis. e.g.; red cells are the most common cells damaged by this mechanism >>> HEMOLYTIC ANEMIA
  
  NO MICROBES!

B) many cell types (macrophages, neutrophils, NK cells) cause lysis of target cell coated by IgG
  - Poststreptococcal rheumatic fever:
    - molecular mimikri: Antibodies produced against S. pyogenes cross react with various tissue eg. heart, joints – inflammation
    - Onecocerca worm infection may lead to blindness because of the cross reaction of Ab produced against to pathogen and proteins of retina
TYPE II HYPERSENSITIVITY
(antibody dependent)

- C) Antibody–mediated cellular dysfunction
  - in some cases Ab is directed against cell surface receptor impairing the function but not cause cell injury
  >>> MYASTHENIA GRAVIS ; Ab reacts with ach receptors on motor end plate.

NO MICROBES!

TYPE III HYPERSENSITIVITY
(immune complex mediated)

- this type is mediated by ag–ab complexes which initiate an inflammatory reaction in the tissue.
TYPE III HYPERSENSITIVITY (immune complex mediated)

- There are 2 patterns of immune complex mediated injury:
  - A) SYSTEMIC DISEASE (serum sickness type, SLE)
    - This is because of large excess of Ab and immune complexes are deposited at site of injury specially within vessel wall, the subsequent events will result in necrotizing vasculatides and accumulation of neutrophils>>>SLE
  - B) LOCAL DISEASE (arthus reaction)
    - Arthus reaction:
      - Intracutan injection of antigens to a presensitized person may lead to local intradermal Ab – Ag complex formation and local vasculitis, redness, swelling.
      - Example: Repeated (booster) vaccination with diphtheria or tetanus rarely lead to local vasculitis.
TYPE III HYPERSENSITIVITY (immune complex mediated)

- Poststreptococcal acute glomerulonephritis: Ab–ag complexes deposit in glomeruli
- HBV infection: HBsAg–Ab complexes may also cause acute glomerulonephritis

TYPE IV HYPERSENSITIVITY (cell mediated)

- This is mediated by T-cells. There are 2 types involves CD4/8+ T Cells.
  - A) Acute (within 2–3 days):
    - tuberculin test, contact dermatitis
  - mediated by CD4+ T helper cells
    - cd4+ cells recognize ag (tuberculin), this leads to formation of sensitized cd4+ cells. Upon cutaneous injection into previous sensitized individual sensitized cd4+ cells become activated and secrete cytokines.
TYPE IV HYPERSENSITIVITY (cell mediated)

- **Tuberculin/Mantoux test**: intradermal injection of tuberculin = purified tuberculoprotein leads to swelling after 48–72 h if the patient have been exposed to Mycobacterium tuberculosis previously. Important: BCG vaccination? Yes/No!

B) chronic (> 1 week):
granuloma formation, graft rejection:
- mediated by cd8+ cytotoxic Tcell
- lymphocytes surrounding epitheloid cells lead to formation of granuloma
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<td>• Anaphylaxis</td>
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<td>II</td>
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<td>• Systemic lupus erythematosus (SLE)</td>
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<td>IV</td>
<td>Delayed-type hypersensitivity (DTH), cell-mediated immune memory response, antibody-independent</td>
<td>• Contact dermatitis</td>
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<td>• Mantoux test</td>
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