Describe the factors affecting left ventricular function.

LV systolic function is a function of its contractility.

Contractility = the change in force generated independent of preload

Factors affecting Contractility

Contractility is primarily dependent on intracellular \( \text{Ca}^{2+} \). Determinants include:

- **Metabolic:**
  - substrate supply – glucose, fat, protein
  - metabolic/electrolyte homeostasis
  - hormones – thyroid, insulin/glucagon

- **Physiological:**
  - integrity of myofilaments
  - co-ordinated depolarisation
  - functional muscle mass
  - autonomic tone – sympathetic and parasympathetic

- **Drugs:** Digoxin, \( \beta \) agonists, PDE3 inhibitors

- **Minor increases in contractility occur as an intrinsic response to:**
  - increased afterload (Anrep effect)
  - increased heart rate (Bowditch effect)

  - **Anrep Effect**
    autoregulation method in which myocardial contractility increases with afterload.

  - **Bowditch Effect**
    autoregulation method by which myocardial tension increases with an increase in heart rate. Also known as the Treppe phenomenon, Treppe effect or staircase effect.
    Contractility improves at faster heart rates. This is because the myocardium does not have time to remove calcium, so it accumulates intracellularly.

- **Disease**
  - Ischaemia / Coronary Blood flow
    Reduced ATP production secondary to hypoxia, which impairs sarcoplasmic reticulum \( \text{Ca}^{2+} \) function. Further exacerbated by intracellular acidosis from anaerobic metabolism.
  - Heart Failure
    Impaired contractility reserve, i.e. minimal increase in contractility with sympathetic stimulation.
    - Reduced peak \( \text{Ca}^{2+} \) and sarcoplasmic reticulum uptake of \( \text{Ca}^{2+} \)

LV diastolic function:

LV diastolic function is determined by its compliance. LV compliance is primarily determined by myocardial characteristics and load.

Factors affecting LV diastolic function:

- Normal HR and rhythm
- LV systolic function
- Wall thickness
- Chamber geometry
- Duration, rate and extent of myocyte relaxation
- LV untwisting and elastic recoil
- Magnitude of diastolic suction
- LA-LV pressure gradient
- Passive elastic properties of LV myocardium
- Viscoelastic effects (rapid LV filling and atrial systole)
- LA structure and function
Mitreal valve structure and function
Pulmonary venous blood flow
Pericardial restraint
RV loading conditions and function
Ventricular interdependence
Coronary blood flow and vascular engorgement
Compression by mediastinal masses

**Examiner Comments:**
12% of candidates passed this question.
Candidates often misinterpreted the question and described determinants of cardiac output. The answer should have focussed on factors affecting/contributing to normal LV function - not pathological states. Some answers showed a lack of appreciation that normal left ventricular function is afterload independent, due to compensatory reflexes. Answers needed to consider intrinsic and extrinsic factors affecting LV function - the latter (e.g. SNS, PSNS, hormones, drugs) was often left out. Answers needed to consider both systolic and diastolic function. An excellent answer included physiological phenomena such as the Treppe effect, Anrep effect and baroreceptor and chemoreceptor reflexes. Mention of normal conduction and pacing as well as blood supply limited by diastole scored additional marks.