Modelling Solid Tumour Growth
Lecture 4: Summary and Future Directions

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Summary of Previous Lectures

Avascular Tumour Growth

- ODE models - spatially-averaged models
- 1D PDE models - radially-symmetric models
- 2- and 3D PDE models - symmetry-breaking or invasion

Angiogenesis

- PDE models - analytically tractable in 1D
- Probabilistic models - realistic simulations in 2- and 3D

Outline

References

- H.P. Greenspan (1976) *J. theor. Biol.*, **56**: 229–242.
- K.R. Swanson, E.C. Alvord and J.D. Murray (2000). *Cell. Prolif.* **33**: 317-329.
- T.L. Jackson and H.M. Byrne (2002) *Math. Biosci.* **180**: 307-328.
- C.J.W. Breward, H.M. Byrne and C.E. Lewis (2002) *J. Math. Biol.* **45**: 125-152.
- M.R. Owen, H.M. Byrne and C.E. Lewis *J. theor. Biol.* (accepted)
- S.J. Franks et al *J. Math. Biol.* (in press)
- M.A.J. Chaplain and B.D. Sleeman (1993) *J. Math. Biol.*, **31**: 431-479.

Current Modelling Challenges

- Cellular heterogeneity within tumour:
  - clonal cell populations
  - vasculature
  - ECM/surrounding tissue
- Coupling mechanical effects and growth:
  - stress may influence proliferation/death
  - proliferation/death may influence stress
- Specialising models to describe specific aspects of tumour growth, including
  - gliomas (Swanson et al.)
  - tumour encapsulation (Perumpanani and Sherratt; Jackson and Byrne)
  - ductal carcinoma in situ (Franks et al.)
  - Macrophage-based gene therapy (Owen et al.)

Summary

- Modelling solid tumour growth is an exciting and challenging area of mathematical research
- There are an increasing number of models being developed
- In order to be of clinical value, these models need to become more specific (eg particular tumour, particular mutation)
- Many parts of the cancer jigsaw have now been identified (ie subcellular, cellular and macroscopic phenomenon).
- Mathematics provides framework with which to assemble the jigsaw and thereby to help improve our understanding and treatment of cancer

We will discuss briefly

- gliomas
- tumour encapsulation
- DCIS
- vascular tumour growth

Therapeutic Challenges

- Gene-based therapies
- DNA condensation
- Viral therapies
- Anti-angiogenic treatments
- Hyperthermia
- Magnetically-tagged drugs