CHAPTER 9

CONCLUSION

This thesis is an attempt on in-vitro and in-vivo study of photodynamic activity employing lasers and photosensitizers. The in-vitro study has been made on three tumour cell lines and also on normal human erythrocytes using pulsed as well as CW lasers in conjunction with photosensitizers belonging to different families. The main features of the investigation are:

i. The cell degradation reported in the thesis arises mainly due to photochemical reaction. The thermal effect is minimal.

ii. The cell damage increases with increase in the fluence and depends upon the concentration of photosensitizers.

iii. All the photodynamic activity reported here are influenced by the amount of oxygen content. In other words, the present study reports in-vitro cell damage arising out of the combined effect of photon, sensitizer and oxygen.

iv. Among the three tumour cell lines studied, the fibrosarcoma exhibited higher photosensitivity than the epithelial tumour cell lines.

v. The photodynamic activity (photohemolysis) has two stages; (a) the immediate effect due to the photo-
oxidation and (b) the delayed effect due to the cross-linking of biomolecules and the osmalitic changes in the membrane due to cross linking of bonds as observed in photohemolysis.

vi. Though both pulsed and CW lasers are effective, the effectiveness depends mainly on the wavelength of the laser and the absorption cross-section and the triplet quantum yield characteristics of the sensitizer.

vii. Among the many sensitizers used, the PDA due to DHE > HPD > RB > EY > FL.

viii. Among the lasers used, pulsed N₂ laser in conjunction with DHE and CW Ar ion laser in conjunction with EY are quite effective. However, for any clinical trial the latter combination with higher average power and deeper penetration capability is much better than the former.

ix. Since the photodynamic activity due to EY and RB are comparable with HPD, the most common clinically used sensitizer, Ar ion and EY combination was chosen, because EY has much less toxicity than HPD and has good absorption cross-section for Ar ion laser at 514.5 nm.

x. The follow up PDT clinical trials on chemically induced rat tumour and native human oral carcinoma vindicated our approach. We have confined our work in this pilot study to the topical application of EY to the easily accessible malignancy or premalignancy and by external irradiation using Ar ion laser. Yet, we
were able to suppress the early tumours in rats and human beings though only arrest the growth and alleviation could be achieved if the tumour has grown into fairly larger volume (> 1 cm³). Thus our results have shown that cancer treatment employing suitable laser in conjunction with suitable photosensitizer is indeed realistic.

xi. This thesis also gives detail of the sideline but important result of tumour detection from the autofluorescence of tumour under N₂ laser excitation. This will be a very useful spin off result since mass screening by this method is quite possible.

9.1 SUGGESTION FOR FURTHER WORK

i. The study can further be expanded/extended to intercompare the PDA between pulsed and continuous wave lasers at the visible region.

ii. At the larger volume of tumours, one can try the interstitial therapy by using optical fibers,

iii. The sensitizer can also be injected intravenously, for that one has to study all the pharmacological parameters especially toxic effects on the normal organs.

iv. To classify the stages of the tumour, one can develop proper optoelectronic device by measuring the intensity of emission from tumour cells.