The role of ENT surgeons in 2025

Rhydian Harris — Guys, Kings' & St. Thomas' Medical School

Introduction

Minor ailments like colds and pharyngitis cause only brief upset but remind us how wonderful it is to be well. We take for granted the ability to hear, speak, smell and swallow, walk straight and breathe freely. Life becomes exceptionally difficult when disease affects these basic functions [1]. ENT is therefore an important and varied specialty. Medical history has many pioneers and technological breakthroughs to celebrate, but at no point has there been such an exciting and perhaps bewildering array of developments as there is at the present time. We are on the verge of a period of radical change in our understanding of disease, bringing an exciting outlook on the future of medicine, and Ear, Nose and Throat surgery is by no means any exception. [2,3]

The history of otolaryngology

To envisage the future one has an obligation to reflect upon the past to appreciate the significance of the efforts of our predecessors who helped give the specialty its present status.

The early otologists were surgeons and the early laryngologists were physicians. The link between the two only came together in the middle of the first half of the 20th century, when many doctors began to practise a type of oto-rhino-laryngology. With increasing knowledge and complexity the specialty has tended to subdivide again. [5]

Before anaesthesia surgery was a terrifying last resort to save life. Few operations were possible. The first British operation under ether anaesthesia was undertaken in 1846, by Robert Listen at University College Hospital. Surgery could slow down, become more accurate and could move into unfamiliar areas of the body. Lister also introduced antisepsis to the operating theatre in 1869, through use of his antiseptic carbolic acid spray. [6,7]

The discovery of penicillin in 1947 marked the beginning of an era of great progress in pharmacology which completely changed the face of ENT. The surgeon was freed from the chains of post-operative infection and has been able to investigate and treat disorders of speech and hearing; topics which up to then had received scant attention. [8]

Endoscopes were devised primarily for direct examination of the urinary bladder, vagina and rectum, but Chevalier Jackson expanded the usefulness of endoscopy to examination of the auditory meatus, nasal fossae, pharynx, larynx, oesophagus and stomach. Improvements continued throughout the 20th century with Hopkins developing a fibre-optic system in 1954 and Ikeda's development of a flexible endoscope has enabled many potential hospital admissions for direct laryngoscopy to be avoided. Together with the development of computerized tomography and magnetic resonance imaging, many of the hidden secrets of the normal and pathologic anatomy of the head and neck have been unravelled. [9,10]

Contributions from molecular biology & genetics

With the discovery of DNA by Watson and Crick in 1959, the answers to molecular questions were soon to follow and the human genome project is now complete. [2,10] Nothing provides information about the nature of disease and ways in which disease can be controlled like molecular biology. [2] The differentiation of neurofibromatosis type I from type II for example, was greatly facilitated by molecular analysis [11] and developments in molecular biology will continue to have a major impact on deafness genetics. [12]

The question of tomorrow will not be “which disease does this person have?” but rather “which person may get this disease?”. In 2000, Steel predicted that within 10 years time every individual will carry their “genome smart card” to be swiped routinely as a preliminary to consultation. [13] This will allow rapid detection of the commonest gene mutations associated with deafness, and combined with comprehensive imaging, will provide the basis for diagnosis and treatment of most disorders. [12]

The promise of tissue engineering

In 70% of cases, hearing loss is due to malfunction of hair cells. A potential threat to cochlear implant surgery is the recent interest in hair cell regeneration as animal experiments have shown neural and hair cell regeneration using neurotrophic factors. [14] Although this new era of molecular preventive medicine shows great promise, Steel thinks it may by 20 years before gene therapy becomes available to halt or reverse the progression of hearing loss. [13]

Tissue engineering has been pursued for decades and scientific interest in the field is escalating. Current efforts of replacement or repair of damaged tissues or organs through transplantation are limited by infection, insufficient blood supply and immune rejection. Different methods are being explored to avoid host rejection, including the use of immunotolerant modified cells through gene manipulation or the use of pluripotent embryonic stem cells. The benefit of pluripotent stem cells is that they may be directed into different cell types as required, offering enormous variety of applications. [15]

Disease processes and therapeutic interventions result in destruction or malformation of tissues such as the trachea, pinna, nasal cartilages, and ossicles, and reconstruction of these structures offers particular functional and aesthetic challenges. Tissue engineering has the potential to overcome these challenges and is sure to change the way that we practice medicine in the future. [15]

Immunopathology in ENT

Immunology is another molecular science which has provided great benefits to ENT. Airway compromise secondary to acute infections such as diphtheria or epiglottitis were once common ENT emergencies but the development of vaccines has led to radically decreased incidence in the developed world. [15] Early conductive hearing loss from otitis media with effusion (OME) can have a devastating effect on speech and language but improvements in early diagnosis have not been matched by the development of treatment options. The future of OME treatment seems to be vaccination against upper respiratory pathogens, and universal pneumococcal vaccination of infants was implemented in the US in 2000. [15] Similarly, it is hoped that further vaccine developments will result in the almost total elimination of meningitis, the single largest cause of acquired sensorineural deafness in children [11,3].

Meanwhile, increasing antimicrobial resistance remains one of doctors' greatest fears. Long durations of treatment, inappropriate dosage regimens and poor compliance drive the development of resistance. Simplifying treatment regimens to promote compliance and shorter treatment periods may delay resistance but future success of antimicrobial therapy is ultimately dependent on the development of new classes of drugs like the Ketolides, which are unaffected by resistance and minimize the potential for further development of resistance. [16] Failing this, we might return to managing these problems surgically and this has potential to change the nature and workload of ENT considerably. [2,3]

In the UK, the highest incidence of HIV infection remains in London but with the national redistribution of immigrant and refugee families, any doctor in any speciality can expect to be involved with patients who are HIV positive, or have clinical AIDS. Ear, nose and throat diseases are common across the whole clinical spectrum of HIV/AIDS and children with HIV may well present first to ENT doctors. Great Ormond Street Hospital noted that 91% of their paediatric HIV series had ENT symptoms. [17] Common symptoms included cervical lymphadenopathy (70%), otitis media (46%) and conductive deafness, oral candidiasis (35%) and adenotonsillar disease (31%). The HIV epidemic is not going to go away in the near future. ENT doctors must therefore ensure that they are able to suspect the infection clinically, and to recognise the ENT manifestations of the infection and disease. [17,18]

With the introduction of leukotrine pathway modifiers to treat rhinositis, much like they are used to treat asthma [4], it is becoming clear that future ENT practice will become increasingly dependent on immunological knowledge and technology.

A glimmer of hope for head and neck oncology

Patient survival from head and neck cancer has not improved dramatically in the last 30 years despite notable treatment advances. [22] Accelerated radiotherapy dosing, such as hyperfractioned schedules, have contributed to greater locoregional control but we are increasingly seeing the development of metastases. [20,21]

The search continues for a magic bullet that will specifically target tumour cells. Mapping chromosomal changes within malignant cells has stemmed from the human genome project and significant progress has already been made in identifying oncogene aberrations. Tumour sub-typing may enable better prediction of tumour behaviour, prognosis and response to treatment, as well as predicting those patients whose cancers are likely to recur or benefit from systemic therapy. [19,22] Therapeutic approaches have already been devised – the pathogenesis of adenovirus has been exploited to inactivate the p53 gene and destroy carcinoma cell lines with mutant p53 gene sequences. Similar manipulations have incorporated suicide genes to sensitize tumours to the cytotoxic substances. Angiogenesis is fundamental to tumour growth and metastasis, and is also being targeted with thalidomide currently undergoing trials. [19] Will these new types of treatment replace conventional surgery? Until then, advances in endoscopic surgery will enable most nasal and pituitary tumours to be removed with minimal tissue disruption, and the use of lasers will facilitate controlled bloodless excision.

Local and systemic therapy can only cure the curable and it is important to identify those patients with favourable host and tumour factors. Will there be one-stop FNA clinics for the rapid diagnosis of head and neck tumours as there are currently for breast cancer? [2,21]

Advances in Otology

Enormous strides have been taken in otology over the last century – few would have believed that electrical stimulation of the cochlea could produce the exceptional results that are seen today. The same technology has been adapted to stimulate the brainstem cochlear nucleus in treating neurofibromatosis type II, [1] and with the arrival of middle-ear implants we are now close to having an implantable alternative for every form of hearing loss. [11]

A visible appliance is unacceptable to some whilst in others, crudely amplified sound, frustration of whistling from auditory feedback, and irritation caused by occlusion of the ear canal, is more of a hindrance than a help and so 20% of hearing aids remain unused by their recipients. [1] The opportunity of having a totally implantable middle-ear device that is programmable to an individual’s requirements, with no external parts, is incredibly attractive to patients and has the potential of causing enormous expansion in otologists’ workload.

Balkany suggested that in the not too far future there is no technical reason why a cochlear implant with a radio antenna should not be able to receive messages transmitted from a remote source. [23] Equally as feasible, a cochlear implant system could incorporate an interpreting facility capable of translating any received language into that of the listener, just as the Babelfish do in “Hitchhikers guide to the galaxy”! It does not require a great deal of imagination to see that in the future, individuals without cochlear implants could be at a decided disadvantage. The prospects of otological technology are frightening.

Surgically we have moved medially up the auditory pathway from the external ear to the brainstem cochlear nucleus. Where will the next territory of the implantation otologist be? Perhaps the inferior colliculus will prove appropriate for stimulation or even the auditory cortex itself? Otology has now developed to the point when it can no longer be viewed as a single specialty. It will separate itself from the rest of otorhinolaryngology and training will need to be tailored to a more narrowed field of interest. [11]

Imaging the future

Although medical imaging is still in its infancy, the introduction of endoscopes and microscopes into routine outpatient practice caused a revolution in ENT practice. Improvements in the resolution of both CT and MRI will provide detailed images of the inner ear, enabling the diagnosis of endolymphatic hydrops and benign positional vertigo. [11] MRI microscopy will soon be able to image down to and beyond the cellular level and yield enormous amounts of information about the pathology of inner ear disorders, whilst real time dynamic MRI will eventually tell us what really happens in the inner ear during attacks of Meniere’s disease. [12]

Image guided surgery employs computerised preoperative CT/MRI images to guide the surgeon to the target field. However, CT pixel size is 0.5mm and MRI voxel size is 0.7mm, and in this way a satisfactory degree of safety cannot be guaranteed for certain procedures. Other limitations are cost and patient distress caused by additional imaging, attachment of fiducials and intraoperative steps, including the initialization and calibration of the system. [24] Having said that, image guided surgery is helpful to select an optimal approach in transnasal endoscopic tumour resection or complicated skull base surgery. [24]

If image guidance surgery is to succeed, developers must first address hesitations of whether the extra effort is justifiable? Whatever the outcome, despite the progress achieved by modern technology, the surgeon's anatomical knowledge, experience and ability to obtain 3D orientation, remains essential for safe surgical practice. Image guided surgery will therefore not replace but only supplement knowledge and skill.

The age of cybersurgery

Laparoscopic surgery provided the "wake-up call" to the information age and has become the accepted standard of medical practice. Minimal invasive surgery is not an end-point but rather a transitional phase between open surgery and non-invasive image-guided procedures which are replacing the golden age of surgery. We are currently in the middle of this transition and future developments depend on the emerging information age. [25]

Robotic surgery was first envisaged by the military, who saw a potential for telecommunication to allow a wounded soldier to be operated on by a surgeon with 3D imaging console at a safer location. That initial vision has since been realized, but rather with application to minimally invasive surgical procedures when a laparoscopic cholecystectomy was performed on a patient in Strasbourg, France by a surgeon seated 3800 miles away in New York. [26]

Two systems have been developed to date: the da Vinci surgical system and Zeus. Both use motion scaling to translate large natural movements to extremely precise micromovements whilst eliminating physiological tremor. The system also avoids the need for the reversed counterintuitive motions used in minimally invasive surgery. [27] None of the systems under development involve a machine acting autonomously. Instead the machine is semi-active, behaving as a remote extension of the surgeon, just as minimal invasive surgery is itself a form of telemanipulation because the surgeon is physically separated from the workspace. [26,27]

FDA approval has been granted for telerobotic surgery in minimally invasive cardiothoracic and gastrointestinal surgery [26]. The repertoire of procedures it is used for is increasing steadily. Haus et al reported the first introduction of this technology to the head and neck in 2003, claiming that the technology is capable of significantly enhancing current operative technique, especially within confined neck cavities where working space is limited. [26, 28]

The technology could be used for rural areas where generalists might need assistance from specialists to perform emergency procedures or procedures they perform infrequently. Benefits from telementored surgery are also apparent for graduate medical education as juniors will be allowed to operate while physically alone but with remote supervision, thus building self-confidence. [29]

Learning curves are significant and operative time is longer but collisions of the operative arms, resulting from lack of tactile feedback, are currently being addressed. Costs associated with the implementation of robotic surgery are also substantial. The initial purchase cost of the da Vinci system stands at $1,000,000 excluding annual maintenance costs, training costs and surgical instruments which must be replaced after 10 uses. Nevertheless, length of stay is significantly reduced and the system is cost-effective when compared with the cost of inpatient hospitalization. [26]

Surgical robotic systems remain in the early stages of development and future development will have to address these limitations before improved outcomes and widespread use can be expected and justified.

Political aspects of future ENT practice

In recent years the public has increasingly been alerted to instances of lack of quality in the service that the NHS provides. Is it possible for a comprehensive health care service to continue to be funded entirely from taxation? Will a form of private-public partnership soon develop? Or will the NHS evolve to provide high quality care for a limited range of disorders or serious conditions and restrict treatment for non-serious conditions? [30,31,32]

Developments in ENT have been impressive, yet the irony is that expectations have outstripped achievements and there is a misunderstanding among the public of what the profession can achieve. Doctors are now subject to much media criticism and highlighting the gross malpractice of a few practitioners has aroused suspicion and damaged the reputation of the medical profession. [30] Litigation cases will continue to increase and the old ethic of loyalty, tradition of duty, and scientific advance, is being replaced by a consumer-driven response to patients' wishes and demands. In which case, what authority will we have for refusing treatment if patient benefit is doubtful?

What was once a fairly encapsulated field of study has become more sub-specialized and no one possesses all the skills needed to carry out laryngectomy, cosmetic surgery, audiometry and rehabilitation of deaf children. The skills and abilities of medical staff, audiologists and hearing therapists, clinical scientists, speech and language therapists and psychologists will need to be combined. Following sub-specialisation, the bulk of care in the UK may be provided by a large number of generalists working in district general hospitals while centres of excellence mandate referral of complex medical issues. [33] The consequence of such clinical governance may be litigation over the inadequate experience of these generalists. [31] It also worrying that if surgical practice becomes dominated by narrowly defined roles as a result of sub-specialization, future generations of surgeons may lose the mature experience that allows them to recognise and manage difficult clinical challenges. [34] That would be something very valuable to lose.

Transformation of ENT practice from an operative setting to the outpatient clinic is likely to continue as novel anaesthetic and surgical procedures are introduced which would have previously required operating room intervention. The relative increase in medical treatment options including allergy testing, gene therapy and immunotherapy, reflect this shift in focus. Following this shift, training will need to be reviewed with less time spent on learning surgical techniques and more emphasis placed on clinic-based training. Moreover, with the increasing number of women entering the otolaryngology workforce, the profession will need to adjust to differences in training and practice, and offer greater flexibility to accommodate child bearing. [33]

External forces such as the European working time directive are having a profound effect on the UK's healthcare workforce. There aren't enough doctors to support the traditional working patterns and so new professional roles will have to be designed. The UK's first nurse consultant in coloproctology and a nurse led minor surgery service aroused great opposition when first introduced. By learning straightforward procedures, these provide a much needed addition to the workforce and free consultants to teach more complex tasks. [34] But will this just transfer staffing shortages from one part of the system to another? How will these practitioners cope when straightforward procedures go wrong? The skills of experienced consultants are essential and take years to acquire and are hard to define. Practitioner care will undoubtedly need to be combined with consultant led surgical practice.

Conclusion:

The role of ENT Surgeons in 2025.

Throughout the past century, there has been one characteristic feature of oto-rhino-laryngology which has remained unchanged – the mixture of medicine and surgery. This double orientation exists in very few disciplines and looks set to continue in the future.

As with many other areas of medicine, molecular biology will become increasingly important, with immunotherapy, gene therapy and tissue engineering influencing many areas of ENT practice. Robotic surgery and a greater outpatient emphasis may lessen the hands-on approach with which we are familiar, but this will benefit patient care and reduce inpatient stay. The ENT workforce will need to be flexible and adapt to such changes.

The future is not easy to predict and it is probable that the any speculation grossly underestimates the exciting developments that await us in the decades to come.

[1] Richards A, Gleeson M; Recent Advances – Otolaryngology; BMJ. 1999, Vol 319, p1110-1113.
[2] Weir J, Shah K; The future of pathology; The Journal of Laryngology & Otology. 2000, Vol 114 p491-493.
[3] Baguley DM, Luxon LM; The future of audiological rehabilitation; The Journal of Laryngology & Otology; 2000, Vol 114 p176-169.
[4] Rowe-Jones JM, Lund VJ; The future of rhinology, anterior skull base and facial plastic surgery; The Journal of Laryngology & Otology. 2000, Vol 114 p245-247.
[5] Weir N; Otolaryngology – an illustrated history; Butterworth & Co. London. 1990
[6] http://web.ukonline.co.uk/b.gardner/Lister.html
[7] http://www.aagbi.org/pub_history.html
[8] Helidonis ES; American journal of otolaryngology; 1993. Vol 14 p382-393.
[9] Sircus W, Flisk E, Craigs B; Milestones in the evolution of endoscopy; Journal of the Royal college of physicians, Edinburgh; 2003, Vol 33 p124-134.
[10] Snow JB; Evolution of research in otolaryngology over the past century; Laryngoscope. 1996, Vol 106 p529-31.
[11] Irving RM, Proops DW; The future of otology; The Journal of Laryngology & Otology. 2000, Vol 114 p3-5.
[12] Ramsden R, Saeed S; The future of neruo-otology; The Journal of Laryngology & Otology; 2000, Vol 114 p89-92.
[13] Steel KP; New interventions in hearing impairment; BMJ. 2000, Vol 320, p622-625.
[14] Walsh RM; An in vivo study o vestibular sensory hair-cell degeneration and regeneration in the guinea pig inner ear. MD thesis, Trinity College, Dublin, 1998.
[15] Patel NN, Butler PEM, Buttery L, et al; Tissue engineering and ENT surgery; The journal of laryngology and otology; 2002, Vol 116 p165-169.
[16] Lecrecq R; Safeguarding future antimicrobial options – strategies to minimize resistance; Clinical Microbiology and Infection; 2001 Vol 7 (S3) p18-23.
[17] Hadfield PJ, Birchall MA, Novelli V, Bailey CM; The ENT manifestations of HIV infection in children; Clinical Otolaryngology & Allied Sciences; 1996 Vol 21(1), p30-6.
[18] Hoare S; HIV infection in children — impact upon ENT doctors; International Journal of Pediatric Otorhinolaryngology 2003 Vol 67(S1) p85-S90.
[19] Buckley JG; The future of head and neck surgery; The Journal of Laryngology & Otology; 2000, Vol 114 p327-330.
[20] Weissler MC, Scharer S; What's new in otolaryngology; Journal of the American college of surgeons; 2004. Vol 199 p114-121.
[21] Brigewater CH, Spittle M; The future of radiotherapy and chemotherapy in head and neck cancer; The Journal of Laryngology & Otology; 2000, Vol 114 p411-413.
[22] Lambert PR; What's new in otolaryngology; Journal of the American college of surgeons; 2002. Vol 195 p72-78.
[23] Balkany T, Hodges AV, Luntz M; Update on cochlear implantation; Otolaryngologic Clinics of North America; 2001 Vol 1(3) p18-23.
[24] Lenarz T, Heermann R; Image-guided and computer-aided surgery in otology and neurotology – is there already a need for it?; The American journal of otology. 1999, Vol 20 p143-144.
[25] Darzi A; Cybersurgery; presented at the RSM Otolaryngology AGM on 6th May 2005.
[26] Gourin CG, Terris DJ; Surgical robotics in otolaryngology – expanding the technology envelope; Current opinion is otolaryngology head and neck surgery; 2004 Vol 12 p204-208.
[27] Darzi A, Mackay S; Recent advances in minimal access surgery; BMJ. 2002, Vol 324 p31-34
[28] Haus BM, Kambham N, Le D, et al; Surgical robotic applications in otolaryngology; Laryngoscope 2003, Vol 113 p1139-1114.
[29] Burgess LPA, Syms MJ, Holtel MR, et al; Telemedicine – Teleproctored endoscopic sinus surgery; Laryngoscope. 2002, Vol 112, p216-219.

[30] Cherry J, Weir R; Medicolegal and ethical aspects of ORL in the new millennium; The Jounral of Laryngology & Otology. 2000, Vol 114 p737-740.
[31] Browning GG, Burton MJ; Quality issues in otorhinolaryngology – part 2; The Journal of Laryngology & Otology; 2000, Vol 114 p910-914.
[32] Browning GG, Burton MJ; Quality issues in otorhinolaryngology – part 1; The Journal of Laryngology & Otology; 2000, Vol 114 p817-820.
[33] Pillsbury HC, Cannon R, Holzer SES, et al; The workforce in otolaryngology – moving into the next millennium; Otolaryngology – head and neck surgery. 2000, Vol 123 p352-356.
[34] Kneebone R, Darzi A; New professional roles n surgery; BMJ. 2005, Vol 330 p803-804.