Commission on the Future of Surgery: Vascular Surgery

Purpose

'The purpose of the Commission on the Future of Surgery is to set out a compelling and credible vision of the future advances in medicine and technology, and how those developments will affect the delivery of surgical care in the United Kingdom. In particular, the Commission will consider what the future of surgery is likely to look like for patients in five years, could look like in ten years, and might be in 15 to 20 years.'

Methodology

This report on the 'Future of Vascular Surgery' has been generated for the Royal College of Surgeons on behalf of the Vascular Society of Great Britain and Ireland. The VS Secretary approached individuals by email and after discussion at Council, contributions were then collated by the Chair of the Research Committee (Prof Imray) and a Council Member of the Royal College of Surgeons (Prof Shearman).

Role of research and innovation in the future of vascular surgery

Many of the future developments in vascular surgery are likely to be generated from research. These will include clinical trials, translational research (linking basic science to bedside advances) and will also be derived from co-related specialties such as cardiology, diabetes and stroke medicine.

Innovation is a broad term that encompasses new ideas, devices, methods or ways of working. Innovation can be evolutionary (or non-disruptive), where there is a gradual stepwise development of novel approaches, or it can be disruptive. Disruptive innovation is innovation that creates completely new techniques, devices or ways of working which will tend to displace older organisational structures, workforce, processes, products, services and technologies.

The timelines involved in any innovation or major research advance is usually of the order of 8-15 years. The implication being many of the major advances that will be implemented within the next 20 years are already at an early stage of development.

Funding

Whilst funding of future developments with vascular surgery is outside the remit of this review, failure to recognise the reality of ongoing funding restrictions would risk offering naïve aspirations that would ultimately fail to gain traction from key funding bodies. The need to demonstrate value for money, improved QoL, longevity of intervention and efficacy in delivery are key components when considering the future of vascular surgery.

Definition of vascular disease and the vascular team

Vascular disease encompasses a wide range of conditions but in terms of the prevalence and severity include:

-Occlusive peripheral vascular disease

-Diabetic related vascular disease

-Aneurysmal disease (mainly aortic)

-Carotid artery disease and stroke prevention

-Venous disease

-Vascular trauma

The first five conditions tend to increase in prevalence and severity with age. With the changing demographics of vascular patients (discussed below), there is a predicted increase in the number of individuals affected by vascular disease.

A key feature of vascular surgery is the complexity and synergy of both the medical and surgical components affecting vascular patients. To address these multiple issues a multidisciplinary approach is required.

Whilst the multidisciplinary team is traditionally led by the vascular surgeon, it includes vascular anaesthetists, interventional radiologists, ITU, ward, theatre, community and specialist nurses, vascular technologists. The team work closely with hospital physicians (including diabetologists, stroke physicians, cardiologist, renal physicians, geriatricians, emergency physicians, rehabilitation physicians) and GPs.

Overriding principles

In putting together this report our primary aim was to focus on the patient and in particular:

-Improve clinical outcomes

-Improve patient experience

-Deliver ymore cost effective means of treatment

-Improve Quality of Life (QoL is a measure of the perceived measure of an individual's daily life or a measure of wellbeing)

-More sophisticated team working and information sharing.

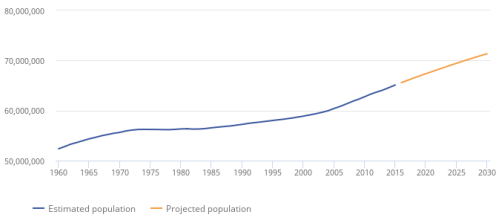
Patients factors and current trends

Demographics

The UK population is rising and is predicted to continue to rise.

Ref Office of National Statistics 2017

Figure 1: UK population estimates and projections, 1960 to 2030



Source: Office for National Statistics

However, this continuing upward trend in life expectancy has not been followed in the US, where for the last two years there has been a fall in life expectancy. This may in time be reflected more widely.

Age distribution shows a persistent trend with a greater proportion of older individuals (increasing the prevalence of vascular pathology within the population).

Table 1: Age distribution of the UK population, 1975 to 2045 (projected)

Year	UK Population	0 to 15 years (%)	16 to 64 years (%)	65 years and over (%)
1975	56,226,000	24.9	61.0	14.1
1985	56,554,000	20.7	64.1	15.2
1995	58,025,000	20.7	63.4	15.8
2005	60,413,000	19.3	64.7	15.9
2015	65,110,000	18.8	63.3	17.8
2025	69,444,000	18.9	60.9	20.2
2035	73,044,000	18.1	58.3	23.6
2045	76,055,000	17.7	57.8	24.6

Source: Office for National Statistics

United Nations, Department of Economic and Social Affairs, Population Division (2011): World Population Prospects: The 2010 Revision. New York

Burden of vascular disease

Increasing age is associated with a greater burden of peripheral vascular disease and diabetic vascular disease. However, there currently appears to be a decreasing incidence of abdominal aortic aneurysmal disease, possibly related to reduced smoking and better medical therapies.

Expectation of patients

An evolving feature of the modern world is better access to information the disease processes and communication. This often associated with this is a greater expectation of patients.

Public health

Government and NHS driven changes in public health such as smoking cessation, lipid lowering targets, blood pressure control and early diabetes detection have played a critical role improving the vascular health of the nation. Looking to the future, it is highly likely that preventative measures and lifestyle changes are going to be key areas to reducing the cardiovascular vascular disease burden. Public health advice that is widely adopted has major downstream effects as evidenced by changes in smoking habits. Greater uptake of exercise, healthier diets etc by the general population could impact in a major positive way on the incidence obesity, diabetes and vascular health.

Organization, integration and delivery of vascular services

Delivery of a complex healthcare pathway to large numbers of high risk patients is challenging. Significant advances and developments led by the Vascular Society have already occurred and are outlined within the Provision of Vascular Services (POVS) document. The POVS document has driven an evolutionary organisational improvement in the proposed delivery of vascular care. It is a good

example of non-disruptive innovation, demonstrating what can be achieved with an evidenced based visionary approach adopted by a national body. The actual delivery of vascular services has been further examined in the 2018 GIRFT (Getting it right first time) document which has highlighted further areas for focus.

Hub and spoke models- *POVS, GIRFT*

Optimal populations for vascular units- POVS, GIRFT

Speed of access to appropriate expertise- *POVS, GIRFT*

Assessment of adequacy of care, outcome measures-

National Vascular Database

Intelligent audit and unique device identifier NVR (National Vascular Registry) - Aspirational

Single uniform computerised NHS patient database-Aspirational

Optimised patient pathways and acceptable timelines- Aspirational

Advancing technologies

Genetic profiling:	Diagnostic-disease targeting, such as abdominal aortic aneurysmal disease. This is likely to lead to potential therapeutic genetic interventions
Robotics:	Robotic surgery has the potential to offer less invasive procedures with shorter length of hospital stay. The caveat to this approach is the current high costs associated with robotic surgery, and the relative ease of endovascular approaches.
3D printing:	These techniques have the potential to assist in specific endo graft development. The combination of 3D printing and regenerative medicine may allow patient specific 'biologic' grafts to be developed.
Imaging:	Reducing radiation dosing, better computer modelling. Synergistic or integration of multimodal imaging such as 3D ultrasound Point of care U/S Fusion imaging

	Software engineering to generate 3 D models of diseased circulation and plan interventions and predict outcomes
Point of care testing	Thrombo elastograms (TEG) represents a recent development in point of care tests for bleeding. It is likely that further tests will be developed for use either in the community or in hospital such as the 'SmartChip' for ischaemic and glial fibrillary acidic protein (GFAP) for traumatic brain injury
Infection control	Novel antibiotics, implant covering or implant technology such as biologically compatible or absorbable materials need to be developed
Big data	Greater interrogation of the existing data sets in the community or using the NVD are like to inform decision planning Easier methods of data capture including standardised approach to patient information recoding electronically across NHS. Voice activated recoding to avoid repetitive writing, prompts for questions. Integrated investigation and therapy pathways allowing clinicians more time to focus on high end decision making.
Stent technology	Technology continues to develop rapidly and the stent options increase rapidly. Better design, novel materials and delivery systems need to match the individual patient characteristics.
Artificial Intelligence	There is an emerging role for AI in the interpretation of images and this may well be applicable to say endograft selection or even management of complex patients.
Atherectomy devices	Endovascular atherectomy devices show theoretical promise but the exact technique and their role have yet to be fully defined.
Composite grafting	Endothelial seeding onto a 3D matrix might improve graft patency and reduce infection risk
Gene editing	Gene editing techniques are currently being used for xenogenic organ growth in pigs for planned eventual use in humans. Such techniques might be applicable for vessel growth
Virtual care	There is likely to be a development of virtual care and clinics improving of patients access to expert opinion.

	Remote monitoring of leg ulcers and problem wound care will be supervised in a remote fashion.
Stem cells	Stem cell vascular regeneration including the restoration of normal vascular function and structure; the reversal of vascular senescence; and the growth of new blood vessels is already in progress and likely to become more important in the future
Personalized or precision medicine	
	Merging genomics and other –omics (proteomics, metabolomics) with an individual's cardiovascular risk factors and individual circumstances should inform clinicians about diagnosis, planning of treatment efficacy of treatment and prognosis.
New drugs	Novel vascular drugs are more likely either to come from cardiological and / or diabetic routes if one considers the patient numbers and relative cost margins. Re-targeting of existing drugs in novel settings such as metformin for delaying AAA growth is a relatively inexpensive approach to existing conditions. Combination use of drugs (such as aspirin and clopidogrel) has been used to great beneficial effect. There is emerging evidence of the use of synergistic existing drugs combinations in personalized approach to cancer treatment. It is likely that options may be suitable for vascular patients.
Remote monitoring	Remote monitoring of patients eg diabetic foot using nanotechnology. Pressure and temperature sensors embedded in footwear and sending data ro remote monitoring centre via mobile phone. Subject only contacted if abnormal results

Innovative training

Training simulators	Endovascular training- virtual reality and simulated reality systems Surgical training-individual and team based training within simulated environments Cadaveric training is both popular and helpful for specific situations Immersion training

Mentor via video	Such as Proxime (mentor)
"Touch Training" before real life surgery	
Modelling and planning interventions	

Workforce and safety

Recruitment	There is a potential manpower crisis emerging and active innovative steps to mitigate the potential shortage need to be explored. Medical student involvement, looking at the way we train our junior doctors. Earlier career path selection and tailored undergraduate training for surgery?
Other staff	There is likely to be a growing role for the appropriately trained surgical care practitioners
Training	The Vascular Society ASPIRE Training Program is an innovative approach and an exemplar of holistic training specifically geared at each year group's requirements. Further development and refinement is expected.
Burnout & resilience	With the huge investment in training of the vascular multidisciplinary team, greater investment in understanding of, and steps to increase resilience and so mitigate burnout. Use of aps and avatars to support surgeons
Bullying/harassment	Whilst we have a zero-tolerance policy towards such behaviours, education, recognition and better understanding is required to reduce/eliminate the problem.
Safety checks	The introduction of the WHO Checklist is an example of a simple approach which reduces basic and avoidable surgical events. This approach could be further refined and developed perhaps along the lines of inter-operative checks during multidisciplinary trauma surgery

Research Organisation and Funding

Delphi/JLA research	The VS is in the process of completing the first Delphi process to determine the research priority setting for vascular surgery. This process will be

followed by James Lind Alliance process to further delineate research topics that James Lind Alliance process to further delineate research topics that are relevant to both patients and the multidisciplinary vascular team. NIHR / Welcome / MRC funding streams will be approached. Quality applications with well-designed studies are more likely to be funded.

Vascular research collaborative

The Vascular Research Collaborative is beginning to gain traction with trainees both leading and participating in trials. This has been shown to be a key approach to engaging trainees with research and is likely to be important in long term support for research and innovation.

Patient and public involvement

We need to develop an expectation for patients to want to be enrolled in research and to facilitate their involvement in the design of future proposals

PROMS Patient reported outcome measures registry could potentially inform future areas for improvement in care

Industry involvement Commercial involvement in certain aspects of research or registry funding is important potential area to develop. Registry data and unique device identifier NVR

Conclusions

Vascular surgery is a multidisciplinary specialty which has evolved rapidly over the last few decades. There is a strong record of inventing, developing and embracing new techniques and technologies; of developing new working practices, collaborative multidisciplinary team work, and of developing new educational approaches. The evidence base has been used to inform the reconfiguration of services delivering improved modern and holistic care to patients. Many vascular patients are relative frail and personalising best care for the individual patient is challenging. Vascular surgical care will continue to develop and innovate and the future is exciting.