Characteristics of the applicant pool to vascular surgery residency programs

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Objective: Based on the significant number of unfilled vascular fellowship positions in the 2004 National Residency Matching Program (NRMP) and the perception of program directors that the quality of candidates is deteriorating, the Issues Committee of the Association of Program Directors in Vascular Surgery (APDVS) explored the characteristics and the trend of the applicant pool to develop recommendations for improvement.

Methods: The Electronic Residency Application Service (ERAS) database was queried for the total number of applicants, medical school, gender, and age, among other characteristics. The vascular surgery applicant pool was compared to the applicant pool for general surgery; the applicant pool for all fellowship positions, including a variety of medical subspecialties; the applicant pool for all residency positions; and the applicant pool for colorectal surgery, the only other surgical subspecialty participating in ERAS in 2004. NRMP data was used prior to 2004. The $\chi^2$ test was used for statistical analysis, with significance set at $P < .05$.

Results: In the 2004 match for June 2005 positions, there were 100 applicants for 110 first-year vascular surgery positions in 90 programs. In 1989, there were 123 applicants for 56 positions in 49 programs. In 1989, 55% of vascular surgery applicants did not match; whereas in 2004, only 7% were unmatched. Although the overall number of vascular surgery applicants has remained relatively stable, the number of United States applicants has decreased from 89% in 1990 to 68% in 2004 ($P < .01$). There was a significant geographic variation: 54% of those in the applicant pool came from the state of New York, but 23 states did not contribute a single applicant to the pool. In addition, vascular surgery, like other fellowships, attracts fewer female applicants.

Conclusions: The data from the ERAS database support the impression held by many in the vascular surgery education community that the size of the applicant pool for vascular surgery fellowship positions has remained stagnant, while the number of positions has significantly increased. Strategies to increase the size and quality of the applicant pool are needed. (J Vasc Surg 2005;42:519-23.)

Few surgical specialties have experienced such sweeping change as vascular surgery during the last 15 years. The explosion of endovascular techniques, the burgeoning elderly population, challenging reimbursement pressures, competition from other surgical and medical specialties, and other forces have created both enormous opportunity and considerable uncertainty in vascular surgery.1-8 At the same time, there has been rising concern that surgery and its subspecialties are no longer attractive to the brightest and most talented medical students.6,9,10

Based on a significant number of unfilled vascular fellowship positions (23 of 110) in the 2004 National Residency Matching Program (NRMP) and the perception of program directors that the quality of candidates is deteriorating, the Issues Committee of the Association of Program Directors in Vascular Surgery (APDVS) was asked to analyze the characteristics of the vascular surgery applicant pool to develop recommendations for improvement. One phase of this strategy involved examining the data available from the Electronic Residency Application Service (ERAS).

ERAS is a proprietary, Web-based computer program designed to transmit universal residency applications, letters of recommendation, deans’ letters, transcripts, personal statements, photographs, and United States Medical Licensure Examination (USMLE) scores to each residency program specified by the applicant. ERAS was first implemented in the 1995-1996 application year for obstetrics and gynecology residency programs as a large-scale pilot test. In 1996-1997, ERAS was used by obstetrics and gynecology and all US Army specialties, and its scope was extended the following year to family practice, radiology, orthopedic surgery, emergency medicine, and transitional-year programs.11 Vascular surgery programs first accepted residency applications from ERAS in 2004.

Methods

The ERAS database was queried for the total number of applicants, location of the medical school from which the applicant graduated, visa status, location of general surgery residency, gender, age, and the presence of a linked vascular surgery fellowship to the parent general surgery program. Applicants that graduated from an allopathic medical school in the United States are designated as US applicants regardless of citizenship. All other applicants are included under the designation international medical graduate. This

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includes all applicants who graduated from non-allopathic medical schools in the United States, including graduates of foreign medical schools including Canada and a small number of graduates from osteopathic medical schools.

The vascular surgery applicant pool was compared with the applicant pool for general surgery; the applicant pool for all fellowship positions, including a variety of medical subspecialties, the applicant pool for all residency positions; and the applicant pool for colorectal surgery, the only other surgical subspecialty participating in ERAS in 2004. To protect the confidentiality of individual candidates, no candidate-specific information was released by ERAS or included in this report. Data from the National Residency Matching Program (NRMP) were used to determine the number of United States and international medical graduates in the applicant pool before 2004.

To analyze the geographic variation in the vascular surgery applicant pool, we compared the location of the general surgery residency of vascular applicants with the available general surgery resident pool from each state. The percentage of vascular applicants from each state was determined by dividing the number of vascular surgery applicants from the state by the total number of vascular applicants. The percentage of general surgery residents from each state was determined by dividing the number of categorical positions in each state by the total number of categorical positions in the United States. The ratio of the percentage of vascular surgery applicants to the percentage of general surgery positions in each state was determined. A ratio greater than one indicates a “vascular rich” applicant pool. The \( \chi^2 \) test was used for statistical analysis, with significance set at \( P < .05 \).

**RESULTS**

According to the NRMP, in 2004 there were 100 applicants for 110 first-year vascular surgery positions in 90 programs. In 1989 there were 123 applicants for 56 positions in 49 programs (Fig 1). In 1989, 55% of vascular surgery applicants did not match; whereas in 2004 only 7% were unmatched. During the 1990s, there were never more than 6 unfilled vascular surgery positions, but in 2004 there were 23 unfilled positions. The lowest number of candidates (\( n = 89 \)) occurred in 1993 and the highest number (\( n = 126 \)) in 1996. The lowest number of US candidates occurred in 1993 (\( n = 76 \)) and the high occurred in 1996 (\( n = 107 \)).

Although the number of vascular surgery applicants has remained relatively stable, the number of US applicants decreased from 89% in 1990 to 68% in 2004 (\( P < .01 \)) (Fig 2). Thirty-two percent of vascular surgery applicants were international medical graduates compared to 50% of general surgery applicants and 18% of colorectal fellowship applicants (Table 1). The total number of vascular surgery applicants that did not graduate from allopathic medical schools in the United States reached an all time high of 32. During the past 15 years, a small number of US citizens have graduated from international medical schools and are included as international medical graduates. Before 2004, there were never more than 6 applicants who were US citizens that graduated from international medical schools, but in 2004 this number increased to 14.

The percentage of male candidates (73%) was higher in the vascular surgery pool than in the other applicant pools (Table II). The age of vascular surgery candidates was similar to other fellowship applicants (data not shown).

From a geographic standpoint, 90% of vascular surgery applicants trained in general surgery programs from only eight states (New York, Texas, California, Tennessee, Illinois, Ohio, Pennsylvania, and Massachusetts). Thirty-four percent of vascular applicants originated in New York (Fig 3). There were no applicants from 23 states. To determine if the state of origin of vascular applicants simply reflected the general surgery applicant pool or represented real geographic variation, we compared the number of vascular applicants to the number of general surgery positions in each state. In seven states (New York, Tennessee, Mary-
land, Oregon, Connecticut, Colorado, New Mexico, and Ohio), the number of vascular applicants was at least twice that expected from the size of the general surgery applicant pool (Fig 4).

Fifty-two candidates (49%) for whom the information is available came from general surgery programs that have a linked vascular surgery fellowship. Of these 52 applicants with linked vascular programs, 20 were from New York. An additional 20 applicants (19%) reported that a vascular surgery fellowship was present in their city. Thirty-five applicants (33%) reported that their general surgery program was not linked to a vascular surgery program nor was there a vascular surgery fellowship in their city.

**DISCUSSION**

The most notable finding in the present study is that the size of the vascular surgery applicant pool has not significantly changed during the past 15 years. During the same period of time, the number of vascular surgery fellowship positions has doubled. Furthermore, the number of US graduates applying for vascular surgery has decreased. The reasons for these trends have been the subject of considerable discussion, but few conclusions have emerged.3,7

Vascular surgery remains a predominantly male surgical specialty. This trend is reflective of similar findings regarding the relatively small number of women in advanced engineering and mathematics careers as well as in general surgery and surgical specialties.12,13 The most common explanation for the apparent gender disparity typically focuses on the rigorous training and long working hours thought to be unappealing to female surgeons with plans for raising a family.

The Blue Ribbon Committee on Surgical Education of the American Surgical Association has recently noted that fewer men are obtaining undergraduate degrees, and at the present, women comprise 60% of college undergraduates and 50% of graduating medical students.12 In 2003, women represented less than 30% of the total number of students matching to general surgery residencies.12 At present, only 20% of surgical residents taking the American Board of Surgeons Qualifying Examination are female.14 In a survey of general surgery residents, Gabram et al identified six items that were of more concern to women than men: availability of role models, mentors, or both; comfort in expressing emotions at work; initiating and maintaining personal relationships; having children during residency; and postponing family plans.15 Debas has noted that “unless surgical training and careers in surgery are made more attractive to women, a pipeline problem may develop in the production of surgeons.”12 The future of vascular surgery may well depend on strategies to increase the number of competitive female candidates.

There appears to be significant geographic variation in the applicant pool in vascular surgery. Approximately one-third of all vascular surgery applicants are from New York, which is disproportionately high compared with the number of categorical general surgery positions or the number of vascular surgery fellowships linked to parent general surgery programs. In addition, 23 states did not contribute a single applicant to the vascular surgery pool. Although the reasons for the significant geographic variation in the vascular surgery applicant pool are unclear, this provides valu-

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**Table I.** Percentages (number) of United States graduates (USG) and international medical graduates (IMG) in 2004

<table>
<thead>
<tr>
<th>USG/IMG</th>
<th>Vascular surgery</th>
<th>Colorectal surgery</th>
<th>General surgery</th>
<th>Fellowship*</th>
<th>Residency</th>
</tr>
</thead>
<tbody>
<tr>
<td>USG</td>
<td>68% (68)</td>
<td>82% (73)</td>
<td>50% (2528)</td>
<td>47% (364)</td>
<td>59% (19,333)</td>
</tr>
<tr>
<td>IMG</td>
<td>32% (32)</td>
<td>18% (16)</td>
<td>50% (2497)</td>
<td>53% (405)</td>
<td>41% (13,249)</td>
</tr>
</tbody>
</table>

*Fellowship indicates all Electronic Residency Application Service applicants for fellowship positions regardless of specialty.

$^1x^2 = P < .05$ and

$^2P < .001$ compared with vascular surgery.

**Table II.** Gender distribution for Electronic Residency Application Service applicants in 2004

<table>
<thead>
<tr>
<th>Gender</th>
<th>Vascular surgery</th>
<th>Colorectal surgery</th>
<th>General surgery</th>
<th>Fellowship</th>
<th>Residency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>73% (73)</td>
<td>62% (55)</td>
<td>72% (3,609)</td>
<td>73% (560)</td>
<td>54% (17,723)*</td>
</tr>
<tr>
<td>Female</td>
<td>19% (19)</td>
<td>30% (27)</td>
<td>25% (1,239)</td>
<td>22% (169)</td>
<td>42% (13,801)</td>
</tr>
<tr>
<td>Unknown</td>
<td>8% (8)</td>
<td>8% (7)</td>
<td>4% (177)</td>
<td>5% (40)</td>
<td>3% (1,058)</td>
</tr>
</tbody>
</table>

*$x^2 = P < .001$ compared with vascular surgery.
able information to allocate and focus resources to improve the situation.

Lifestyle issues continue to dominate the factors listed by graduating medical students in selecting postgraduate training. Current applicants to residency positions belong to what is termed “Generation X”; this generation is quite distinct from the prior generation, the “Baby Boomers.” Baby Boomers are goal oriented, hard workers, and driven to succeed. Generation X reacted to their Boomer parents’ hectic lifestyles and sought a balance in their life: they work to “have a life.”

Radiology, dermatology, ophthalmology, and emergency medicine continue to attract significant numbers of candidates because of perceived favorable working conditions during residency and beyond. Long work hours, stress related to highly-demanding technical procedures with significant morbidity, increasing exposure to malpractice, competition from other specialties, difficulties in obtaining credentials to perform endovascular procedures and in gaining access to appropriate interventional imaging suites, shrinking reimbursement, and other factors may influence some medical students and general surgery residents to avoid vascular surgery.

Calligaro recently reported that the two most significant factors in the selection of vascular surgery are the highly technical nature of the surgical procedures and the positive influence of vascular surgery mentors. Thus, vascular surgeons should be encouraged to actively participate in medical student education and provide appropriate mentoring for junior level residents and students. In addition, vascular surgeons should solicit the rotation of junior surgery residents on vascular rotations and ensure that they have an adequate exposure to complex procedures.

Currently, the pool of candidates for vascular surgery is limited by the number of available general surgery resident positions. Strategies to develop pathways into vascular surgery independent of general surgery certification are needed. Another method of attracting general surgery residents to vascular surgery involves direct financial support for general surgery residents and medical students to attend the annual national meeting of the Society for Vascular Surgery.

CONCLUSION

These data from the ERAS database support the impression held by many in the vascular surgery education community that the applicant pool for vascular surgery fellowship positions has remained stagnant during a period of time that the number of positions has significantly increased. Vascular surgery remains a predominantly male surgical specialty that attracts few qualified female applicants. There appears to be significant geographic variation in the origin of the vascular surgery applicant pool. The forces behind this geographic variation are unclear.

We would like to end by submitting the following recommendations:

1. Develop strategies to increase the size of the applicant pool. Methods to attract more qualified general surgery residents, including female residents, such as sponsorship to the national vascular meeting are needed.
2. Support the development of pathways to vascular surgery training that do not depend on general surgery certification.
3. Participate in the development of medical school curriculum to ensure that medical students have appropriate education in vascular disease and opportunities to identify vascular surgeons as role models.
4. Acknowledge the importance of lifestyle considerations in both vascular surgery training and practice.

Fig 4. Ratio of the percentage of vascular surgery applicants from each state to the percentage of general surgery positions in each state in 2004. Note: This chart does not include 23 states with no applicants in 2004. A ratio >1 indicates a “vascular-rich” applicant pool.
5. Focus recruitment efforts and resources on regions of the country that have had few vascular applicants in the past.

REFERENCES

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