Five-year results of a merger between vascular surgeons and interventional radiologists in a university medical center

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Objectives: We examined economic and practice trends after 5 years of a merger between vascular surgeons and interventional radiologists.

Methods: In 1998 a merger between the Division of Vascular Surgery and the Section of Interventional Radiology at the University of Rochester established the Center for Vascular Disease (CVD). Business activity was administered from the offices of the vascular surgeons.

Results: In 1998 the CVD included five vascular surgeons and three interventional radiologists, who generated a total income of $5,789,311 (34% from vascular surgeons, 24% from interventional radiologists, 42% from vascular laboratories). Vascular surgeon participation in endoluminal therapy was limited to repair of abdominal aortic aneurysms (AAAs). Income was derived from 1011 major vascular procedures, 10,510 catheter-based procedures in 3286 patients, and 1 inpatient and 3 outpatient vascular laboratory tests. In 2002 there were six vascular surgeons (five, full-time equivalent) and four interventional radiologists, and total income was $6,550,463 despite significant reductions in unit value reimbursement over the 5 years, a 4% reduction in the number of major vascular procedures, and a 13% reduction in income from vascular laboratories. In 2002 the number of endoluminal procedures increased to 16,026 in 7131 patients, and contributions to CVD income increased from 24% in 1998 to 31% in 2002. Three of the six vascular surgeons performed endoluminal procedures in 634 patients in 2002, compared with none in 1998.

Conclusions: Gross revenues increased in a declining reimbursement and conventional practice environment, because of the increased number of endoluminal procedures, in part provided by vascular surgeons. The implications of these data should be considered by those responsible for training vascular surgeons. (J Vasc Surg 2003;38:1213-9.)

In 1998 a merger between the Division of Vascular Surgery and the Section of Interventional Radiology at the University of Rochester was effected under the auspices of the Dean of the School of Medicine and Dentistry, thereby creating the Center for Vascular Disease (CVD). The goals of the merger were to improve efficiency in patient care, practice management, and training. The merger integrated all clinical, educational, and financial activities. Physician compensation was not directly determined by clinical productivity, in an attempt to dissociate clinical decision-making from the economics of practice.

The CVD continues to operate as an integrated unit with control of the vascular practice in a large university system. We recognize that the local issues at our institution do not easily transfer to others and that our relationship may be unique. Nevertheless, our experience provides important information about the evolving scope of a contemporary vascular practice.

METHODS

Structure of CVD. The CVD operates surgical services in three hospitals in Rochester, NY, including Strong Memorial Hospital (SMH), Highland Hospital (HH), and Rochester General Hospital (RGH); diagnostic laboratories in one hospital (SMH) and four outpatient sites; and interventional radiology services at two hospitals (SMH, HH). The CVD is the only provider at SMH; the other hospitals have competing vascular surgeons and interventional radiologists. All CVD faculty and support staff are employed by the University of Rochester. In 1998 there were five vascular surgeons (full-time equivalents [FTE]) and three interventional radiologists (FTE). At that time interventional procedures, both vascular and nonvascular, with the exception of endovascular aneurysm repair, were performed by interventional radiologists. Vascular surgeons provide preventive and medical aspects of vascular care, and vascular laboratory management at our institutions. In 2002 there were six vascular surgeons (five FTE) and four interventional radiologists (FTE). Three vascular surgeons (R.M.G., C.S., K.I.) and two interventional radiologists (D.W., C.S.) performed endovascular procedures.
ologists (D.W., D.L.) have participated in the CVD over the entire 5-year period.

Three vascular surgeons (two FTE) performed interventional procedures in 2002. One vascular surgeon (0.5 FTE) functioned within the interventional radiologists call structure, and performed both vascular and nonvascular interventions; another vascular surgeon (0.5 FTE) job-shared in another city; and one vascular surgeon (1 FTE) limited interventional procedures to vascular interventions. Both vascular surgeons and interventional radiologists used angiographic suites and the angiographic operating room at SMH, which opened in February 2002. Both specialties have primary patient care responsibility in the outpatient setting, but only vascular surgeons have hospital admitting privileges.

The CVD arrangement with the University of Rochester enabled the CVD to bill global fees for all services (site of service 11). In 2000 the university and CVD negotiated a capitation agreement whereby the CVD billed only for professional services for in-hospital patients. Outpatient billing was not affected by the revised agreement. All revenues for clinical services were deposited into a single account administered by a centralized university business office. Departmental and Dean taxes were paid on the basis of collections according to the University of Rochester Faculty Compensation Agreement. Faculty compensation was determined by faculty rank, years of service, equity in entity before the merger, and total productivity. Extra compensation is paid to individuals on the basis of receipts in excess of yearly expenses; thus the practice account is zeroed out at the end of each academic year.

An essential aspect of the merger has been integration of training for both residents and attending staff. Interested vascular surgical staff spent dedicated time in the early years of the merger working directly with an interventional radiologist to obtain hands-on training. The first-year vascular fellow spends 1 to 2 days per week in the interventional suites, functioning as a third interventional radiologist fellow, with rotating on-call responsibilities on nights and weekends, averaging 150 days per year in this capacity. In addition, the first-year fellow spends 1 to 2 days per week in one of the vascular laboratories to satisfy the criteria for the Registered Vascular Technologist examination, although taking the test is not a requirement of the program. The remainder of the work week is devoted to research activity. The interventional radiologist fellow spends 1 day per week in one of the outpatient care sites (SMH) under the direction of interventional radiologist faculty and the remaining time in the interventional suites working with both vascular surgeons and interventional radiologist faculty. Interventional radiologist fellows work in the operating room suite on an ad hoc basis. Although the faculty of vascular surgeons and interventional radiologists do not see patients together, the educational program maximizes exchanges between trainees in both specialties so that each understands the thought processes and techniques of the other.

Data collection and analysis. Financial information for the diagnostic laboratories, outpatient visits, and surgical procedures over the past 5 years was obtained from the University of Rochester central billing office database. Interventional procedures were tracked on a separate SMH Omega billing system. Income from interventional radiol-
ogists refers to catheter-based procedures rather than the specialty of the provider. Interventional procedures are recorded as patients treated per session rather than procedures performed. Relative value unit activity was not included in this analysis, because our local carriers do not recognize component coding and therefore the activity billed does not have a relationship to income received. The data were examined for trends over the 5 years with linear regression analysis, with the significance level for the t test set at \( P = .05 \).

**RESULTS**

**CVD clinical activity.** In 1998 total CVD income was \$5,789,311. The relative contributions to that total from vascular surgeons, vascular laboratories, and interventional radiologists were 34%, 42%, and 24%, respectively. In 2002 total CVD income was significantly higher, at \$6,551,768, despite a weighted reduction in unit reimbursement of 4.88% \( (P = .0079) \). The relative contributions in 2002 from vascular surgeons, vascular laboratories, and interventional radiologists were 36%, 33%, and 31%, respectively. Trends over the 5 years are illustrated in the Figure. The relative contribution from interventional procedures to total income increased significantly \( (P = .0031) \), at a rate of approximately 2.8% per year. The percentage of income from noninvasive laboratory tests decreased significantly \( (P = .0079) \), at a rate of approximately 2.9% per year. There was considerable variation in the contribution of surgery from year to year, but no significant income trend was identified \( (P = .7662) \).

**Surgical case volumes.** Surgical activity was assessed with number of aortic procedures, carotid endarterectomies, infrainguinal procedures, venous operations, and dialysis access, recognizing that many other activities, including office-based practice, amputation, and miscellaneous arterial reconstructions, contributed to the total experience (Table I). Surgical income includes all operative procedures and evaluation and management services. The number of aortic interventions has remained constant, as has the percentage of endovascular repairs relative to open repairs. The degree of complexity of open aneurysm repairs has increased. Proximal clamping above the renal arteries was necessary in 23% of patients undergoing open aneurysm repair in 1998, and 53% of patients in 2002. The number of infrainguinal reconstructions has decreased significantly, from 228 in 1998 to 72 in 2002 \( (P = .05) \). Our policy of preferential use of autogenous saphenous vein remains intact, but two of the six surgeons now advocate percutaneous recanalization of the superficial femoral artery in lieu of prosthetic bypass grafting. The number of carotid endarterectomies decreased by 19% over the 5 years, without any change in our indications for operation and significantly more diagnostic ultrasonographic examinations. This decline was not the result of increased numbers of patients who underwent carotid artery stenting or referrals to competing surgeons. In 2001 our group began offering dialysis access services at the request of the nephrology service, and the 114 operative cases in 2002 offset the loss in other operative categories.

**Noninvasive laboratory procedures.** In 1998 there were two outpatient laboratories and one inpatient laboratory. In 2002 there were three full-time outpatient vascular laboratories, two part-time laboratories, and one inpatient laboratory. The total number of studies increased from 14,705 in 1998 to 15,266 in 2002, with a corresponding shift in complexity from 44% imaging examinations (as opposed to physiologic examinations) to 58% imaging examinations in 2002. There was an absolute reduction in income from laboratory sources from \$2,579,291 in 1998 to \$2,147,262 in 2002, and a dramatic reduction in profits (Table II).
Table III. Interventions by specialty

<table>
<thead>
<tr>
<th>Provider</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
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<td>Interventional radiologist</td>
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<td>Vascular</td>
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<td>1546</td>
<td>2216</td>
<td>2462</td>
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<tr>
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<tr>
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<td>88</td>
<td>299</td>
<td>354</td>
<td>423</td>
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<tr>
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<td>0</td>
<td>37</td>
<td>58</td>
<td>124</td>
<td>135</td>
</tr>
<tr>
<td>Nonvascular</td>
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<td>20</td>
<td>32</td>
<td>69</td>
<td>75</td>
</tr>
</tbody>
</table>

In our practice, percentage for vascular procedures is 41%, for access-related procedures is 38%, and for nonvascular procedures is 21%. Vascular surgeons performed 9% of total procedures and 14% of percutaneous arterial interventions, exclusive of endovascular aneurysm repair.

**Interventional procedures.** Interventional radiologist case volume increased from 3286 in 1998 to 7131 in 2002. Income from interventional radiologists increased 68%, from $1,174,902 in 1998 to $1,979,726 in 2002. Patients treated by various providers and their specialty over the 5 years are presented in Table III. Interventional procedures are classified into three areas: vascular, access-related, and nonvascular. The percentages of these three areas in our practice are 41%, 38%, and 21%, respectively. Vascular surgeons now perform 9% of total procedures and 14% of percutaneous arterial interventions exclusive of endovascular aneurysm repair. The increase in total case volume is due to increased acceptance of percutaneous therapy by vascular surgeons, regardless of the service provider; increase in caseload from the transplant surgeons; increase in the population receiving dialysis; development of new procedures, such as uterine embolization; responsibility for venous access service of SMH; and assumption of interventional services at another hospital.

**Overhead expenses.** Faculty expenses remained constant, but the number of FTEs increased from eight in 1998 to nine in 2002. Nonphysician staff costs increased 33%, from $1,068,447 in 1998 to $1,425,088 in 2002 \((P = .05)\). The demand for more laboratory studies required an increase in the number of personnel, and increased salaries were necessary to keep pace with community standards. The increased demand for laboratory studies also required leasing of additional equipment, at a 45% higher monthly cost. Finally, malpractice expenses more than doubled \((P = .01)\).

**Effect of CVD on interventional training.** For the 6 months beginning July 1, 2002, and ending December 31, 2002, the senior vascular fellow performed 145 diagnostic arteriographic procedures, 52 angioplasty and stenting procedures, and 32 endovascular aneurysm repairs. The two radiology fellows and the first-year vascular fellows performed a total of 709 arteriographic procedures, 232 angioplasty and stent procedures, and 11 endovascular graft procedures during this same period. This volume is consistent with that of previous sets of trainees over the 5 years. Before 1998 no vascular fellows at our institution were trained in interventional techniques. A quantitative assessment of training for both interventional radiology and vascular surgical fellows that examines only case volume neglects the effect of twice-weekly combined conferences and a shared didactic curriculum among the vascular and radiology residents and attending staff. The perspective gained from this interchange is not quantifiable. These numbers and, more important, the continuous exposure to the concepts of interventional radiology over the 2-year period should be sufficient training to enable vascular surgical fellows to use these skills in their practice.

**DISCUSSION**

Creation of the CVD in 1998 was in acknowledgement that expertise in diagnosis, medical therapy, and minimally invasive intervention is important in a practice environment. The predictions made in 1998 about the direction of vascular practice were proved correct with movement toward less invasive therapies. In 2002 the three areas of vascular practice, namely, traditional surgery, noninvasive diagnosis, and percutaneous intervention, each accounted for one third of the income generated. The trends suggest that the contribution from interventional procedures will continue to increase, as will demand for noninvasive therapies. It is unlikely that the number of traditional surgical procedures will increase in the absence of new areas of practice, but it is certain that the complexity of open procedures will increase. This puts additional burden on training programs, because not only are new skills required, but old skills must become more sophisticated.

There was institutional support for the CVD in 1998 that included the chairs of the respective departments and the dean of the medical school. The past chairs have since retired, and the chief of interventional radiology (D.W.) is now the chair of radiology. Although one could make the argument that the CVD should evolve into a department, that is unlikely to happen, given the sustenance provided the parent departments.

The financial engine that allowed the CVD to function in 1998 was our ability to collect global fees for outpatient vascular laboratory testing and generate a large surplus. It is unlikely that we could provide the physician manpower, in particular, to cross-train residents and staff by double-scrubbing, on the basis of professional fees alone. It was a great advantage to own our equipment and hire our own staff in 1998. That is no longer the case, because the operating expenses of the laboratory operation are equal to...
the technical income received. Interventional procedures now provide the small surplus generated.

The CVD does not represent a model that can or should be created elsewhere. It does, however, represent the scope of a complete vascular practice and defines the skill sets required of the vascular surgeon who wishes to provide a full range of diagnostic and therapeutic procedures. We continue to believe that the essence of the center is in training, of both fellows and attending physicians. Each of our graduates works at institutions without centers, but actively participates in the full range of care delivery. Three of the past seven vascular fellows are now directors of endovascular surgery at prestigious institutions (University of California at San Francisco, The Cleveland Clinic, University of Michigan).

After reviewing the trends in our practice and evaluating information submitted by applicants to the 2002 American Board of Surgery Qualifying Examination, we are concerned that the current vascular training model approved by the Accreditation Council for Graduate Medical Education does not prepare residents for contemporary practice. At the least, our training programs should be required to fulfill the minimum criteria for competence as defined by our own national organizations. Guidelines of The Society for Vascular Surgery and The American Association for Vascular Surgery recommend that a surgeon perform 100 catheterization procedures and 50 interventions, as primary operator in 50% of each category, to qualify for interventional privileges. If those guidelines are applied to the data provided by the 2002 applicants to the American Board of Surgery Qualifying Examination in Vascular Surgery, 43 candidates exceed the threshold for qualification, 22 are close to qualifying, and 33 do not qualify, on the basis of criteria for interventions. Almost all candidates fall short on the number of diagnostic arteriography procedures performed.

After 5 years the CVD has accomplished its initial goals of economic and academic integration, and its broad practice base has enabled financial success under adverse reimbursement conditions. During that period the scope of practice has changed, and it is ever more apparent that inclusion of interventional procedures is an absolute and immediate necessity. It is our responsibility to ensure that trainees entering practice have the necessary tools to thrive.

REFERENCES
