ABSTRACT
A donor program for procuring dogs and cats to meet the needs of anatomical instruction was initiated six years ago at Tufts University School of Veterinary Medicine. The program was initiated in order to comply with state regulations that preclude the use of shelter animals and to satisfy ethical objections of students and faculty. The donor program has successfully met the animal needs for teaching gross anatomy and, in addition, provides opportunities to integrate clinical perspectives and ethics beginning from the first year of veterinary education.

Key words – Donor program / Anatomy / Ethics / Veterinary / Education / Euthanasia / Embalming

INTRODUCTION
Teaching veterinary gross anatomy involves sacrificing live animals and then embalming them. This is in contrast to human gross anatomy instruction, which makes use of donated cadavers for student dissections. At most veterinary anatomy departments in the United States, sources of donated cadavers for student dissections. At most veterinary anatomy departments in the United States, sources of dogs and cats are (1) unclaimed animals from animal shelters, (2) purpose-bred animals bought from a USDA-approved vendor; or (3) procured from biological supply companies selling embalmed animals (which may also be acquired from animal shelters). Greyhounds that are retired from racing or breeding by the animal owners are a fourth source of dog cadavers. For many years, Tufts veterinary students dissected donated greyhounds. The greyhound donation program gradually became unsustainable because of the negative public relations impact of the program and the reluctance of greyhound owners to donate culled animals for the anatomy laboratory. Since Massachusetts State regulations prohibit use of shelter animals for teaching and research, we were not able to use embalmed animals from biological supply companies for student dissections. Therefore, the only remaining option was to purchase purpose-bred dogs from USDA-approved vendors. Ethical concerns were raised by some students and anatomy faculty over euthanizing healthy animals for anatomical dissections. To remedy this problem, a client donation program was established three years ago. Anecdotal reports suggest that difficulties in obtaining teaching animals and ethical concerns expressed by veterinary students are major factors in modifying the anatomy curriculum and reducing animal dissections.

The various alternatives to using purpose-bred animals include incorporating plastinated specimens or computer programs and decreasing animal dissections. However, a recent survey conducted by Dr. Judy Provo (Kansas State University) indicates that a significant number of veterinary gross anatomists prefer animal dissections in order to impart a three-dimensional perspective of the body to students. It was important, therefore, to develop a program that could supply demands for animal dissections and at the same time comply with the ethical concerns expressed by students and faculty. Donated animals are also used by students at the Tufts University School of Veterinary Medicine (TUSVM) to practice medical procedures and clinical skills. We describe our client donation program here.

METHODS
A committee consisting of the chairs of the Clinical Sciences and Basic Sciences departments, the head of the division of laboratory animal medicine, the course director of Veterinary Gross Anatomy, and small animal faculty and technicians was set up to establish a body donation policy.

The steps involved in the donation program are as follows:

1. The decision for euthanasia is arrived at in the usual way, by consensus of the client and the veterinarian attending the case. The client has access to the humane euthanasia information brochure (Figure 1).

2. The attending veterinarian informs the client of available options for disposition of remains, as outlined on the euthanasia consent form (Figure 2). Various options available to the client are listed on the humane euthanasia information sheet (Figure 3). To ensure that the client is not induced to donate the pet for primarily financial reasons, the humane euthanasia information (Figure 3) is not divulged to the client until he or she has decided to donate the pet’s remains to the TUSVM teaching program.

3. The client signs the euthanasia consent form, marking an appropriate box (Figure 2). The form is also signed by the attending veterinarian. All client-donated animals received 100,000 units of heparin by IV prior to the injection of the euthanasia solution. Copies of the form are distributed for filing as follows: to medical records, division of lab animal medicine, accounting, and technician.

4. Subsequent to death, a technician makes a decision as to the disposition of the remains based on the condition of the animal and the need for cadavers in various laboratories at the veterinary school. Cadaver condition or size may not be suitable for any laboratories, but this has no bearing on whether the client is allowed to donate the remains.

5. If the cadaver is destined for the anatomy laboratory, the anatomy secretary is contacted immediately and a
copy of the signed donation form with case number is faxed to the anatomy office. The secretary contacts the gross anatomist immediately.

6. The gross anatomist embalms the cadaver within 24 hours.

Embodied animals are tagged with numbered ear tags (Nasco Company). The case file on each animal is identified with the ear tag number for future use. Of the 20 dogs used by first-year students during the fall 1998 semester, only one exhibited poor fixation of thoracic and abdominal viscer.

Figure 1: Euthanasia brochure

Embalmed animals are tagged with numbered ear tags (Nasco Company). The case file on each animal is identified with the ear tag number for future use. Of the 20 dogs used by first-year students during the fall 1998 semester, only one exhibited poor fixation of thoracic and abdominal viscer.

This animal died from ethylene glycol toxicity. All other animals were properly fixed by our methods. The low concentration of formalin used for embalming the animals resulted in proper tissue fixation and kept our gross anatomy laboratory in compliance with OSHA regulations. No appreciable differences in tissue fixation were noticed between animals fixed within 10 hours and those embalmed one to two days after euthanasia (see Appendix for details on embalming procedure). The students were given a questionnaire at the end of the semester requesting their comments on the donor program.

Figure 2: Client consent form for donation of pet remains

Figure 3: Humane euthanasia information sheet
RESULTS
Table 1 shows the clinical conditions most commonly encountered in the donor animals. Student response to the donor animal program was overwhelmingly positive (Tables 2–4). A significant proportion of first-year students preferred donor animals for dissection. Only four of the 80 students felt that animal source did not matter. Of those students who preferred the donor animal program for anatomy dissections, many felt that the donor animal program is very important (64.5%) or important (30.3%) because of their objections to sacrificing healthy animals for dissection (Table 3). A significant proportion of the class, preferring donor animals for dissections, felt that donor animals sometimes have a pathological or clinical condition that may help students appreciate the importance of understanding normal anatomy (Table 3). Written comments from some students are reproduced in Table 4. These comments are typical of TUSVM students’ responses over the past six years.

Table 1: Common clinical conditions for which the dogs were euthanized

<table>
<thead>
<tr>
<th>Clinical Condition</th>
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<tbody>
<tr>
<td>1. Intra-abdominal neoplasia</td>
</tr>
<tr>
<td>2. Pancreatic tumor</td>
</tr>
<tr>
<td>3. Hemoabdomen (trauma)</td>
</tr>
<tr>
<td>4. Right ventricular tumor</td>
</tr>
<tr>
<td>5. Grand Mal seizures</td>
</tr>
<tr>
<td>6. Mast cell tumors on limb</td>
</tr>
<tr>
<td>7. Thoraco-lumbar intervertebral disc disease</td>
</tr>
<tr>
<td>8. Vertebral fracture</td>
</tr>
<tr>
<td>9. Gastric dilatation and volvulus</td>
</tr>
<tr>
<td>10. Osteosarcoma of limb bones</td>
</tr>
<tr>
<td>11. Muscular dystrophy</td>
</tr>
<tr>
<td>12. Gastrointestinal hemorrhage</td>
</tr>
<tr>
<td>13. Thyroid tumor</td>
</tr>
<tr>
<td>14. Lymphosarcoma</td>
</tr>
</tbody>
</table>

Table 2: Responses from first-year veterinary students to the donor program

<table>
<thead>
<tr>
<th>Given a choice, would you rather</th>
<th>Number of respondents</th>
</tr>
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<tbody>
<tr>
<td>a. Dissect and learn anatomy from a donor animal?</td>
<td>76 (95%)</td>
</tr>
<tr>
<td>b. Dissect a purpose-bred animal that is sacrificed?</td>
<td>0</td>
</tr>
<tr>
<td>c. Dissect either donor animal or purpose-bred animal?</td>
<td>4 (5%)</td>
</tr>
</tbody>
</table>

Table 3: Responses from students who preferred to dissect donor animals

<table>
<thead>
<tr>
<th></th>
<th>Very Important</th>
<th>Important</th>
<th>Not Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Donor animal may have important pathology/clinical condition that may help me understand the importance of knowing normal anatomy</td>
<td>34 (44.7%)</td>
<td>34 (44.7%)</td>
<td>8 (10.5%)</td>
</tr>
<tr>
<td>2. Donor animal program is important because of ethical objections I have to dissecting an animal that was healthy but sacrificed</td>
<td>8 (10.5%)</td>
<td>23 (30.3%)</td>
<td>4 (5.3%)</td>
</tr>
</tbody>
</table>

Table 4: Examples of written comments from students on the TUSVM donor program

"We are not going to see perfect purpose-bred dogs in practice. The donor dogs were of all ages and breeds and there were plenty of dogs to compare for normal anatomy."

"I was very glad to have the option of dissecting a donor dog, and I am glad Tufts has such a program for anatomy."

"The (donor) program seemed to be implemented rather easily here despite the split campuses. Considering most normal Vet schools have their anatomy labs on the premises of their hospitals, it would be a very easy, inexpensive and ethically sound program for other schools to adopt."

"Donor dogs are a wonderful idea—I can’t imagine why anyone would want to breed dogs just to kill and dissect them!"

"My group did have a donor dog and I felt much better about the circumstances leading up to our dissection of the dog. I think this program is a great idea and is true to many of the commitments of Veterinary Medicine to better the lives of animals (not take them for our own purposes when there is an alternative)."

"When I started Vet school, I was relieved that Tufts started a donor animal program. Donor dogs come in different shapes, sizes and breeds allowing the students to have a more realistic experience of what we will encounter in the clinics. There is no reason to kill healthy animals when clients will donate their loved pets for our benefit."

"As aspiring veterinarians, I think it is critically important veterinary schools lead the way in promoting progressive thinking about ethical issues involved in the use of animals, particularly lab-bred or otherwise healthy ones, for educational purposes. Awareness of issues surrounding the controversy should absolutely be a part of a veterinary education. I am grateful Tufts recognizes the importance of this awareness and for its support of this notion via the donor animal program."

"At the beginning of the year, I know there were some concerns about how well the donor dogs were preserved. My group had a donor dog and I think it was very well preserved and one of the least stinky dogs in the room by the end of the semester."

"Our dog was a donor dog and was a very good specimen. But even if he had not been, I would much prefer to use a donor dog due to ethical objections to breeding and euthanizing healthy dogs for dissection purposes."

"Our dog was a donor dog and was just as good a specimen (anatomically) as the non-donor dogs (purchased from Nasco). I was more comfortable dissecting a dog that had not been purpose-bred, and the fact a family donated their pet commanded a greater respect during lab. I sincerely hope the school will use donor dogs exclusively in the future."
DISCUSSION
We describe here the donor animal program at TUSVM, which is now entering its fifth successful year. We now procure all animals needed for teaching through the client donation program. Currently, cadaver needs of the first-year gross anatomy course, as well as the needs of our clinical skills and medical procedure laboratories, are met by this program. According to last year’s records, TUSVM had a caseload of 21,484 (dogs and cats). Approximately 240 animals per month (with a canine to feline ratio of about 2:1) are euthanized at the request of the clients, and approximately 20 animals per month are donated to teaching programs. Based on our experience, approximately 8% of the clients who request euthanasia for their pets donate pet remains to TUSVM teaching programs. Based on these figures, we believe the donor program is sustainable at any teaching hospital.

Students who dissected donor animals were uniformly positive about the program. During the formative stages of the donor program for anatomy teaching, half the class dissected donor animals embalmed by us, while the other half dissected embalmed dogs from commercial sources, because of inadequate numbers of donated dogs. As indicated in Table 4, students who dissected donated animals were appreciative of the TUSVM donor program.

Other veterinary schools have expressed interest in the donor program. Some reluctance on the part of anatomy faculty to institute a similar program is based on the following assumptions:

a. The program is labor intensive because client donations occur sporadically and sometimes at odd hours of the day—In fact, the client donation program is no more labor intensive than procuring animals by other more traditional methods, such as purchasing purpose-bred animals and embalming them. We have successfully embalmed donated animals up to four days after euthanasia. TUSVM’s willed program is set up to direct all donations for anatomy use during the months of June and July. Since there is no urgency to embalm the animal immediately after euthanasia, small groups of animals donated over three- to four-day periods are embalmed together. It is easy to recruit a few students and train them in embalming techniques, and this saves time and labor for the teaching faculty.

b. Client donated animals are often neutered and are not ideal for teaching reproductive component of anatomy—Approximately 90% of the animals donated to TUSVM are neutered. Instructors demonstrate the anatomy of the male and female reproductive system to the entire class using intact male and female animals among those being dissected by students. At the end of the course, these intact (student dissected) animals are saved for next year’s class. These specimens may be plastinated for long-term use.

The donor animal program also gives us the option of integrating important learning themes into the professional veterinary education. Students are given the case history of the dog (or cat) they are dissecting (see Table 3). The case histories can be integrated with their Problem Based Learning (PBL) sessions. The students could then be asked to write individual term papers emphasizing the anatomical or physiological basis of the dog’s illness. If the dog suffered from intervertebral disc disease, for example, the students dissecting it could be asked to write individual term papers to integrate the following:

- Developmental anatomy of intervertebral discs and vertebrae
- Normal anatomy of the spinal cord, including upper motor versus lower motor neuron control of skeletal muscles
- Anatomy of the thoracolumbar vertebrae and associated ligaments and anatomical reason why disc herniations are rare in the rostral thoracic region

Alternatively, noon seminars could be arranged by clinicians who can give a brief overview on the donor animal’s clinical condition. We believe that the donor animal program is a workable one that can be implemented by veterinary schools. The program is cost-effective and presents a number of advantages over acquiring animals via the traditional routes. These advantages include providing students with a valuable education that emphasizes clinical aspects of anatomy and the ability to integrate the ethical values of veterinary medicine beginning in the first year of veterinary education.

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APPENDIX: PROCEDURE FOR EMBALMING DONATED ANIMALS
After the cadaver is stretched to full extension, an incision is made 1 cm dorsal to the course of the external jugular vein and the common carotid artery is exteriorized. An appropriate size metal cannula is inserted (slip hub cat #s 708701, 708719, or 708727; Dodge Chemical Company, 165 Cambridge Park Drive, Box 193, Cambridge, MA 02140, 1-800-462-5121). The cannula is fastened within the artery and infused with a solution of Permaflow (Dodge Chemical Company) diluted 1:2 with lukewarm water and injected into the cannula at a flow rate of 300 ml/min with a peristaltic pump (Fisher Scientific). The Permaflow solution is allowed to remain in the animal for approximately 10 min-
utes (or longer if time permits). The embalming solution is then pumped into the animal at approximately 300 ml/minute. Stock embalming solution is procured from Hydrol Chemical Company (Yeadon, PA, 1-800-220-7375). The concentrated embalming solution is made up of the following chemicals:

- Formaldehyde 37%  3%
- Phenol 13%  
- Ethanol 32%  
- Propylene Glycol 42%  
- Maquat (Thymol) 1%

The stock embalming solution is diluted 1 part with 3 parts of water and pumped into the animal (yielding an effective formalin level of 3.25%). As the embalming solution starts flowing into the animal, the external jugular vein is punctured to force out blood along with the previously injected Permaflow solution. The animal is exsanguinated until the flow from the jugular vein indicates fixed blood (light to dark dirty brown). The external jugular vein is tied off and the embalming solution infusion is continued until the muscles feel firm. In our experience, a large dog (30 kg and above) requires 7–10 gallons (30–40 liters) of embalming solution. If the abdomen is found to be bloated, the stomach is trocarized with a 14 gauge needle to evacuate gas. This reduces intra-abdominal pressure and permits passage of embalming solution into the pelvic limbs. Between 100 and 200 ml of the embalming solution is injected into each of the abdominal and thoracic cavities. If any of the muscles feel soft, they are spot injected with an appropriate amount of embalming solution.

**Cats**—After isolating the common carotid artery, a 23 gauge catheter (Baxter, Wingless quick-cath, Baxter Healthcare Corporation, Deerfield, IL 60015) is introduced into the artery and the needle is withdrawn and discarded. The cannula within the artery is secured with a thread. The catheter is connected to a small-bore tube attached to the peristaltic pump, and embalming fluid is pumped at a flow rate of 50 ml/min. A 4 kg cat usually takes 1 liter of embalming solution to fix properly. Spot injection of cavities and muscles is done if necessary as described above.

Although it is possible to double inject the donor animals with blue (for veins) or red (for arteries) latex, we chose not to, as vascular injection is a labor-intensive process. Students who dissected the double-injected commercial source dogs felt that this made it easy for them to identify the veins and arteries. However, the students who were dissecting donor animals on adjacent tables felt that it was no more difficult to recognize non-latexed veins and arteries, and, in fact, the students realized that the vessels seemed more natural. Some felt that vascular injections are not realistic. We have intentionally opted not to double inject the donor animals for the following reasons:

1. Students should be able to recognize major veins and arteries by their individual relationships to surrounding structures and their texture, rather than by color.

2. Present anatomy curriculum demands teaching the most important basic anatomical concepts and highlighting the clinically and functionally relevant regional anatomy to the students. Having latex-injected vessels distracts the students into following every minor branch of the arteries and veins, ignoring the more important neuromuscular anatomy.