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# The Hidden Curriculum of Medicine Portrayed in Popular Television Medical Shows

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**Background:** In addition to the purposeful teaching of knowledge and skills to medical students, the ‘hidden curriculum’ (HC) refers to the inadvertent – and often unrecognized – transmission of implicit ideas, attitudes, and behaviors. One way to raise student and teacher understanding of the HC is to provide them concrete examples of how and when it occurs during medical school. The goal of this study was to investigate how the HC is depicted in popular medical television (TV) shows.

**Methods:** A systematic content analysis of successive episodes of eight prime-time TV shows was completed using a standardized classification scheme. A complete season of each TV program was analyzed to identify and classify depictions of the HC as it pertains to medical students. Our classification scheme used four dominant themes: what students discovered about medicine, what students learned about becoming a physician, what students experienced, and what students realized about themselves. After coding, all incidents were classified as ‘negative’ if a rule or normal procedure was broken or ‘positive’ if they followed established professional values or provided patient-centered care.

**Results:** A total of 137 episodes were viewed with 1,160 depictions of the HC portrayed. The TV shows with the most depictions were *Code Black* and *Scrubs*. Within the four dominant themes, 45 subthemes were identified. Most depictions (66.7%) were described as positive and included conflict resolution, sensitivity, respect, empathy, accountability, and role modeling. However, 33.3% (386/1,160) were negative and included unrealistic patient expectations, working in a chaotic environment, haphazard learning interactions, emotional detachment, loss of idealism, complex social situations, and dealing with uncertainty.

**Conclusions:** Television dramas contain many positive and negative examples of the HC during undergraduate medical training. Short snippets from these incidents could be used in an educational setting to teach related issues including professionalism, ethics, role modeling, communication skills, and coping techniques.

**Keywords:** Hidden Curriculum; medical students; television; medicine; drama; content analysis

## INTRODUCTION

Lectures, class syllabi, grand rounds, and texts do not cover everything that is taught in medical school. In fact, during medical school, the majority of what is learned arises within medicine’s ‘hidden curriculum’ (HC).<sup>1</sup> The ‘hidden curriculum’ in medical education refers to the teaching of assumptions, attitudes, and behaviors of medicine, and it begins with first-year medical students and continues throughout the entirety of their residency training.<sup>2,3</sup> The core idea is that medical education is a cultural process through which students learn what is important and how to distinguish between ‘good’ and ‘poor’ clinical practices. Thus, students learn to subjectively characterize patients in ways that govern

their interactions with them and impact medical care decisions.<sup>4</sup> In particular, the HC strongly influences the professional identity development of trainees.<sup>3</sup>

The practice of medical education requires an understanding of how learners experience and engage with the HC.<sup>3</sup> The importance of addressing the HC has been stressed by educators, medical students, and the lay press.<sup>1-6</sup> The HC can both support or contradict the lessons of the formal curriculum, potentially revealing inconsistencies between an institution’s stated mission, principles, and values versus what students actually experience, observe, and learn while they are in training.<sup>7</sup> The negative consequences might include the loss of idealism, patient dehumanization, moral distress,

suppression of normal emotional responses, development of a 'ritualized' professional identity, and the learning of less formal aspects of 'good doctoring'<sup>8</sup>

Qualitative and ethnographic research have proven to be helpful methods for characterizing and understanding the HC. Empiric methods include recordings of medical students and residents casually discussing work, student reports of ethical and moral dilemmas, senior medical student focus groups, semi-structured interviews, and various survey instruments designed to measure hidden curricula with respect to patient-centered care.<sup>2,3</sup> Even television (TV) medical dramas can be used to illustrate aspects of the HC.

Stanek and colleagues conducted a summative content analysis to identify portrayals of the HC in three TV medical shows (*ER*, *Grey's Anatomy*, and *Scrubs*).<sup>9</sup> They found that depictions of the HC are common in medical dramas, especially in terms of depictions of authority, unprofessionalism, and dehumanization of patients.<sup>9</sup> They proposed creating a database of video vignettes based on situations from these shows to use in teaching undergraduate medical students about the HC.<sup>9</sup>

The goal of this study was to investigate how the HC is depicted in popular medical TV shows, focusing on medical students. These engaging shows have the ability to raise student knowledge of the HC and lead to the creation of instructional vignettes in which students can observe both positive and negative elements of the HC.

## METHODS

We conducted a content analysis of eight popular medical dramas focusing on medical students as the central character. Several TV series were excluded due to minimal viewership, dramatic focus on the private lives of the characters rather than medicine, and frequent inclusion of extremely outlandish situations. One complete season of each TV program was examined (Table 1).

All our coders were second- and third-year medical students. Several steps were taken to ensure the validity of coding. Data collection was guided using standardized abstraction forms. Before beginning the data collection, all investigators met and reviewed the coding scheme and data abstraction tools. To ensure consistency of abstraction and coding as well as resolve questions, one investigator met frequently with abstractors. To determine rater reliability, a blinded critical review of a random sample of 10% of the TV episodes was done. The inter-rater agreement for this sample of datasheets was then determined using kappa statistics. To ensure

quality control of collected data, the principal investigator periodically reviewed the collected data to reduce any interobserver variations or errors in data transcription.

Main outcome criteria were recorded as frequency tables comparing the types and frequency of HC incidents and elements portrayed in TV programs. An incident or element was defined as a conversation between, or actions taken by, characters that involved an HC issue. After coding, all incidents were classified as 'negative' if a rule or normal procedure was broken or 'positive' if they followed established professional values or provided patient-centered care. Our classification scheme for HC incidents was adapted from multiple sources<sup>9-13</sup> and then refined by the general consensus of four faculty members in the Department of Emergency Medicine. The classification scheme used four dominant themes: what students discovered about medicine, what students learned about becoming a physician, what students experienced, and what students realized about themselves. We followed analysis and documentation procedures that we have successfully used in the past.<sup>14-16</sup>

Eight dramas consisting of 137 episodes in total were watched, and HC incidents within were tabulated (Table 1). This sample size enabled us to detect a 5% difference in categorical variables with a power of 0.8 and an alpha of 0.05. Data were entered into Microsoft Excel (version 7.0; Microsoft, Redmond, WA) and imported into SPSS statistical software (version 14.0, SPSS Inc., Chicago, IL) for analysis. Ninety-five percent confidence intervals were calculated using SPSS statistical software.

## RESULTS

During the study period, a total of 137 episodes were viewed with 1,160 depictions of the HC portrayed, an

**Table 1.** Total incidents of hidden curriculum portrayed in medical TV shows.

TV show (# episodes)	Incidents (N = 1,160) (%)
Code Black (18)	411 (35.4)
Scrubs (13)	238 (20.5)
Chicago Med (23)	149 (12.8)
The Night Shift (10)	125 (10.8)
Hawthorne (10)	123 (10.6)
ER (23)	11 (9.5)
Grey's Anatomy (22)	56 (4.8)
Trauma (18)	47 (4.1)

average of 8.47 incidents per episode. The TV shows with the most depictions were *Code Black* and *Scrubs* (Table 1). Within the four dominant themes, 45 sub-themes were subsequently identified by our coders (Table 2). Most depictions (66.7%) were described as positive and included conflict resolution, sensitivity, respect, empathy, accountability, and role modeling. However, 33.3% (386/1,160) were negative and included unrealistic patient expectations, working in a chaotic environment, haphazard learning interactions, emotional detachment, loss of idealism, complex social situations, and dealing with uncertainty. Moreover, there were recurring issues of professionalism and ethical situations that we have addressed in previous studies.<sup>11,13</sup> One member of the research team coded 10% of the episodes and a k-statistic was performed to compare and ensure consistency of coding, which showed a moderate degree of agreement ( $k = 0.46$ ).

## DISCUSSION

We began our investigation by coding data into four broad domains used by Head and colleagues in their evaluation of students completing a palliative care clerkship.<sup>17</sup> These four domains reflect Kolb's theory of experiential learning, which basically involves four stages.<sup>18</sup> The first stage is concrete learning, where the learner comes across a novel experience. This is followed by reflective observation, where the student personally reflects on the experience using their own framework. After this comes the process of making sense of what has transpired, which includes interpreting their actions or emotions to the event; this is known as abstract conceptualization. Finally, the active experimentation stage is where the new knowledge is applied to real-life situations by the student. Kolb noted that all four stages must be present for students to learn from their experiences.<sup>18</sup>

That said, the real-world experiences that medical students have during clerkships may not always align with the themes covered in most typical medical school curricula. Recurring subthemes included working in a chaotic environment, uncertainty in diagnosis and management of disease, complex social situations, time constraints, challenging patients, unreasonable expectations, and coping with responsibility (Table 2). First-year students who are unfamiliar with this undercurrent, such as those without a medical background, may have more emotional difficulty during this learning process than those with more medical knowledge.<sup>2,3</sup> Moreover, although medical students were the focus of our study, similar

observations are likely made by students in nursing and allied health professions.

In the past, medical schools have tended to value science over humanism.<sup>19</sup> Although efforts are underway to reverse this, the formal curriculum still tends to value interventional, high-technology clinical care. Subsequently, humanism, professionalism, and effective communication are competencies that are often taught informally through role modeling and coaching behaviors. During medical school, these everyday learning experiences frequently result in the transmission of attitudes, behaviors, beliefs, and values that can either strengthen or impair these abilities.<sup>20</sup> Offhand derision of patients' poverty, weight, or ethnicity can contradict with principles of cultural sensitivity and competence.<sup>21</sup> It is also well recognized that learners observe and often embody a role model's inappropriate actions, undesirable habits, and questionable attitudes in addition to their professional conduct. Every word spoken or every silence, every action performed or omitted, every personal anecdote, and every complaint imparts values we might never have intended to convey.<sup>21</sup> Notably, research has documented a deterioration in moral reasoning throughout medical training and has identified the HC as one of the reasons.<sup>19</sup>

Medical students' observations of actions, particularly those of their role models, are thought to have a greater impact on learning than curricular instruction.<sup>22</sup> Not all role models are official preceptors (i.e., attending physicians) and could also be residents or upperclassmen in medical school. Research shows that the majority of medical graduates recall role models who influenced their professional attitudes and beliefs.<sup>22</sup> Attending physicians may be so focused on the patient flow that they are unaware of the subliminal messages they are sending. For example, during preclinical years at institutions that place a strong emphasis on collaboration and teamwork, students who encounter instances of harassment – or at the very least emotional indifference – in the clinical setting can be quite shocked and unsettled.<sup>23</sup>

It was encouraging to see that most depictions of the HC by our student coders were described as positive. While often sensationalized, TV dramas included numerous examples of empathy, sensitivity, conflict resolution, effective communication, and respect for the patient and family. Positive role models who treated their patients with care and compassion were frequently central characters.

In a position paper, the American College of Physicians (ACP) presented recommendations for

**Table 2.** Characteristics of four domains (with 45 associated subthemes) identified from qualitative analysis ( $N = 1,160$ ).

I. What students learned about medicine in general ( $N = 342$ )	%
Uncertainty in diagnosis and management of disease	4.4
Team-based approach to care	4.3
Sensitivity (patient's pain, emotional state)	4.1
Role of the student on the health care team	3.2
Dealing with complex social situations	3.1
Critical decision-making	2.9
Treating patients with alcohol or drug-seeking behavior	2.1
Dealing with violent or threatening patients	1.4
Unreasonable patient or family expectations	1.3
Challenging ethical situations	0.9
Conflict resolution	0.7
Appropriate use of humor/language	0.4
Haphazard learning interactions	0.3
Confidentiality	0.2
Medico-legal issues	0.2
<b>Total</b>	<b>29.5</b>
II. What students learned about becoming a physician ( $N = 345$ )	
Developing communication skills	5.9
Appropriate use of symptomatic care	4.3
Respect for the patient and family	3.6
Caring and compassion	3.0
Lifestyle of physician (balance and sacrifice)	2.1
Importance of empathy	2.0
Costs of medical care	1.9
Physician as patient advocate	1.7
Avoiding cynicism or becoming jaded	1.6
Hierarchical nature of medicine	1.4
Accountability	1.2
Recognizing the limits of medicine	1.0
<b>Total</b>	<b>29.7</b>
III. What students learned about themselves ( $N = 182$ )	
Confidence in treating patients	3.2
Recognize self-limitations	2.7
Need for a nonjudgmental approach	2.3
Coping mechanisms	2.1
Fear of making errors	2.0
Importance of balancing lifestyle (friends, family, relationships)	1.7
Dealing with death and dying	0.9
Emotional suppression	0.8
<b>Total</b>	<b>15.7</b>
IV. What students experienced ( $N = 291$ )	
Emotional neutralization/suppression	5.1
Role modeling (positive or negative)	5.0
Intimate encounters with patients and families	4.7
Medicine as ideal vs. medicine as reality	3.4
Learning how to teach others	1.9
Respect for colleagues	1.7
Fear of making errors	1.0
Skill in giving bad news	0.9
Specific experience described will make them a better doctor	0.8
Dehumanization	0.6
<b>Total</b>	<b>25.1</b>

optimizing clinical learning environments by fostering a positive HC in medicine.<sup>24</sup> To this end, faculty and clinicians should model empathy, support clinician wellness, and foster reflection and discussion of positive and bad behaviors in the learning environment. Every individual should be able to address issues about social justice, patient safety, and ethical problems in the therapeutic setting, which should inspire honesty, respect, and inquiry. Specific strategies for modifying the HC include coaching on how to deal with stress, improving communication skills, fostering student mentoring programs, highlighting patient advocacy programs, and providing opportunities for group discussion of concerns about professionalism, ethics, and quality of care.<sup>24</sup>

### LIMITATIONS

The most important limitation in this investigation was the subjective nature of the judgment and categorization of events. Although we took numerous steps to ensure the accuracy of coding, the interrater reliability was only moderate. Furthermore, our abstractors all are affiliated with a single midwestern medical school, which might limit generalizability. However, our findings resonate with other qualitative studies using reviews of TV dramas to explore the clinical learning environment that students confront in the emergency department and possibly in other clerkships or rotations.<sup>15,16</sup> Finally, breaking down the themes or scenarios that medical students face into a few subthemes is likely an oversimplification of the complexities and realities that these students face in the hospital and clinic.<sup>13,16</sup>

### CONCLUSIONS

Television dramas contain many positive and negative examples of the HC during medical training. A selection of brief clips from these episodes could be used in an educational setting to teach related issues including professionalism, ethics, role modeling, communication skills, and coping techniques. Understanding how students experience and engage in this curriculum is essential because what is not taught in medical school can sometimes be as formative or influential as what is taught. Medical educators need to help students think critically while analyzing aspects of the HC, principally when its messages contradict basic morals and canons of emergency medicine and medicine in general.

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# Ethical Issues Confronting Medical Students during a Clerkship in Emergency Medicine

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**Background:** Little is known about the ethical issues confronting medical students during their first exposure to emergency medicine (EM). The aim of this study was to review student narratives to determine the type and frequency of ethical issues that beginning students confront in the emergency department (ED).

**Methods:** This was a prospective, qualitative observational study of consecutive first- and second-year medical students electing to do a pre-clinical clerkship in EM at five university-affiliated hospitals. Students were asked to write a short description of three cases that had the greatest impact on them during the month-long clerkship. Each essay was independently analyzed by five members of the research team. Descriptive and kappa statistics were used to summarize the data.

**Results:** During the 4-year study period, 292 consecutive student essays were evaluated from 103 medical students. A total of 194 specific incidents were coded across 15 categories of ethical standards. Overall, 71.1% (138/194) were depictions of exemplary instances of ethical issues, 13.9% (27/194) were considered normal interactions, and 14.9% (29/194) were categorized as unethical behavior. While generally impressed by the admirable behavior of faculty and staff, students were quick to describe instances of improper treatment of patients, such as poor communication, discrimination, improper pain management, or a perceived lack of empathy.

**Conclusions:** Narrative essays describe a wide variety of interesting ethical situations that beginning medical students confront during their clerkships. Many of these ethical interactions seem to be connected to the student's role as an observer of the health care team and how that role can lead to ethical tension. As educators, we need to shine a light on the subtle ethical issues that clerkship students struggle with daily and give them practical tools to deal with moral decisions required of them in medical practice.

**Keywords:** Medical students; Narratives; Ethics; Emergency department

## INTRODUCTION

**M**edical ethics education has become an important component of the undergraduate core curriculum in most medical schools. While there is a general agreement on the importance of medical ethics to the training of future doctors, there is still significant debate in the curricular content, organization, and delivery across different institutions.<sup>1</sup> Moreover, there are few studies in the literature about what key ethical dilemmas are confronted by medical students as they enter the clinical wards and the impact these dilemmas may have on their resulting clinical practice.<sup>2</sup> Medical educators have a responsibility to assist students as they navigate ethical dilemmas encountered during clerkships and other patient encounters. Portraying and elaborating on real experiences or conflicts allow for students to relate to and learn from other students and practitioners.

We used narrative essays as a valuable source of information about ethical problems that students encounter during their emergency medicine (EM) clerkships. These essays typically describe a personal experience or a lesson learned while in the emergency department (ED). They are assigned to encourage authentic reflection and to promote the professional growth of our students.<sup>3-6</sup> The objective of this study was to review these essays to determine the type and frequency of ethical issues that beginning students confront in the ED.

## METHODS

We conducted a prospective, qualitative observational study of all first- and second-year medical students electing to do a pre-clinical clerkship in EM at university-affiliated hospitals between 2014 and 2017. The settings varied, as participating students rotated at two

urban hospitals, several rural community medical centers, and a children's hospital. Clerkship students signed up for three 4-hour shifts during which they shadowed an attending or resident physician in the ED. During the 4-year study period, all medical students were asked to write a narrative description of three cases that had the greatest impact on them during the month-long clerkship.<sup>7</sup> This assignment was part of their clerkship requirement and it occurred at the end of the rotation. They were given no other guidance or suggestions and were blinded to our study objectives. Papers were to be approximately two pages in length and were submitted online to the clerkship director. The assignment was formative by nature, and students received credit for completion, regardless of the content of their submission. All submissions during the study period were included in our analysis. Each narrative essay was deidentified, assigned numbers, copied, and distributed to the five members of the research team. Essays were independently analyzed by five EM investigators with different clinical and academic backgrounds. These abstractors included two EM clerkship directors, a clinical research associate with a background in educational research, a senior EM resident, and a fourth-year medical student.

The main outcome was the type and frequency of ethical issues described by medical students. Our coding system for ethical problems or violations was adapted from a classification scheme created by the Bioethics Research Library at Georgetown University.<sup>8</sup> All ethical incidents described were then categorized as negative or positive, depending on how they were depicted by the student. Negative incidents were those in which someone violated an ethical standard or norm, while positive incidents exemplified these standards.<sup>7</sup>

In order to prevent measurement bias, we took several measures. Initially, all of the investigators coded and discussed five hypothetical narrative essays to measure the consistency of coding and validate the coding system. One investigator met frequently with abstractors to address questions and determine the uniformity of data abstraction. Dialogue and peer debriefing safeguarded the reliability of the overall findings. Any disagreements in coding were evaluated by all investigators and discussed to reach an agreement. A blinded critical review of a random sample of 20% of the essays was done to determine the reliability of the data abstraction. The inter-rater agreement for this sample of charts was determined using kappa statistics. Finally, standardized

data collection forms were used to manage data abstraction and coding.

According to previously published data from our department of EM, we expected that the prevalence of ethical issues in our student narratives would be approximately 50%.<sup>7</sup> Using a 95% confidence error and a error rate of 5%, we estimated that a sample size of 385 essays would be needed to have 80% power. However, because there were no instances of missing data or withdrawals, we stopped data collection after 4 years, which provided us with more than enough patients to assess our study outcomes. Descriptive statistics were calculated to summarize the data. The study was approved by the local institutional review board.

## RESULTS

During the study period, 292 consecutive student essays were evaluated from 103 medical students. The mean student age was  $26 \pm 3$  years; 55% were male. In general, students provided well-written and thoughtful narratives. A total of 194 specific incidents were coded across 15 categories of ethical standards (Table 1). The most common category was the education of health care professionals (19.6%). Students emphasized the chaotic environment of the ED influenced by complex and increasingly sick patients, multiple interruptions, busy workloads, and fortunate (or unfortunate) accidents. Such challenges are further confounded by issues that are common for all EM learners – making mistakes, encountering bias, learning shortcuts, and choosing physician role models.

Additional recurring themes included access and equity in healthcare (14.4%), limitations of medical knowledge (9.8%), communication skills (9.8%), consent (9.3%), and quality of life (9.3%). Students appeared to be thoughtfully describing their experiences and interactions to provide insight into their own values, behavior, and perceptions of EM. While generally impressed by the admirable behavior of faculty and staff, students were quick to describe instances of improper treatment of patients, be it poor communication, discrimination, derogatory references, improper pain management, or a perceived lack of empathy (Table 2). The majority of all ethical incidents involved clinician interaction with patients or families (58.7%), followed by interprofessional incidents (41.2%). One member of the research team analyzed 60 student essays and a *k*-statistic was performed to compare coding and to ensure consistency of data, which showed a moderate degree of agreement ( $k = 0.78$ ).

**Table 1.** Categorization of bioethical incidents (N = 194).

Education of healthcare professionals	38 (19.6%)
Challenging patients	16 (8.2%)
Teaching environment	8 (4.1%)
Being a 'team player'	6 (3.1%)
Competing priorities	4 (2.1%)
Hierarchy of authority	4 (2.1%)
Access to and equity in healthcare	28 (14.4%)
Cost of care	14 (7.2%)
Right to health care	6 (3.1%)
Resource allocation	5 (2.6%)
Withdrawal of treatment	3 (1.5%)
Medical knowledge	19 (9.8%)
Limitations of knowledge	9 (4.6%)
Psychosocial issues	5 (2.6%)
Questionable departures from standard practice	3 (1.5%)
Medical error	2 (1.0%)
Communication skills	19 (9.8%)
Difficult communications	8 (4.1%)
Conflict resolution	6 (3.1%)
Language barriers	3 (1.5%)
Truth disclosure	2 (1.0%)
Informed consent	18 (9.3%)
Right to refuse treatment	13 (6.7%)
Parental consent/minors	3 (1.5%)
Surrogate decision-making	2 (1.0%)
Quality or value of life	18 (9.3%)
Compassion	14 (7.2%)
Patient dehumanization	3 (1.5%)
Nonmaleficence (do no harm)	1 (0.5%)
Death and dying	17 (8.8%)
Care of the dying patient	8 (4.1%)
Death telling, attitudes toward death	4 (2.1%)
Suicide	3 (1.5%)
Living wills/advance directives	2 (1.0%)
Respect	15 (7.7%)
Socioeconomic disparity	6 (3.1%)
Substance abuse history	6 (3.1%)
Religious, gender, cultural conflicts	3 (1.5%)
Suspicion of abuse (child, domestic, elderly)	10 (5.2%)
Unrealistic patient expectations	9 (4.6%)
Confidentiality	2 (1.0%)
Reproduction (contraception, abortion)	1 (0.5%)
Artificial and transplanted organs	0
Human experimentation	0
Genetics	0

It was apparent that the clerkship provided a number of both positive and negative influences on students. Overall, 71.1% (138/194) of the ethical incidents described by students were positive and included

conflict resolution, respect, sensitivity, accountability, empathy, and role-modeling. These reflections likely shaped student perceptions of the medical profession as well as their views of EM as a specialty. A total of 13.9% (27/194) were considered normal ethical interactions, while 14.9% (29/194) were categorized as unethical behavior. These unethical interactions included truth disclosure, poor communication, emotional detachment, loss of idealism, dehumanization, lack of confidentiality, appropriate informed consent, and questionable departures from standard practice (Table 2).

## DISCUSSION

The majority of EM clerkships in the United States occur in the fourth and final year of training.<sup>9</sup> Our institution also offers a 1-month EM clerkship to beginning students in their first or second year who would like early exposure to clinical medicine. Students mostly shadow residents and attending physicians while rotating through five different EDs, including an inner-city hospital, several rural community medical centers, and one pediatric hospital. This was the first exposure that students had in the complex and often chaotic ED setting. Our study provides a unique view of the ethical and professional struggles these beginning medical students confront during their first clerkship. Medical student essays described a wide variety of interesting ethical situations. Drawn from daily experience, these learning situations occurred at the patient's bedside, during breaks, or in the elevator or hallway. As one student described: *'I noticed that a lot of the doctors and nurses vent to each other in the backroom of the ER'*. First-year students who are not familiar with the ED environment, such as students without a medical background, may experience more emotional conflict in this learning process than more mature students.

Many of these ethical interactions seem to be connected to the student's role of the observer on the health care team and how that role can lead to ethical tension.<sup>10</sup> Examples include witnessing unethical acts committed by other members of the medical team, trying to be a good 'team player', concern about their grades and evaluations, knowing a patient more personally than the rest of the team, and dealing with angry or disruptive families. Although encouraged by accounts in which students described 'exemplary' instances of ethical situations, students also indicated that they struggled with certain dilemmas and their unsatisfactory resolution during the month-long clerkship.

**Table 2.** Excerpts taken from student narratives.

'The best way to describe the emergency room is controlled chaos.'

'A patient came in with a pseudo-seizure, which she had a history of several times previously. I walked into the ER to hear several residents and social workers whispering about this patient, discussing her "fake seizure" and "fake symptoms".'

'I felt a culture of helping people learn without embarrassing them as I watched the intern work on the dislocated shoulder with two attendings in the room. They gave him tips and feedback without demeaning him.'

'It was interesting to see how physicians were able to take a firm line in not giving them the narcotics they were requesting but giving alternatives and not shaming the patients.'

'The resident turned to me and said "This is the worst shift ever. Maybe you should go into plastic surgery".'

'Difficult conversations like this (end-of life) are going to be a part of my life as a future physician and I am thankful to have the opportunity to see physicians ahead of me in training handle these situations gracefully.'

'One of the nurses signaled for me to come speak to her. She told me how this patient would be such a pain, taking up a bed for truly sick people, and would have to be baby-sat until he sobered up. This led me to formulate the opinion that this patient was a nuisance, instead of reminding myself that substance abusers are humans with souls just like me.'

'The attending said, "Your husband didn't suffer." I knew this wasn't true but patient's families often worry tremendously about how or whether their loved ones suffered at the time of their death. I will carry this wisdom that he shared with me into my practice.'

'She wanted the patient to be admitted to the hospital but explained that the decision was determined more by insurance constraints than by her personal judgement.'

'With time running out, the resident had to decide whether to do what she believed was best for the patient or to do what was legal and not administer the TPA without consent from the guardian.'

'A few words into the conversation (with consultant), I heard angry yelling from the other end. The resident's face turned a bright red as she firmly stated "Okay sir, I will call you in 20 min when I know the hemoglobin count." She turned to me and said, "I would have cried as an intern. But I'm not crying today." She said with a smile, "You get used to it. It's a part of the job".'

'I hope that this boy was not being abused and that he can get some help, but I will never know. What I do know is that he taught me not to judge someone when I walk into a room, because there could be sad and terrible reasons why someone acts the way they do.'

'It was refreshing to see Dr. \_\_\_\_\_ and the residents joking around, enjoying their job but being respectful about patients and knowing when to be serious.'

'It was interesting to see the dynamics in the ER with homeless patients that are brought in. Most of them were intoxicated and had been there on several occasions before, so the staff didn't pay them much attention, merely put a bed in the hallway and let them sleep it off. However, I found myself wondering several times during the evening if the ER was really the best place to bring them or if a homeless shelter would have been more appropriate?'

The ED can be a challenging place for beginning medical students and presents a unique set of conditions that may contribute to a difficult learning experience. These learners encounter many new and different issues not confronted in other areas of medicine. Ethical tension is heightened by several factors such as urgency, (in)efficiency, unrealistic expectations, overcrowding, and the high incidence of impaired cognitive abilities in the patients. One study demonstrated that ED patients admitted to the hospital often present with ethical issues significantly affecting their health care and

overall medical outcomes.<sup>11</sup> However, ethical challenges can be found in every health care setting. The question is what effect these ethical challenges have on the student's moral development and their subsequent perception of medicine and its values.

The results of studies performed in this country and worldwide demonstrate that 'ethical erosion' is a universal and serious problem among medical students.<sup>10,12-15</sup> These studies, using different methodologies, came to divergent conclusions – showing decreased ethical sensitivity and/or a significant decline in moral

development throughout their medical education. For example, Feudtner et al. surveyed 665 third- and fourth-year medical students, and 62% of them felt that their ethical principles had been seriously eroded or lost.<sup>10</sup> In a similar survey, Hicks and colleagues found that 47% of medical students had been placed in a clinical situation in which they had felt pressure to act unethically and 61% had witnessed a clinical teacher acting unethically.<sup>14</sup> Clinical faculty who exhibit unethical or unprofessional behavior toward patients was the most frequently cited problem.<sup>14</sup> Because students are in a formative phase, have limited clinical knowledge, and are dependent on faculty, they may be especially distressed by unethical behavior and sensitive to the responses of others. In contrast, ethical dilemmas may present an opportunity for faculty and residents to model professional values, such as sensitivity, accountability, and integrity.

Although all medical schools in the United States now require that ethics be included in the undergraduate curriculum, the best approach to teaching ethics to students is still debated. Although problem-based discussion is a commonly used method for teaching ethics, several innovative strategies have been suggested by educators. Examples include role-modeling, workshops, didactic sessions, team-based learning, hospital ethics committee discussions, essays, faculty-student mentorship sessions, online modules, pastoral care shadowing, and simulation-based clinical scenarios.<sup>1,16,17</sup>

There is a need for rigorous studies to determine the best strategies for teaching medical ethics and to evaluate their long-term impact on clinical practice.<sup>17</sup> Knowledge of these teaching approaches would greatly assist faculty in developing the best ethical curriculum for their particular institution. The ultimate challenge will be to *'develop a curriculum that will enable medical students to at least maintain their stage of moral development if not increase it through the medical education experience'*.<sup>12</sup>

Teaching medical ethics to medical students in a diverse society can be challenging. Educators are responsible not just to teach the subject matter but to create an environment that reinforces a student's moral development.<sup>2,4</sup> As far back as 1994, medical educators were encouraging medical schools to place emphasis on the ethical aspects of daily medical practice and not just on dramatic cases with important historical implications.<sup>2,18</sup> These historical cases often emphasize tough decisions that physicians will not make until much later

in their professional careers while largely discounting the ethical decisions that clerkship students make daily.<sup>10</sup> Christakis and Feudtner in their classic article, 'Ethics in a Short White Coat', have critically studied the way medical ethics is taught in many institutions. They concluded that, *'ethical education must be participant-driven and developmentally stage-specific, focusing more attention on the kinds of ethical decisions made by medical students as opposed to those made by residents or practicing physicians'*.<sup>2</sup>

Our results are consistent with other researchers who evaluated student narratives from medical students and concluded that day-to-day clinical experiences during clerkships significantly influenced moral development as well as professional identity.<sup>2,3,5,15</sup> Further study into what students encounter and relay through essays or narratives will help to guide and add structure to any ethics-based curricula. Going forward, we plan to share the results of our student narratives with EM faculty and residents to make them more responsible in modelling ethical behavior and how they might encourage students to speak up if they have moral or ethical concerns during patient care.<sup>16</sup>

Several limitations were inherent in this qualitative observational study. These included the small sample size and the subjective nature of the narrative essays (response bias). Students were instructed to write about three cases that had the greatest impact on them during their ED clerkship. To reduce measurement bias, they were kept blinded to our study objectives and were not specifically asked to address ethical issues or professionalism. However, many of the essays focused on their struggles to be an ED physician and the consequent moral and ethical concerns (Table 1). These results might not be generalizable to more advanced students or those rotating in other clinical departments.

We took several steps to ensure the accuracy of coding; however, the interrater reliability was only moderate, with a median kappa statistic of 0.78. And finally, although our students had pre-clerkships at five hospitals, all came from a single midwestern medical school that might limit applicability. However, our findings resonate with other qualitative studies using narrative essays to explore ethical dilemmas that students confront in the ED<sup>15,17</sup> and in other hospital clerkships.<sup>2,3</sup> In addition, we continued to recognize these same ethical categories (Table 1) in the informal review of narrative essays written by subsequent groups of medical

students over the following years. The type and frequency of ethical issues documented here are likely an underrepresentation of the situations that students confront during their first clerkship. Even when students seem to write honestly, there will be influences either hidden from the students themselves or so taboo that students do not feel comfortable writing about them.

## CONCLUSIONS

Narrative essays describe a wide variety of interesting ethical situations that medical students confront during their EM clerkships. This study provides a unique view of the ethical struggles that medical students confront during their first clerkship. The ED can be a challenging place for beginning medical students where they encounter moral, professional, and ethical issues not confronted in other areas of medicine. Many of these interactions seem to be connected to the student's role of the observer on the health care team and how that role can lead to ethical tension. Going forward, we plan to share these results with our EM faculty to make them more responsible in modelling ethical behavior and suggest ways they might encourage students to speak up when they have moral or ethical concerns. As educators, we need to shine a light on the subtle ethical dilemmas that clerkship students struggle with daily and give them practical tools to deal with moral decisions required of them in medical practice.

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# A Case of Petit's Hernia Presenting as Bilateral Lipomata of the Back

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*We aim to add to the literature regarding Petit (inferior lumbar) hernias. The presence and location of lower back masses may have a deeper origin than initially apparent. We urge the surgical community to keep in mind the differential diagnosis of lumbar hernia, although rare, when evaluating subcutaneous masses and lipomata in this region. Simple excision may address the mass but not the cause and will lead to early recurrence of the presenting problem.*

**Keywords:** lipomata; petit hernia; lumbar triangle; lumbar hernia

## INTRODUCTION

With only approximately 300 reported cases in the literature, lumbar hernias are notably rare.<sup>1</sup> Lumbar hernias are generally categorized as either superior (Grynfelt) or inferior (Petit), with inferior being the less common of the two.<sup>1</sup> An inferior lumbar hernia is a protrusion of either extraperitoneal fat or intraperitoneal contents through the inferior lumbar triangle.<sup>2</sup> The inferior lumbar triangle is anatomically defined by the iliac crest inferiorly, the external oblique muscle anteriorly, and the latissimus dorsi muscle posteriorly.

Because of their rarity, lumbar hernias are frequently misdiagnosed as lipomas, fibromas, hematomas, or abscesses.<sup>1</sup> Wrongful diagnosis can cause a delay in or lack of appropriate treatment, which can then lead to further complications. Lumbar hernias slowly expand in size over time, increasing repair difficulties, risk of incarceration to 25%, and risk of strangulation to 8%.<sup>3,4</sup> Early diagnosis is integral to prevent ischemia of herniated intestine, which may lead to death.

Lumbar hernia patients are typically between 50 and 70 years old.<sup>5</sup> They occur more commonly in males than females at a ratio of 3:1 and are found more commonly on the left than the right (2:1 ratio).<sup>5</sup> Lumbar herniation is rarely bilateral.<sup>6</sup> Approximately 20% of lumbar hernias are congenital; the more common form of lumbar hernia is acquired, which compose approximately 80% of cases.<sup>7</sup> Acquired hernias can be attributed to either spontaneous origin (primary, 55%) or secondary origin such as trauma,

surgery, or inflammation (25%).<sup>5</sup> Spontaneous herniation is usually because of increased intra-abdominal pressure, which may result from risk factors such as muscle atrophy, obesity, old age, or debilitating disease. Importantly, patients are often asymptomatic although may report lower back pain or colic.<sup>5</sup>

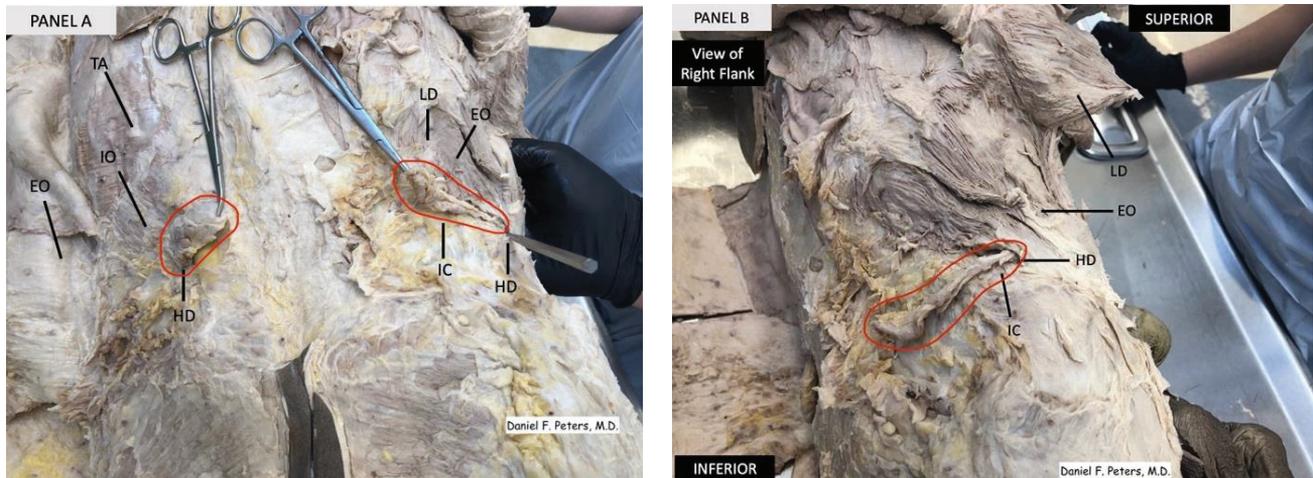
## CASE PRESENTATION: BILATERAL PETIT'S HERNIAS PRESENTING AS BILATERAL LIPOMATA REMOTE FROM THEIR POINT OF ORIGIN IN THE LUMBAR TRIANGLE

After the removal of the skin and superficial fascia during a cadaveric dissection, two masses were identified in the right and left lumbar regions. Initial evaluation showed each of these to be located in the superficial fascia extending laterally, superficial to the latissimus dorsi muscle and its fascia.

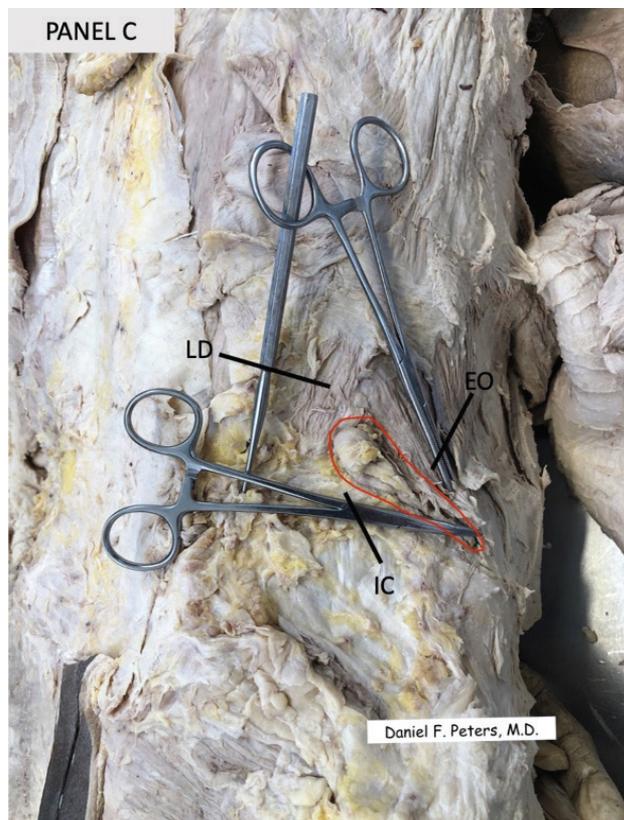
The right-sided mass was dissected first. It was traced deeper and laterally into the posterolateral body wall. Eventually it was seen to be emerging from deeper tissue bounded by the iliac crest inferiorly, the external oblique anteriorly, and the latissimus dorsi posteriorly – Petit's triangle (Figure 1). Dissection was then performed on the left mass, showing that this adipose tissue had also gained access to the subcutaneous region via Petit's triangle (Figure 2).

## DISCUSSION

Lumbar hernias are a rare condition that are commonly misdiagnosed as lipomas, fibromas, abscesses, or



**Figure 1.** Panel A: Posterior view of bilateral hernia defect. Panel B: View of the right flank. EO = external oblique; HD = hernia defect; IC = iliac crest; IO = internal oblique; LD = latissimus dorsi (partially removed); TA = transversus abdominis.



**Figure 2.** Panel C: Magnified view of inferior lumbar triangle. EO = external oblique; IC = iliac crest; LD = latissimus dorsi (partially removed).

hematomas. A major difficulty in diagnosing lumbar hernias is that they are often either asymptomatic or present with non-specific symptoms, such as low back pain. Generally, patients undergo surgery to remove a suspected lipoma.<sup>8</sup> Simple excision will indeed remove the mass but does not address the underlying defect in the muscular body wall. A localized lipoma would be indistinguishable from fat herniated through the body wall on pathologic examination. Although they rarely become incarcerated or strangulated, misdiagnosis can lead to a delay in treatment, increased morbidity, and early recurrence post simple excision. When dealing with a mass in this area, CT scan, which is the standard test for diagnosis of Petit hernias, can identify the location of the defect. It can also help determine the nature of any contents protruding through the defect. In addition, there are other diagnostic criteria that can be of help in determining a Petit hernia such as the deep positioning of a hernia compared with a lipoma, as well as its larger surface area.<sup>8,9</sup>

Lumbar hernias will increase in size with straining or coughing, unlike other more common pathologies. While there are several surgical techniques, none have been deemed significantly superior to another owing to the rarity of the condition and the anatomical location that may limit exposure. Moreover, the proximity of the hernia to bone complicates the closure process. As in other types of hernias, the proper use of mesh may provide a more tension-free repair decreasing the chances of a recurrence.<sup>9</sup>

Petit hernias such as those seen in this case are incredibly rare. A general surgeon may only see one Petit hernia in their entire career, and they are almost exclusively unilateral. Our findings in this case serve to alert the operating surgeon to the possibility that masses in this region may require more extensive workup as they may be indicative of deeper pathology. Simple excision may treat the symptom but not the cause of the condition.

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# Idiopathic Acute Four-Compartment Syndrome of the Lower Leg

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**Case:** We present a case of acute idiopathic four-compartment syndrome of the leg, treated by four-compartment fasciotomy, and wounds left to heal by secondary intention due to persistent edema following surgery.

**Conclusion:** This case highlights the importance of maintaining a high level of clinical suspicion for idiopathic spontaneous compartment syndrome presentation. This case also illustrates the variability of compartment syndrome treatment and recovery. The standard treatment for compartment syndrome is fasciotomy with delayed primary wound closure, but the patient elected to heal by secondary intention. The patient's long-term follow-up results showed positive outcomes.

**Keywords:** Compartment Syndrome; Orthopedics; Wound; Wound Complication; Wound Closure; Idiopathic Compartment Syndrome

## INTRODUCTION AND PATIENT PROFILE

**C**ompartment syndrome is a surgical emergency commonly associated with a traumatic event.<sup>1</sup> The pathophysiology involves increased fluid and tissue volume within a rigid fascial-contained compartment leading to tissue hypoxia and necrosis.<sup>2</sup> Compartment syndrome typically presents with pain, pallor, paresthesia, pulselessness, and paralysis. Diagnosis is difficult, and misdiagnosis can lead to significant morbidity and mortality.<sup>3</sup> Intracompartmental pressure monitoring can confirm compartment syndrome, but this is invasive and painful.<sup>4,5</sup> Treatment is straightforward with fasciotomy and delayed primary re-approximation.<sup>6</sup> The most difficult aspect of compartment syndrome is swift diagnosis due to the rapidly progressive nature of its pathophysiology. By maintaining a high degree of clinical suspicion, a physician can decrease the odds of making a potentially fatal misdiagnosis. Here we present a case of acute idiopathic compartment syndrome of the leg, treated by four-compartment fasciotomy and wounds left to heal by secondary intention due to persistent postoperative edema. Long-term follow-up showed great patient satisfaction, improved muscle function and strength, and return to normal ambulation.

## INTERVENTIONS AND OUTCOMES

A 32-year-old woman with a medical history of rheumatoid arthritis and sarcoidosis presented to an outside emergency department due to persistent right foot pain and numbness that woke her from sleep. She was evaluated in the emergency department (ED) and found to have mild swelling and tenderness in the right lower leg. She received an ultrasound that was negative for deep vein thrombosis (DVT), and she was discharged home with crutches and without orthopedic consultation.

Due to persistent pain, swelling, numbness, and weakness in the right leg, the patient returned to the emergency department 8 hours later. She reported no recent history of trauma or unusual physical exertion. Workup included X-rays, blood work, repeat venous Doppler ultrasound, and computed tomography (CT) scan. X-rays of the tibia and fibula were unremarkable. CT scan of the right leg showed diffuse, four-compartment edema with no obvious source. Orthopedic consultation was obtained to work-up suspected compartment syndrome. Upon orthopedic physical exam, the right leg showed no active muscle activity below the right knee, passive range of motion produced significant discomfort, distal pulses were diminished, and the compartments were tense to palpation.

Anterior and posterior intracompartmental pressures were measured at 55 and 52 mmHg confirming the diagnosis of compartment syndrome. The patient was diagnosed with idiopathic acute right leg compartment syndrome, and informed consent was obtained to perform emergency fasciotomy.

In the operating room, the patient was given general anesthetic, she was prepped and draped in routine fashion, a four-compartment right lower extremity fasciotomy was performed, and the wounds were packed with saline-soaked gauze and loosely wrapped to prevent further increased compartment pressures (Fig. 1).

Following surgery, the patient had bounding dorsalis pedis pulse, persistent loss of sensation to light touch, and complete loss of motor function below the knee.

The patient was discharged the following day with close outpatient follow-up.

Two weeks post-op: The right leg below the knee showed persistent edema and significant granulation tissue in the wounds. There were no signs of active infection. The patient had significant improvement to light touch sensation of the right foot, but no motor activity was observed. Due to persistent edema, referral to a wound clinic and re-evaluation for future skin grafting were ordered.

Four weeks post-op: The patient returned with significantly improved edema. The wounds had excellent closure and granulation. Delayed wound closure versus

healing by secondary intention was discussed. The patient elected for wound healing by secondary intention (Fig. 2). Use of an ankle-foot orthosis (AFO) was prescribed to keep the ankle in a neutral position when resting.

Three months post-op: The wounds were healed. She had active eversion of the foot and active flexion and extension of the toes. She could not significantly dorsiflex. She had intact sensation to light touch from the knee all the way down to the ankle. Below the ankle, she had light touch sensation in patchy distributions.

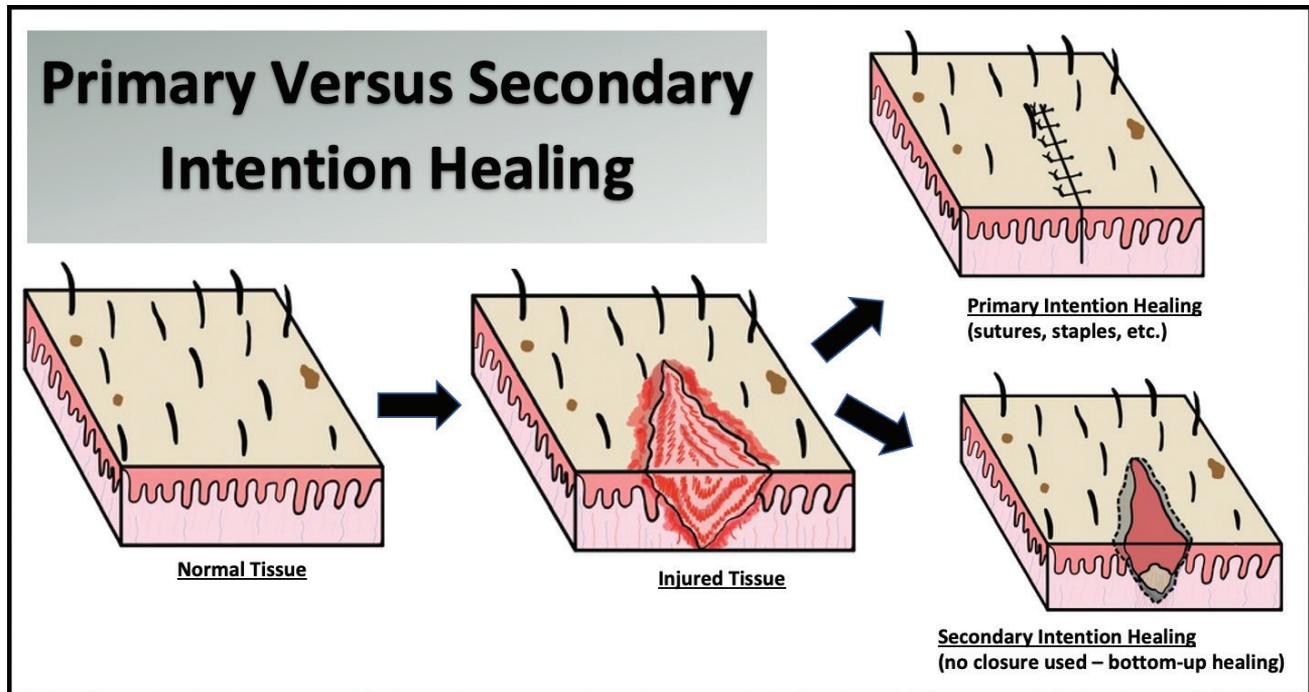
Six months post-op: The patient had a similar clinical picture with improved dorsiflexion.

Twenty-eight months post-op: The patient had weakness and limited range of motion in her right ankle. Her prior AFO broke, and the patient had not been using it for some time. At this time, treatment with physical therapy was started to improve ROM and strength in the ankle. Physical therapy evaluation showed full strength to plantar flexion, inversion, and eversion of the right ankle when compared to the left. The patient still had 2/5 strength to dorsiflexion in the right ankle.

Thirty months post-op: She ambulated with a normal gait and had improved dorsiflexion from the prior visit. The ankle rested in a neutral position. The patient was satisfied with her progress and was prescribed a new AFO and encouraged follow-up as needed.



**Figure 1.** Surgical image of a fasciotomy to decrease compartment pressures. (This is an open access photo with no citation required.)



**Figure 2.** Illustration of primary versus secondary intention healing. (This is an image created by the author, Zachary Jodoin.)

## DISCUSSION

This patient's plan of care had two unique components: the idiopathic presentation and the secondary intention healing.

Lower leg compartment syndrome is almost always associated with a high-energy trauma.<sup>1</sup> A study of 164 patients with acute compartment syndrome linked 69% of the cases to a fracture.<sup>7</sup> It can also be seen with surgical insult such as total knee arthroplasty or coronary arterial bypass grafting. Other rarer causes of compartment syndrome include systemic diseases such as diabetes mellitus, HIV, hypothyroidism, hematogenous malignancy, systemic sclerosis, and neuroleptic psychiatric or statin medications.<sup>1,8,9</sup> Our patient had a history of sarcoidosis with resulting rheumatoid-like arthropathy but given the patient's mild nature of these conditions and lack of evidence relating to the cause of compartment syndrome, it is unlikely the inciting factor in this patient's case. The fact that idiopathic acute spontaneous compartment syndrome has no real intrinsic or extrinsic trigger makes it very difficult to consider as a diagnosis. This, combined with the morbid and even fatal consequences of missing the diagnosis is what makes this case so important. The patient's discolored

muscle, visualized after fasciotomy, echoes the importance of maintaining a high level of clinical suspicion for compartment syndrome. Further delay of this patient's care could have led to amputation, renal failure, or death. Although other case reports have been published pertaining to acute idiopathic compartment syndrome of the lower leg, this report gives readers more insight to postoperative recovery and follow-up.<sup>11,12</sup>

Closure of post-fasciotomy wounds is often challenging due to soft tissue edema and protrusion of muscles through the wounds.<sup>13</sup> Due to the likely increased risk of infection, research into wound closure by secondary intention has been limited. In a 1992 study evaluating wound closure techniques in patients with traumatic compartment syndrome, wound complication rate was observed in 51% of wounds with delayed primary closure or wounds left to heal by secondary intention. This was compared to 5% with post-fasciotomy skin-grafting.<sup>14</sup> Long-term follow-up, however, has found increased morbidity with skin grafting.<sup>13</sup> Multiple post-fasciotomy wound closure techniques have been described. Kakagia reviewed techniques to achieve delayed primary closure, including the use of dynamic dermatotraction mechanical devices to provide

negative pressure therapy to the wound.<sup>13</sup> It should be noted that persistently increased compartment pressures have been observed in premature primary closure of wounds, increasing the risk for recurrent iatrogenic compartment syndrome.<sup>15</sup> Due to the significant risk of complications with premature closure, it is important to evaluate each patient individually when deciding which wound closure technique to perform. Although delayed primary closure is the prevailing method of wound closure in the literature, our patient was unique due to her late presentation, idiopathic nature of her compartment syndrome, and persistent edema following fasciotomy. Despite this unique wound closure plan, the patient's long-term follow-up showed promising results in terms of ambulation and physical abilities, as well as a high level of patient satisfaction.

### Bulleted Learning Points

- Compartment syndrome basics.
- Recognizing compartment syndrome with high clinical suspicion.
- Wound closure options in compartment syndrome.

### STATEMENT OF INFORMED CONSENT

The patient was informed and consented that data concerning the case would be submitted for publication.

### Acknowledgments

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# Quadricuspid Aortic Valve by Transesophageal Echocardiography

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*Quadricuspid aortic valves (QAVs) are a rare congenital anomaly associated with increased risk of aortic insufficiency. This case presents the incidental finding of a QAV on intraoperative transesophageal echocardiography (TEE) after going undetected on transthoracic echocardiography multiple times, suggesting that TEE may be a superior imaging modality for the identification of this defect. This patient with a history of coronary artery disease presented with sudden onset moderate to severe aortic insufficiency and required subsequent aortic valve replacement (AVR).*

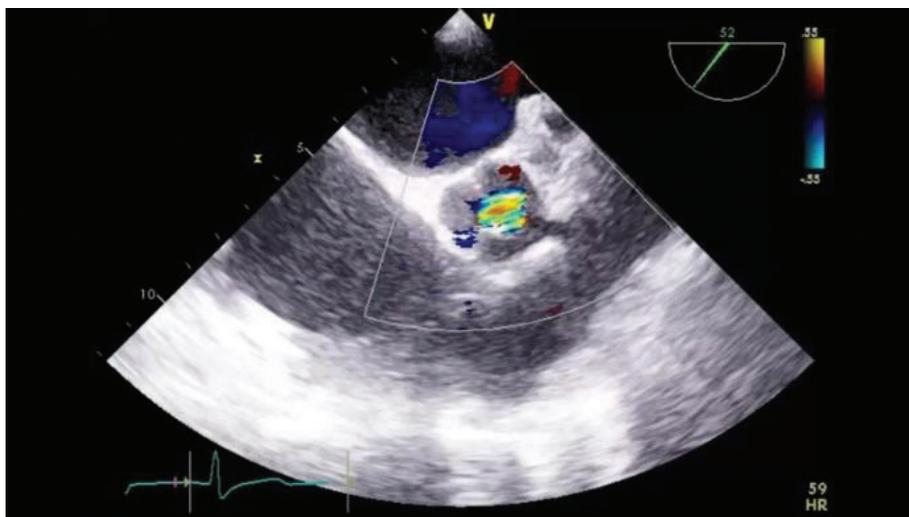
**Keywords:** quadricuspid aortic valve; aortic valve; aortic insufficiency; aortic regurgitation; transesophageal echocardiography

## INTRODUCTION

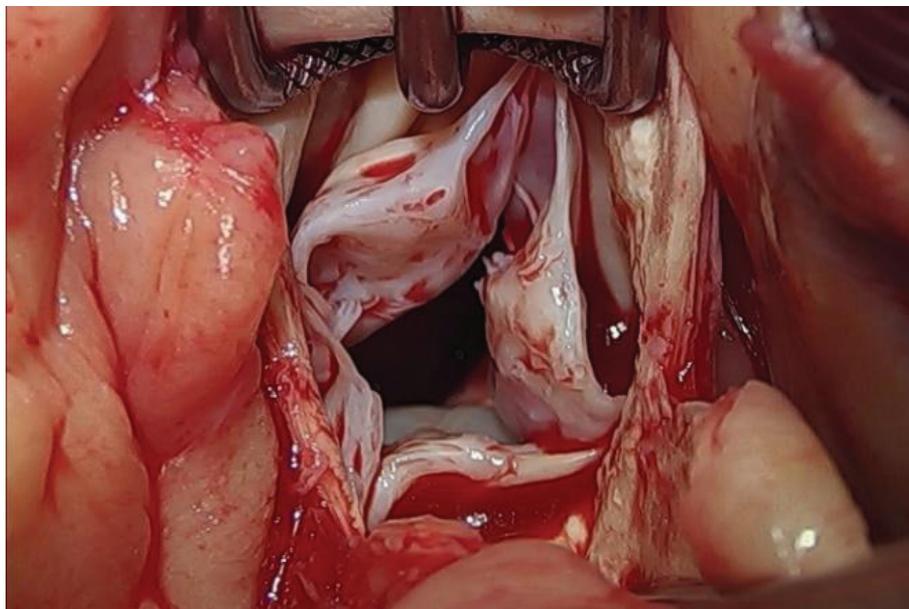
**A** 65-year-old woman with a known history of moderate aortic insufficiency was found to have hypertensive urgency and diagnosed with pulmonary embolism shortly after undergoing a mandibulectomy for squamous cell carcinoma. She was found to have an acute coronary syndrome and subsequent transthoracic echocardiogram (TTE) revealed a left ventricular ejection fraction of 35%, though the quadricuspid aortic valve (QAV) was not readily visualized at this time. She then

underwent left cardiac catheterization, which demonstrated severe aortic insufficiency and 80% stenosis of the right coronary artery. Her aortic root measured 33 mm on preoperative CT angiography with the ascending aorta measuring 29 mm. Patient was taken to the operating room and underwent single coronary artery bypass grafting and aortic valve replacement (AVR).

During this procedure, transesophageal echocardiography (TEE) revealed the patient to have a four-leaflet aortic valve as shown in Fig. 1. The valve



**Figure 1.** Short-axis view of quadricuspid aortic valve on intraoperative TEE revealing severe aortic regurgitation.



**Figure 2.** Intraoperative view of quadricuspid aortic valve with four equal-sized cusps consistent with type A on Hurwitz and Roberts classification system.

had four equal-sized cusps, as shown in Fig. 2, consistent with type A on the Hurwitz and Roberts classification system.<sup>1</sup> AVR was performed with a bovine pericardial tissue valve. The patient was discharged home without associated complications on postoperative day 20.

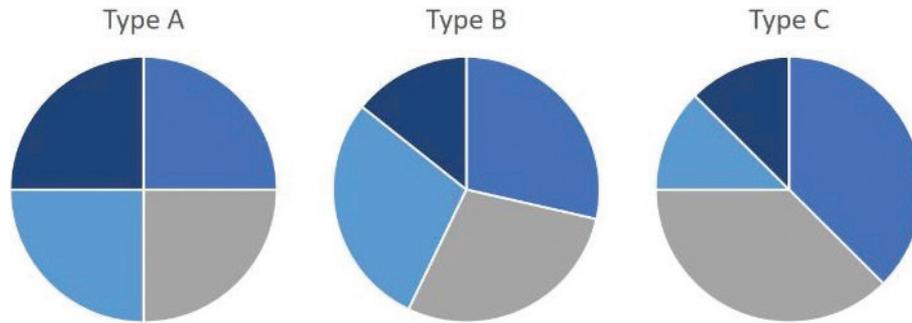
## DISCUSSION

QAVs are a very rare congenital cardiac anomaly that usually presents in isolation but occasionally presents with other defects. The bicuspid aortic valve is the most common aortic anomaly, present in 2% of the population, followed by the unicuspid aortic valve.<sup>2,3</sup> QAVs have an estimated prevalence of 0.008–0.033% by autopsy and 0.013–0.043% by echocardiography.<sup>1,4</sup> The first QAV was incidentally discovered in 1862 and less than 300 cases have been described since this time.<sup>5</sup>

Studies on Syrian hamsters have suggested that QAVs arise from an extra partition in one of the three mesenchymal swellings that form cusps during early development.<sup>6,7</sup> Other studies propose that the anatomy of malformed semilunar valves tends to suggest an alteration later in development, such as further septation of a normal valve cushion, as opposed to a malformation.<sup>8</sup> Embryological formation of QAVs remains largely unknown.

QAVs are classified into seven different types based on a schematic devised by Hurwitz and Roberts. Of these, type A (four equal cusps), type B (three equal cusps and one smaller cusp), and type C (two equal larger cusps and two equal smaller cusps) are the most common presentations of QAV as shown in Fig. 3.<sup>5</sup> Our patient demonstrated a type A QAV based on this classification system, composed of four equal-sized cusps.

QAVs were historically detected primarily during surgery or at autopsy. They are now most often detected via echocardiography, followed by surgery, at autopsy, and by other diagnostic means such as computed tomography angiogram or magnetic resonance imaging. TTE is used as a primary screening tool; however, the advent of TEE has enabled increased diagnostic accuracy.<sup>9,10</sup> TEE gives the transducer better access to image the aortic valve with less structures between it and the valve, as opposed to TTE that must penetrate lung and chest wall tissue.<sup>10</sup> This study provides one example of TTE failing to detect a QAV, which was then detected on TEE. Screening with TEE rather than TTE may increase the diagnosis of QAVs, allowing for better preparation and planning prior to surgical management. TEE may also provide a better assessment of valve morphology and measurement of other parameters useful for surgery, ultimately improving patient



**Figure 3.** Hurwitz and Roberts classification of the most common types of quadricuspid semilunar valves: Type A (four equal cusps), type B (three equal cusps and one smaller cusp), and type C (two equal larger cusps and two equal smaller cusps).

outcomes without requiring magnetic resonance imaging or computed tomography angiograms.<sup>5,11</sup>

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