Bruising in the Geriatric Population

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Abbreviated Title for Running Head: Bruising in the Geriatric Population

Executive Summary

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When a child is seen with suspicious bruising, pediatricians are routinely called upon by child protective agencies to document the injury, estimate the age of the injury, and support or refute claims of child abuse. With the increased awareness of the estimated 1 - 2 million cases of elder abuse, adult protective services is similarly looking to geriatricians and the medical community for input in elder mistreatment cases involving clients with extensive bruising.

While there is a body of research on the site, pattern, and dating related to bruising in children, research on the differentiation between accidental and inflicted bruising in the geriatric population does not exist. The first step in building this literature is the documentation of normal bruising in the geriatric population. The systematic documentation of accidentally occurring bruising in older adults could provide a foundation for comparison when considering suspicious bruising in older adults. To that end, the goal of this study is to summarize the occurrence, progression, and resolution of accidentally inflicted bruising in a sample of adults aged 65 and older. Based upon what is known about bruising in children and what is known to differ between children and seniors, four research questions guide the current study:

(1) Do accidental bruises occur in a predictable pattern in older adults?
(2) Do color changes in bruises occur in a predictable pattern in older adults?
(3) How do medications and medical conditions that interfere with normal blood clotting impact bruising in older adults?
(4) Do older adults with compromised mobility and/or functional ability have more bruising?

Between April 2002-August 2003, 101 subjects were recruited from three community based living settings (n=77) and two skilled nursing facilities (n=24) in Orange County, California. Similar to the population of the participating community and SNF settings, the study population was 66% female, and had an average age of 83. Forty-five percent of study participants required assistance with one or more activity of daily living. Seventeen subjects were cognitively impaired and assented to surrogates in the informed consent process.

Once a subject was enrolled in the study, one of two trained interviewers went to his/her home each day and examined the subject from head-to-toe for any bruises. The subject undressed fully so that the entire body was examined. If a bruise was present at the first visit, the bruise was documented and not included in the study. If however, a new bruise appeared on the second to the fourteenth day, it was known to have occurred during the prior 24 hours and was then documented every day until resolution or up till 6 weeks. Subjects and/or caregivers were asked if they knew what caused the bruise.

When a bruise was identified, characteristics of the bruise including the location, size and color were visually inspected, recorded in subject files, and digitally

photographed. The bruise was re-examined at the same time each day (within a four hour time period) for a period of 6 weeks or until complete resolution of the bruise, whichever came first. For each subject, the following data was collected: age, gender, ethnicity, functional status, handedness, medical conditions, medications, cognitive status, depression, and history of falls.

Results suggest that accidental bruises occur in a predictable pattern in older adults. Nearly 90% of the bruises were on the extremities and in daily observation of 101 older adults, not a single accidental bruise was observed on the neck, ears, genitals buttocks, or soles of the feet. Most large bruises that are accidentally inflicted are on the extremities. Of the 20 large bruises (5-50 cm) in this study only 1 was on the trunk. Moreover, older adults are significantly more likely to know how the bruise happened if the bruise is on the trunk.

While a discernable pattern was observed in the location of the bruises, the initial color and color change over time are less predictable. Contrary to the perception that a yellow coloration indicates an older bruise, 16 bruises were predominately yellow on the first day of observation, and 30 bruises were largely purple on their tenth day of observation. Consistent with the pediatric literature, red coloration was observed throughout the course of the bruise, often from day 1 all the way until day 42, the last day of observation. Those on medications known to have an impact on bruising were more likely to have multiple bruises. Older adults with compromised functional ability were more likely to have multiple bruises.

In a step toward building the literature on the medical forensic aspects of elder mistreatment, this study documents the occurrence and progression of normal bruising in the geriatric population. The systematic documentation of accidentally occurring bruising in older adults provides a foundation for comparison when considering suspicious bruising in older adults. There is a great need for research on bruises known to have been inflicted as the result of physical elder abuse, as well as on bruises that arouse suspicions of elder abuse but are inconclusive.

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When a child is seen with suspicious bruising, pediatricians are routinely called upon by child protective agencies to document the injury, estimate the age of the injury, and support or refute claims of child abuse[1]. With the increased awareness of the estimated 1 - 2 million cases of elder abuse, adult protective services is similarly looking to geriatricians and the medical community for input in elder mistreatment cases involving clients with extensive bruising[2].

This poses a special challenge to geriatricians given the prevalence of normal, accidental bruises in older adults. While there is a body of research on the site, pattern, and dating related to bruising in children, research on the differentiation between accidental and inflicted bruising in the geriatric population does not exist. The first step in building this literature is the documentation of normal bruising in the geriatric population. The systematic documentation of accidentally occurring bruising in older adults could provide a foundation for comparison when considering suspicious bruising in older adults. To that end, the goal of this study is to summarize the occurrence, progression, and resolution of accidentally inflicted bruising in a sample of adults aged 65 and older.

Given the paucity of research on bruises in the geriatric population, it is helpful to understand what is known about bruising in children. A study of accidental bruising in children and adolescents (n=1467) found that most children had 1 or more bruises (76.6%) with less than 2% if the bruises occurring on the buttocks, pelvis, abdomen, or thorax and less than 1% of the bruises on the chin, ears, or neck [3]. In a study comparing

children who had been bruised as a result of abuse (n=133) with children who has been accidentally bruised (n=189), bruises from abuse were found to be greater in length. These differences were greatest in the head and neck and were less notable in the limbs[4].

Although a number of textbooks on forensic medicine that include charts on dating a bruise by color[5 6 7], the American Academy of Pediatrician's Continuing Medical Education course on bruising and skin trauma (2000) states, "that bruising charts for determining the age of bruises are unreliable. The scientific basis for these charts is tenuous and does not allow for accurate dating of bruises"[8]. Moreover, physician estimates of the age of bruises have been shown to be inaccurate when the bruises are presented as photographic evidence[9] as well as when bruises are observed directly in a physical examination[1].

Because of the predictable sequence of biochemical changes in the bilirubin molecule as it is broken into its constituent parts, bruises tend to go from purple/black to green to yellow with red coloring appearing anywhere throughout the duration of the bruise. The only study to compare bruising between young (10-65 years old) and old (>65 years old), found that bruises in older subjects developed yellow color at a slower rate, although the time difference was not specified[10].

A combination of normal age-related changes, common age-related changes, and medications conspire to increase the likelihood of accidental bruising in older adults. Normal age-related changes include a thinner epidermis, capillary fragility, and less subcutaneous fat[11]. Common age-related changes include medical conditions such as diabetes and hypertension as well as functional conditions such as falls and gait instability. Many pharmaceutical agents, both prescription and non-prescription

medications, may prolong bleeding time. Older adults are more likely to have medical conditions such as atrial fibrillation that lead to the use of these medications.

Based upon what is known about bruising in children and what is known to differ between children and seniors, four research questions guide the current study:

(1) Do accidental bruises occur in a predictable pattern in older adults?

(2) Do color changes in bruises occur in a predictable pattern in older adults?

(3) How do medications and medical conditions that interfere with normal blood clotting impact bruising in older adults?

(4) Do older adults with compromised mobility and/or functional ability have more bruising?

METHODS

Study Population

Between April 2002- August 2003, 101 subjects were recruited from three community based living settings (n=77) and two skilled nursing facilities (n=24) in Orange County California. Inclusion criteria required that subjects be: 65 years or older; able to provide informed consent, or assent to surrogate consent, in accordance California law; and reside in the community or SNF research sites. A subject was excluded from the study (and the case reported to Adult Protective Services) if there was a suspicion of elder mistreatment. In the recruitment and study periods, there were no suspicions of elder mistreatment. Similar to the population of the participating community and SNF settings, the study population was 66% female, had an average age of 83, and all were Caucasian. Seventy-seven percent of study participants ambulated independently at

home (without an assistive device) and 67% ambulated independently in the community. Forty-five percent of study participants required assistance with one or more activity of daily living. Seventeen subjects were cognitively impaired and assented to surrogates in the informed consent process. A subject was considered cognitively impaired if he or she had a legally authorized representative as a result of documented incapacitation; or was deemed to be impaired by the geriatrician on our research team who evaluated all potential subjects who showed any confusion or disorientation to time, place, or person.

Data Collection

Once a subject was enrolled in the study, one of two trained interviewers went to his/her home each day and examined the subject from head-to-toe for any bruises. The subject undressed fully so that the entire body was examined. If a bruise was present at the first visit, this bruise was documented and was not included in the study. If however a new bruise appeared on the second to the fourteenth day, it was known to have occurred during the prior 24 hours and was then documented every day until resolution or up till 6 weeks. Subjects and/or caregivers were asked if they knew what caused the bruise.

When a bruise was identified, characteristics of the bruise including the location, size and color were visually inspected, recorded in subject files, and digitally photographed. The bruise was re-examined at the same time each day (within a four hour time period) for a period of 6 weeks or until complete resolution of the bruise, whichever came first.

Measures

The location, size, and colors of each bruise were measured everyday until resolution through visual inspection, detailed charting, and digital photographs.

For each subject, the following data was collected: age, gender, ethnicity, functional status, handedness, medical conditions, medications, cognitive status, depression, and history of falls. Functional status was measured using the Katz activities of daily living (ADL)[12] and Lawton intermediate activities of daily living (IADL)[13] scales. Mobility was measured using the Tinetti Gait and Balance scale, and the self-reported Ambulation Scale. Subjects were asked to report how many falls they had taken in the past week, month, six months, and year.

Because the community-based elders were examined in their homes, the research team asked to see the medication bottles and asked specifically about non-prescription vitamins, herbs, medications, and supplements. Medication sheets were reviewed for each nursing home subject. The names, dosage, and frequency of usage were recorded for each pharmaceutical.

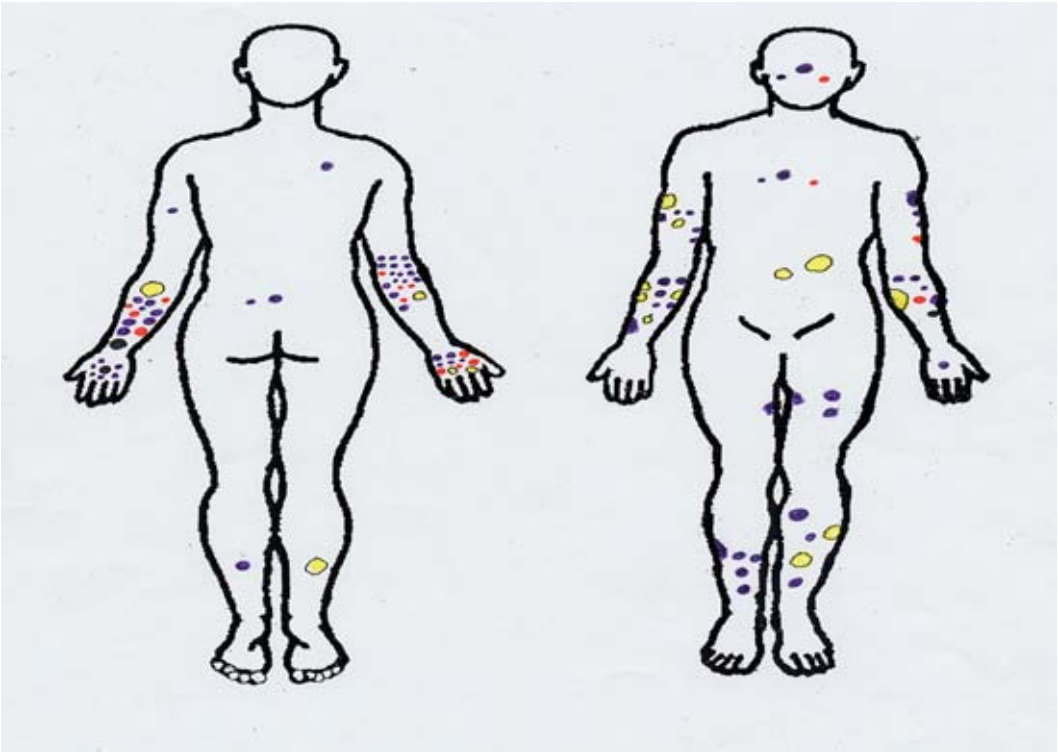
RESULTS

Location and Size of Bruises

Of the 101 participants, 72 had at least one bruise occur in the two week tracking period. Of the 72 participants with bruises, 48 had one bruise, 17 had 2 bruises, 3 had 3 bruises, 3 had 4 bruises, and 1 had 5 bruises for a total of 108 bruises. Of the 108 bruises, 89% of the bruises were on the extremities, and of those, 76% were on the dorsal surface of the arms. No bruises were observed on the neck, ears, genitals buttocks, or soles of the

feet. Diagram 1 depicts the location, size, and primary initial color of the 108 bruises at Day 1.

Diagram 1. Combined Summary of 108 Bruises Observed on 73 subjects at Day 1



The area of the bruises varied from 0.12 cm2 to 50.0 cm2 (Mean=3.42 SD=6.72) with width diameters ranging from 0.3 cm to 10 cm. As summarized in Table 1, only one of the large bruises was on the trunk.

Table 1. Bruise Area by Location Crosstabulation

		Bruise locations by trunk and extremities		Total
		Trunk	Extremities	
Size of Bruise - Categorized	**Small .1cm-1cm**	5	31	36
		41.7%	32.3%	33.3%
	Medium 1.1cm-4.9cm	6	46	52
		50.0%	47.9%	48.1%
	Large 5.0cm-50cm	1	19	20
		8.3%	19.8%	18.5%
Total		12	96	108
		100.0%	100.0%	100.0%

Ability to recall how a bruise occurred varied by location of the bruise. When the bruise was on the trunk, 42% of subjects knew how the bruise occurred. In contrast, when the bruise was on the extremity, 17% of subjects knew how the bruise occurred ($p = .04$). Of those who did know the mechanism of the bruise, most reported bumping into something and 2 reported falling.

Timing and Sequence of Color Change

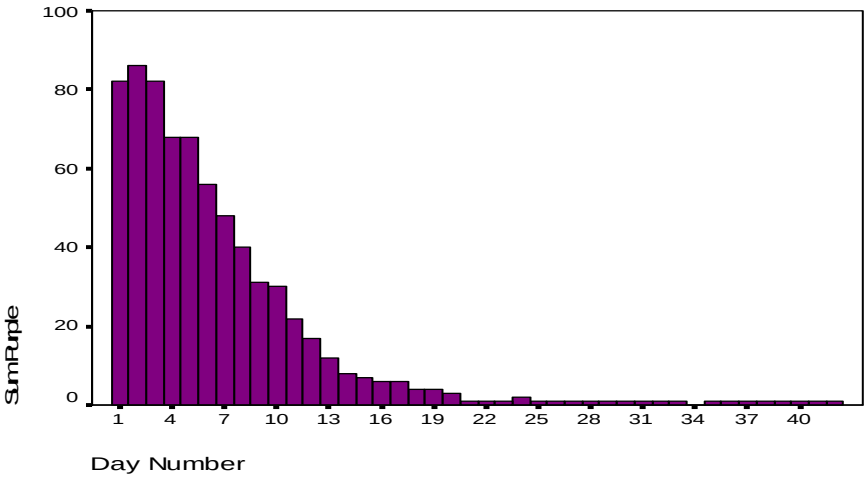
The period that the bruises were visible varied from 4 to 41days (Mean=11.73, SD=7.13). Half of the bruises (54%) resolved by Day 6, and most (81%) resolved by Day 11. In observing the bruises, the research team recorded all colors observed on each bruise, everyday. In the first 48 hours, most bruises were observed as red (90%) and/or purple (80%) with fewer displaying black (25%), yellow (20%), green(10%) and blue (8%). Table 2 depicts the progression of color by day.

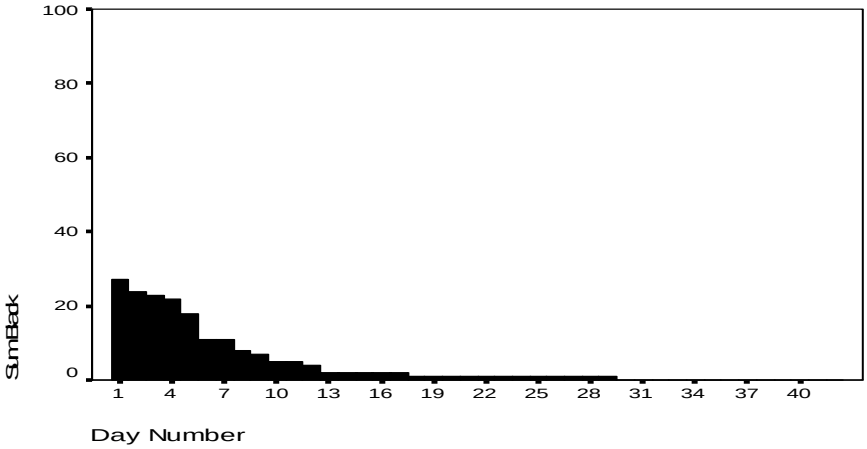
Consistent with the pediatric literature, the color red was observed throughout the duration of the bruise. In days 1 through 6, 90% if the bruises contained the color red and over 20% of bruises stayed red for 2 weeks with some bruises appearing red all the way up to 6 weeks. The color purple was very prevalent in the first 3 days of the the bruises (over 80% contained purple) and made a progressive decline over 2 weeks and was less than 5% obseved thereafter.

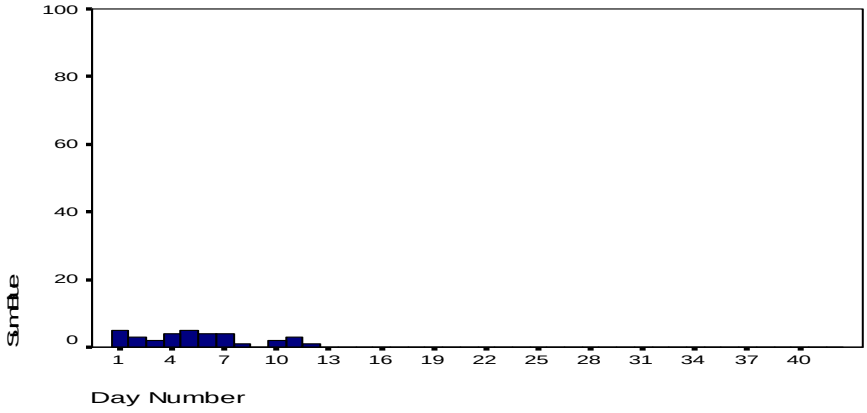
Black appeared in 20% of the bruises during the first 4 days of the bruises. At a week, 10% contained black, and after 2 weeks, only 1 of the bruises continued to show black. Contrary to the notion of bruises as “black and blue”, blue was the least commonly observed color. In the first week, blue was observed in only 5% of the bruises, with no blue showing after day 12.

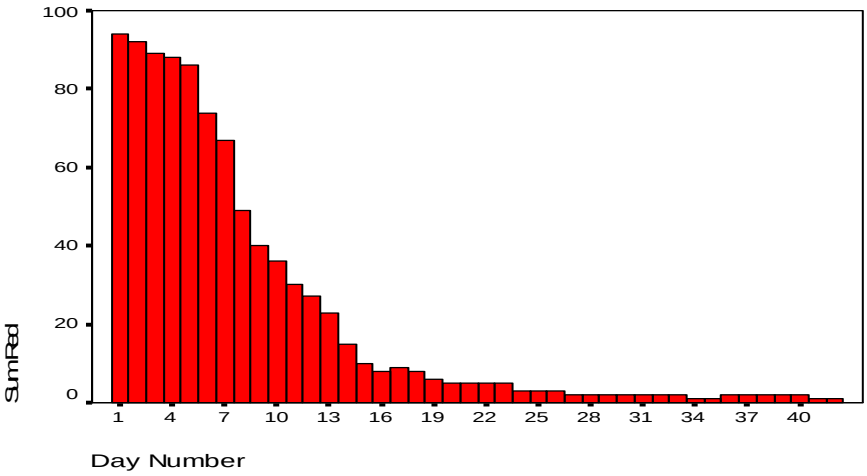
Green was also infrequent with 8% of bruises showing green in the first week, 3% in second week. Green was unusal in that it was observed in a bruise one day, not the next, and then again the following day. The color yellow increased over time for the first 6 days with nearly 60% of bruises showing yellow at day 6. In contrast to the perception that the appearance of yellow always indicates an older bruise, 16% of the bruises included the color yellow on day 1. After day 6, yellow was present in 30% of the cases and was the most common color in bruises lasting over 3 weeks.

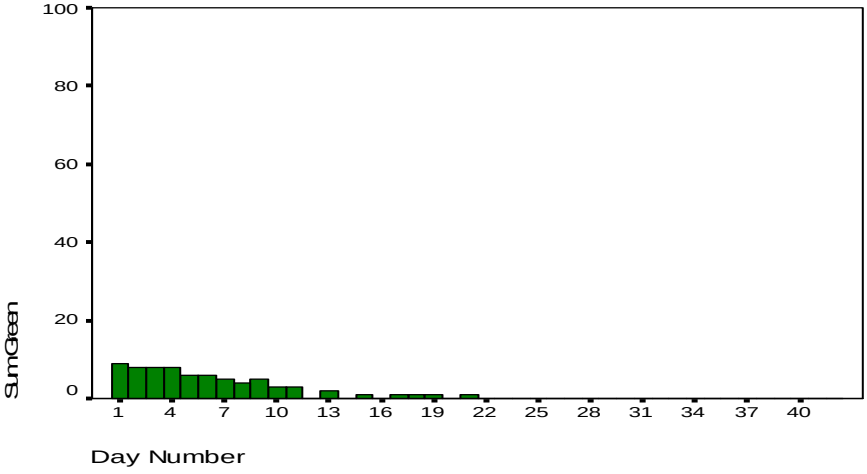
Table 2. Progression of Color by Day

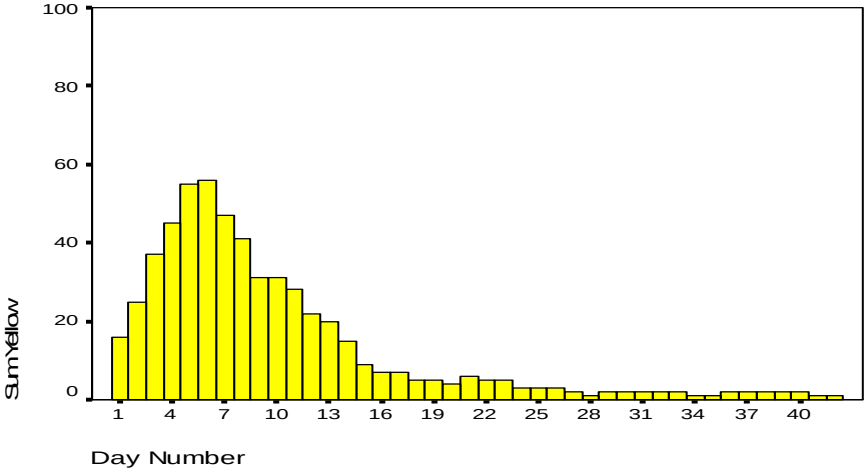












Relationship to Medications and Medical Conditions

All of the subjects, except one, were on prescribed medications with a mean of 6.7 medications. Eighty-six percent of the sample were on over the counter medications with a mean 3.6 over-the-counter medications.

With the consultation of a pharmacist who specializes in geriatric pharmacology, medications were divided into three categories: those which are expected to have no effect on bleeding time/bruising, those which are expected to have minimal effect; and those which are expected to have at least a moderate effect on bleeding time/bruising. (Table 3).

Table 3. Categorization of Medications Based on Effect on Bleeding Time/Bruising.

Effect on Bleeding Time/Bruising	**Medications in this Category**	**Percent of Participants On this med**
No Effect	Antihypertensive, Thyroid, antiarrhythmics	53%
Minimal Effect	Daily ASA 81 mg, NSAID use (<3 days/week), Ginkgo	7%
≥ Moderate Effect	Daily prednisone, Daily ASA 325 mg, Warfarin, Plavix	40%

For those on medications expected to have a minimal or moderate effect on bleeding time/bruising, 46% had multiple bruises. For those not on such medications, 26% had multiple bruises (p=.08). There was no a significant correlation between medications known to impact bruising and the duration of bruises, nor color change.

Given a relatively small sample size and having controlled for medications, medical conditions did not significantly impact number or duration of bruises. A notable exception was the condition Hypertension. Forty percent of the sample had Hypertension but 100% of the bruises on the trunk were on subjects with Hypertension. That is, of 108 bruises, 12 bruises (on 10 subjects) were on the trunk and all 10 of those subjects had hypertension. Of those 10 subects, only one was on a medication that impacts bruising.

Relationship to Function

Activities of Daily Living

There was a statistically significant difference in the number or bruises between those who require assistance with one or more Activity of Daily Living (ADL) and those who required no assistance. Fifty percent of those who require ADL assistance had 2 or more bruises as opposed to 25% of those not requiring ADL assistance ($p = .037$). There were no relationships between ADLs and the location of the bruises or days until resolution.

Residential Setting

Of those residing in a SNF, 79% developed a new bruise during the two-week observation period which was similar to the rate of 71% if those living in the community. Eighteen percent of SNF subjects with bruising had bruises on the trunk as compared to 9% of those in the community, though the difference was not statistically significant. There were no correlations between the residential setting and the location of the bruise on the body, or days to resolution.

Mobility

Seventy-seven percent of study participants reported that they ambulated independently at home (without an assistive device) and 67% reported that they ambulated independently in the community (67%). No significant differences were observed in the number of bruises, location of bruises, or number of days until resolution between those who ambulate independently and those who use assistive devices.

Falls are the most common cause of injury in older persons and a common sequelae of bruises[14]. Subjects were queried on the frequency of falling in the past week, month, 6 months, and year. Three subjects fell in the last week, 7 in the past month, 10 in the past 6 months and 23 participants had fallen in the past year. Two of the bruises in this study were reported to be the result of a fall. Those who reported falling were not more likely to have more bruises than those who reported not falling in the last year.

On the Tinetti Gait assessment, a score of 12 indicates a steady gait and 0 indicates a gait characterized by hesitancy, non symmetrical steps, discontinuity, marked sway in trunk, deviation, wide stance[15]. Scores ranged from 1-12 with a mean of 9.25 (S.D. 2.19). On the Tinetti Balance assessment, a score of 16 indicates a steady balance and 0 indicates significant problems with balance. Scores ranged from 3-16 with a mean of 11.82 (S.D. 3.27). No significant correlation was observed between gait or balance and number or location of bruises.

DISCUSSION

Millions of American seniors have been injured, exploited, or otherwise mistreated by someone on whom they depended for care and protections[16]. Actual abuse or neglect is rarely directly observed by medial, legal, or social services professionals. In the absence of eyewitness testimony, law enforcement must rely on circumstantial evidence such as investigation and physical examination by medical professionals. The current state of knowledge, however, does not always allow physicians to link physical signs with diagnosis of abuse or neglect[17].

In a first step toward building this literature on the medical forensic aspects of bruising, we sought to document the occurrence and progression of normal bruising in the geriatric population in hopes that the systematic documentation of accidental bruises could provide a basis for comparison when considering suspicious bruising in older adults.

Results suggest that accidental bruises occur in a predictable pattern in older adults. Nearly 90% of the bruises were on the extremities and in daily observation of 101 older adults, not a single accidental bruise was observed on the neck, ears, genitals buttocks, or soles of the feet. Most large bruises that are accidentally inflicted are on the extremities. Of the 20 large bruises (5-50 cm) in this study only 1 was on the trunk. Moreover, older adults are significantly more likely to know how the bruise happened if the bruise is on the trunk.

While a discernable pattern was observed in the location of the bruises, the initial color and color change over time are less predictable. Contrary to the perception that a yellow coloration indicates an older bruise, 16 bruises were predominately yellow on the

first day of observation, and 30 bruises were largely purple on their tenth day of observation. Consistent with the pediatric literature, red coloration was observed throughout the course of the bruise, often from day 1 all the way until day 42, the last day of observation.

Medications that impact with normal blood clotting appear to impact bruising in older adults. Those on medications known to have at least a moderate impact on bruisability were more likely to have multiple bruises. Given a relatively small sample size and having controlled for medications, medical conditions did not significantly impact number or duration of bruises. A notable exception was association between bruise location (trunk verses extremity) and the condition Hypertension. All of the bruises on the trunk occurred on subjects with hypertension. Only one of those subjects was on a medication known to have an effect on bruising.

Turning next to the relationship to functional ability, we observed that older adults with compromised functional ability were more likely to have multiple bruises.

A serious limitation of this study is the absence of participants from other ethnic backgrounds as skin color is likely to impact the appearance of bruising. Future research is needed on accidental bruising in older adults from various racial and ethnic communities. In addition to increasing our understanding of bruising in seniors with various skin tones, data from an ethnicity study could be coupled with existing data to increase the sample size and potentially provide more definitive results on such variables as medications, medical conditions, and functional ability.

After examining accidental bruising in older adults, the next step is research on bruises known to have been inflicted as the result of physical elder abuse. Identifying

these types of bruises would require a multidisciplinary partnership with law enforcement, the district attorney, and social services as there are still relatively few cases that have been legally identified as physical elder abuse.

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