March 2019 Featured Articles, Volume 228

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Article 1: Burn, Trauma, Critical Care; General Surgery
Wounding patterns based on firearm type in civilian public mass shootings in the United States. Sarani B, Hendrix C, Matecki M, et al. J Am Coll Surg 2019;228:228–234

Article 2: General Surgery; Plastic Surgery
Preemptive treatment of phantom and residual limb pain with targeted muscle reinnervation at the time of major limb amputation. Valerio IL, Dumanian GA, Jordan SW, et al. J Am Coll Surg 2019;228:217–226

Objectives: After reading the featured articles published in this issue of the *Journal of the American College of Surgeons* (JACS), participants in this journal-based CME activity should be able to demonstrate increased understanding of the material specific to the article featured and be able to apply relevant information to clinical practice.

A score of 75% is required to receive CME and Self-Assessment credit. The JACS Editor-in-Chief does not assign a manuscript for review to any person who discloses a conflict of interest with the content of the manuscript. Two articles are available each month in the print version, and usually **4 are available online for each monthly issue, going back 24 months.**

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ARTICLE 1

(Please consider how the content of this article may be applied to your practice.)

Wounding patterns based on firearm type in civilian public mass shootings in the United States

Sarani B, Hendrix C, Matecki M, et al
J Am Coll Surg 2019;228:228–234

Learning Objectives: After study of this article, the reader should be able to describe the pattern of wounds associated with use of different firearm types used in civilian public mass shooting (CPMS) events; describe the case fatality rate associated with use of different firearm types used in CPMS events; and describe the incidence of potentially preventable death associated with use of different firearm types used in CPMS events.

Question 1

This study found that, as compared with civilian public mass shooting events that were carried out with a handgun, events that were carried out using only a rifle were associated with:

a) More people injured but a lower-case fatality rate
b) Fewer people injured but a higher-case fatality rate
c) Fewer people injured and a lower-case fatality rate
d) More people injured and a higher-case fatality rate
e) No difference in number of people injured or case fatality rate

Critique: Events that involved only a rifle were noted to have a higher number of people injured but a lower number of gunshot wounds per victim. This, in turn,

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resulted in a lower probability of having a fatal organ injury and therefore, risk of death.

Question 2

Potentially preventable death was more likely in events involving:

a) Only handguns
b) Only shotguns
c) Only rifles
d) A mix of different firearm types
e) There was no difference in potentially preventable death rate based on firearm type used.

Critique: The potentially preventable death rate was highest in events that had the least number of gunshot wounds per victim. Events involving handguns had a higher number of gunshots per victim; events involving rifles had a lower number of gunshots per victim. As the number of gunshots per victim increased, the probability of fatal organ injury increased.

Question 3

The organ injury that most commonly resulted in a potentially preventable death regardless of type of firearm used was:

a) Intestine
b) Lung
c) Brain
d) Spinal cord
e) Femoral artery

Critique: The most common cause of potentially preventable death was a pneumothorax without concomitant hemothorax or thoracic great vessel injury. Spinal cord injury was the next most common cause of potentially preventable death. Brain injury was noted to be the most common cause of nonpreventable death.

Question 4

What was the relationship noted between firearm type and specific organ injury?

a) Injuries from rifles were more likely to involve the liver.
b) Injuries from shotguns were more likely to involve an extremity.
c) Injuries from handguns were more likely to involve the brain and heart.
d) Injuries from mixed firearm events were more likely to involve the vena cava.
e) Injuries from handguns were most likely to involve the aorta.

Critique: Events involving handguns had the highest case fatality ratio because they were most likely to involve injuries to the brain and heart. Rifle injuries most commonly involved the brain and lung. Shotgun injuries most commonly involved the liver. Injuries from multiple firearms most commonly involved the lung, liver, heart, and brain.

ARTICLE 2

(Please consider how the content of this article may be applied to your practice.)

Preemptive treatment of phantom and residual limb pain with targeted muscle reinnervation at the time of major limb amputation

Valerio IL, Dumanian GA, Jordan SW, et al
J Am Coll Surg 2019;228:217–226

Learning Objectives: After study of this article, surgeons should be able to compare the effectiveness of primary targeted muscle reinnervation (TMR) surgery as a pain reduction surgical treatment strategy to a cohort of amputee patients who have not undergone the investigational surgery.

Question 1

Targeted muscle reinnervation (TMR) surgery involves the following:

a) Moving an amputated peripheral nerve into any surrounding muscle within the residual limb.
b) Performing an end-to-end nerve transfer of an amputated peripheral nerve to a freshly deinnervated motor nerve in surrounding muscle within the residual limb.
c) Taking the amputated peripheral nerve, pulling on it, and cutting it back so that it can retract back into the more proximal surrounding muscle or wound bed of the residual limb.
d) Splicing the amputated peripheral nerve into many subunits and burying these smaller peripheral nerve segments into any surrounding muscles.
e) Taking multiple small muscle grafts and wrapping these grafts around the amputated peripheral nerves and then replacing these muscle-grafted peripheral-nerve interfaces into the surrounding wound bed.

Critique: Targeted muscle reinnervation (TMR) is a peripheral nerve transfer procedure that reroutes the amputated axons to motor endplates and sensory organelles in nearby muscles via an end-to-end nerve transfer. Placing amputated nerves into muscle is a technique that has been previously accepted as a treatment strategy for

neuromas, although a recent randomized controlled trial showed that TMR surgery was superior in various pain control measures as compared with the burying-in-muscle surgical technique. Placing tension on the nerve and cutting it refers to traction neurectomy, which is a way many nerves have been treated during amputation surgery. Splicing the nerve into multiple segments to be buried into muscle is not a general principle of TMR surgery. Placing amputated nerves into muscle grafts and then re-implanting these created nerve-muscle-graft interfaces is a peripheral nerve treatment strategy described as regenerative potential nerve interfaces and does not refer to TMR surgery.

Question 2

Which of the following principles is a general suggestion in primary TMR:

a) Attempts to locate the transferred nerves in areas where the residual bone does not compress directly on the nerve coaptations/transfers.
b) Maintaining excessive tension on the nerves to be transferred during the entire procedure to aid in expansion of the nerve during the surgery.
c) Avoiding any nerve targets because this procedure involves placing the nerve into muscle.
d) Partially affixing the nerve to bone to prevent movement of the nerve transfer.
e) Purposely damaging the axons within the amputated nerves to inhibit nerve regeneration.

Critique: Dissection of nerves during primary TMR and any peripheral nerve surgery case is incredibly important. Nerves should be handled with care, with minimal tension, and avoiding trauma, such as crushing the nerves, is critical to minimize axonal injury and allow the regenerating nerves to grow into the targeted muscle for reinnervation to occur. Partially affixing the nerve to bone could cause pistoning of the bone on the nerve and lead to increased nerve irritation and pain. Purposely damaging the nerves is to be avoided. Nerve regeneration for reinnervation of the target muscle is the ultimate goal of TMR surgery because this technique has been shown to reduce phantom and residual limb pain in a number of amputees.

Question 3

Primary TMR surgery has been shown to reduce:

a) Only phantom limb pain
b) Only residual limb pain
c) Both phantom and residual limb pain
d) Neither phantom nor residual limb pain
e) It affects only neuroma pain and not phantom or residual limb pain

Critique: In this article, multiple types of pain suffered by amputees were investigational areas of interest and focus. Phantom limb pain and residual limb pain were specific pain types included in the surveys used to assess both cohorts of amputee patients (primary TMR amputee patients and amputee patients who did not receive TMR surgery), as was symptomatic neuroma pain. Patients who underwent primary TMR had less phantom limb pain and residual limb pain compared with untreated amputee controls across all subgroups and by all measures.

Question 4

Which of the following is TRUE about primary TMR amputee patients during their postoperative recovery?

a) Patients experience significant delays in their ability to perform prosthetic fitting and wear because of the extensive soft tissue dissection and change in technique for any level of amputation.
b) Patients can never use a prosthetic because the surgery is only for pain control and precludes use of prosthetics in the amputee's rehabilitation.
c) Patients have much longer hospital stays that those patients who do not undergo primary TMR surgery because the surgery is much more extensive than an amputation and severely delays the amputee patient's ability to perform rehabilitation.
d) Typically, patients have the same recovery and rehabilitation experiences as those amputee patients who did not receive TMR surgery.
e) These patients do not have any postoperative care or recovery needs.

Critique: Although primary TMR surgery does require increased time to perform the nerve transfers at the time of the index amputation surgery, this surgery has postoperative recovery and rehabilitation experiences that are similar to those in other amputee patients. Delays in prosthetic fitting are not typical, and primary TMR surgery amputee patients often report better tolerance to their prosthetic wear; they suffer less often from symptomatic neuromas or phantom and/or residual limb pain. These patients do have more soft tissue dissections, but this has not been shown to delay their timing to prosthetic wear. The length of hospital stay is not statistically different between amputees who undergo primary TMR surgery and those who do not undergo this nerve transfer surgery.

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ANSWERS

Article 1	Article 2
Question 1 _____	Question 1 _____
Question 2 _____	Question 2 _____
Question 3 _____	Question 3 _____
Question 4 _____	Question 4 _____

Evaluation Form

Article 1	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Topics and content were consistent with learning objectives.	○	○	○	○	○
2. Content was relevant to my educational needs.	○	○	○	○	○
3. I will seek additional information on this subject.	○	○	○	○	○
4. The article and questions were relevant to my practice.	○	○	○	○	○
5. Content was fair, objective, and unbiased.	○	○	○	○	○
(Please explain any specific instance[s] of bias or conflict of interest.)					
Article 2					
1. Topics and content were consistent with learning objectives.	○	○	○	○	○
2. Content was relevant to my educational needs.	○	○	○	○	○
3. I will seek additional information on this subject.	○	○	○	○	○
4. The article and questions were relevant to my practice.	○	○	○	○	○
5. Content was fair, objective, and unbiased.	○	○	○	○	○
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