Root Cause Analysis of Preventable Limb Loss and Subsequent Death After Arteriogram: Improved Focused Nursing Education and System Processes

■ Jennifer J. McClaran, BSN, RN, CRN, CLNC; and Krystal Scarbrough, BSN, RN

ABSTRACT: **The purpose of this article is to identify, by root cause analysis (RCA), the contributory factors in patient care leading to limb loss with subsequent death after elective arteriogram. A case study demonstrating a system failure and the ensuing action plans are presented. This RCA identifies inadequacies displayed in the nursing process and a breach of duty, specifically during the nursing assessment. Competency, communication, and compliance were reviewed as well during this investigative process, and necessary revisions were made. Mandatory nursing education and training were implemented regarding vascular anatomy, intravascular procedures occurring in interventional radiology, and neurovascular assessment after lower extremity arteriogram. Policies were standardized involving specific hospital units caring for postintravascular procedure patients. As evidenced in this sentinel event, negligent acts can occur without the utilization of appropriate and complete nursing processes. (J Radiol Nurs 2015;34:39-42.)**

KEYWORDS: **Root cause analysis; Arteriogram; Assessment; Breach of duty; Education.**

INTRODUCTION

The objectives of this root cause analysis (RCA) were to identify the contributory factors of inadequate system processes and any breach of duty during the postarteriogram phase of care. The legal duty of the health care system begins when a relationship with a patient is established (Milazzo, 2011, p. 122). Understanding patient anatomy and performing an appropriate nursing assessment in the postarteriogram patient is pivotal in applying correct nursing diagnoses, care plans, and interventions. Accurate and timely nursing assessments are crucial in determining the postarteriogram patient's baseline and aid in identifying any deviations that elicit concern. We present a patient who had an elective lower extremity arteriogram that resulted in loss of arterial blood flow through the entirety of his right lower extremity and ended with an above-the-knee amputation and ultimately death.

Table 1 demonstrates *The Joint Commission's Root Cause and Action Plan Framework Template* used in identifying a chronology of events with associated failures in the system processes and guidance for implementing a risk reduction plan (The Joint Commission, 2013). Interviews were performed with each health care provider who had established duty to this patient

Jennifer J. McClaran, BSN, RN, CRN, CLNC, is the Certified Legal Nurse Consultant at the Prosperity Legal Certified Nurse Consultants, Holden, MO

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Corresponding author: Jennifer J. McClaran, 750 NW 1371st Road, Holden, MO 64040. E-mail: prosperitylegalnc@gmail.com

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Table 1. System failures and risk reduction strategies

What happened? (proximate cause)	Why did this happen? (contributing factors)	Action plan (risk reduction strategy)
Inadequate patient assessment	1. Failure to identify vascular compromise of the lower right extremity 2. Failure to correlate the patient's complaint of pain with the pathophysiology of ischemia	1. Mandatory review of the proper assessment skills used in the care of postarteriogram patients 2. Mandatory education pertaining to lower extremity vascular anatomy and review of pathophysiology and the "6 P's" of ischemia
Absence of procedural compliance	1. Failure to perform pulse checks at ordered intervals 2. Failure to notify physician of patient's persistent complaints of pain 3. Failure to notify physician regarding the change in neurovascular status of patient's right lower extremity	1. Review of standing orders, interventional radiology postarteriogram orders, as well as cardiology and vascular surgery order sets
Ineffective communication	1. Failure to notify physician of patient persistent pain 2. Failure to notify physician of change in right lower extremity condition 3. Handoff report between night shift nurse and oncoming day nurse did not take place at the patient's bedside 4. Charge nurse did not implement the postarteriogram care plan for the unit nurse 5. Failure to properly document vital signs, groin site checks, and neurovascular status on postarteriogram patients	1. Review of IR postarteriogram order set 2. Implementation of bedside safety handoff between off-going and oncoming nursing staff 3. Training provided to all staff (staff nurse, charge nurse, and secretary) on appropriate computer charting and correct care plans and interventions for postarteriogram patients 4. Interval audits performed on postarteriogram patient charts and feedback provided as necessary
Inadequately demonstrated competency	1. Nursing supervisor placed patient on a medical/surgical unit who infrequently receive postarteriogram patients 2. Lack of critical thought process with regard to basic fundamentals in neurovascular functions	1. Medical/surgical unit policies reviewed and standardization of unit placement of postarterial access patients (i.e., postarteriogram and postcardiac catheterization) 2. Mandatory education on the neurovascular system

IR = interventional radiology.

throughout the duration of this hospital course. The included providers interviewed were the interventional radiology (IR) physician, IR nurses, nursing house supervisor, medical/surgical charge nurse, medical/surgical floor nurse, and IR technologists.

CASE STUDY

An elderly man with a history of peripheral vascular disease, hypertension, transient ischemic attacks, dementia, and bilateral foot wounds was sent in consultation to IR for evaluation and treatment of his claudication symptoms. He was currently being treated in a wound center with unsuccessful resolution of his diagnosed lower extremity arterial ulcers. A noninvasive ultrasound duplex of his bilateral lower extremities identified an area of stenosis amenable to treatment. A bilateral lower extremity arteriogram with possible intervention was recommended. The patient and his durable power of attorney were elected and consented to proceed with outpatient arteriogram to be performed by the interventional radiologist. The lesion of high-grade stenosis was identified during right lower extremity angiography. Angioplasty with stent placement was performed without difficulty, and the arterial flow in the right lower extremity was restored. Because of the time of day the procedure took place, the IR physician ordered overnight observation. The nursing house supervisor was notified, and an inpatient room and nurse were assigned on the medical/surgical unit. The IR nurse transported the patient to his room, and a bedside handoff was performed with the unit nurse. The postarteriogram physician orders were reviewed by both nurses and placed on the patient's chart.

The IR physician did not receive any phone calls regarding this patient. Postprocedure day 1, the patient's newly assigned day nurse called the IR department requesting the IR physician and/or IR nurse to "please come see him (patient), so I can discharge him." The unit nurse then stated, "I felt a small knot at the groin, but there is no hematoma or blood I can see. I'd like someone to come and look at it (groin site) and also he (patient) has been complaining that his right leg hurts."

On patient assessment by IR physician and IR nurse, the patient's right leg was notably cyanotic from the knee extending down to his toes. The patient was found to have the same intact dressing on his right