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Vascular Surgery Sample Case

Knee dislocation with severely torn popliteal artery with delays in surgical artery repair, and incomplete fasciotomy (muscle tension release procedure) resulting in amputation.

The patient was at the time of the accident a 19-year-old white Caucasian male. He was riding a dirt bike where he was living. He was possibly under the influence of alcohol, and he popped a wheelie and lost control of his bike at that point. There was no collision with anything, and after losing control, he injured his left knee, most probably with an hyper-extension mechanism.

He was complaining of severe pain in his left leg, he was not able to use it, and then the emergency crew or medical services were brought. After being transferred to another ambulance on his way to the hospital, for unknown reasons, he was admitted to Hospital #1 on the night of March 17. His admission was around 7:00 p.m., and the reported incident or his first pickup by the ambulance service was around 5:45 p.m., if the records are accurate for that particular time report.

A final diagnosis at the Emergency Room by the Physician, Dr. #1, was of a left knee dislocation with possible associated vascular injury. This was confirmed by Dr. #2, the Orthopedic Surgeon who was asked to consult. He was there within 40 minutes of the arrival of the patient and, based on the x-ray and his clinical assessment, immediately diagnosed a dislocated left knee and that it was imperative to immediately remove the patient from the Emergency Room department and to send him to the Operating Room. The patient was given general anesthesia, and a closed reduction of the anterior dislocation of the left knee was performed by Dr. #2.

Review of the operative report says that prior to his reduction, he was not able to find any distal pulse in the arteries of the left leg, and that the pulse did not return after the closed reduction. Although it was clinically obvious that he had a vascular injury, the patient

was extubated and sent to the radiology suite for having a full angiogram (artery x-ray dye study) performed. This took about two hours which, I think, is an unnecessary delay since it was obvious clinically, he had an arterial injury. Vascular exploration should have been commenced immediately in the operating room under the same anesthesia, and if needed to be, an on table arteriogram could have been performed prior to the definite surgery.

I cannot find through the records if the angiogram, as performed in the radiology suite, was standard procedure or it was originating as a direct order from Dr. #3, the Vascular Surgeon. Anyway, this constituted an unnecessary delay, standard tests pointed that it was obvious clinically, as reported by Dr. #2, that there was an arterial injury that needed immediate exploration, and to send the patient down to the radiology suite for having an angiogram constituted an unnecessary delay and seems to be departing from usual standards.

The Surgeon who performed the vascular exploration was Dr. #3, assisted by Dr. #4, and the surgery was done the same night after the arteriogram. The day of surgery is listed as March 18, but since the surgery ended up after midnight and was dictated after the surgery, the date of surgery is actually the continuation of the surgery started on March 17.

Report of the surgery shows that a left popliteal artery was found to be avulsed (*torn*) from its distal insertion, and there was a large hematoma (*blood clot*). Exploration of the popliteal space was done, repair of the popliteal artery avulsion with a reverse left saphenous vein graft was done, and medial and lateral fasciotomy (*severing the fibrous flesh surrounding the muscles*) were supposedly performed. We don't know the details about the fasciotomy as mentioned, and an on table intraoperative arteriogram was performed during surgery.

I reviewed the arteriograms and, although there was some reperfusion (blood flow), there was a lot of spasm at the saphenous vein graft site, and there was no evidence of any good distal perfusion after that surgery. It was reported that a good flow was obtained, and the patient was sent to the ICU, where the vascular assessment was done. Apparently, after an hour or two, they were able to find a distal pulse and a slight recoloration of the limb and an improvement of its warmth.

The patient's case did not progress well after the surgery and as expected, and he progressively showed signs of ischemia (*poor blood flow*) or arterial insufficiency. Two days later, March 20th, he was returned to surgery because of a thrombosis (*clotting*) of the bypass graft. Dr. #3 performed an embolectomy (*clot removal*) but was not successful in completely returning the flow. The surgery was performed by Dr. #3 on March 20, and

was started at 10:30 a.m. and finished at noon. The surgery shows that a blood clot was found in the left popliteal artery bypass graft, and that a Fogarty catheter was inserted proximally and distally to remove the blood clots. Good pulsation was noted in the popliteal artery, as reported, and it seems that the graft as well as the popliteal artery were reperfused.

It was decided to continue with heparinization (*a blood thinner: anticoagulant*) of the patient, and the patient was taken to the recovery room in stable condition. Blood loss was reported as 250 ccs (*8 ounces*). This operative report was dictated on the following day, March 21, at night. It seems that the patient was not able to reperfuse his left leg, and severe life-threatening ischemia was developing. Arrangements were made to transfer the patient to Hospital #2 for further assessment and treatment.

I didn't find details about how the transfer was done, but apparently the patient's condition deteriorated on March 20th. From comments picked up from the patient, the nurses, and the family, it seems that Dr. #3 told the patient's mother that discussions were made to eventually transfer the patient to a more specialized center. Dr. #2 was in surgery and actually was not the one who made the decision since the limb threatening ischemia was the result of vascular problems, and Dr. #3 had to make the decision. The patient finally was transferred late that night to Hospital #2.

In the recovery room, at 12:15, the patient's peripheral pulses were absent upon on return from surgery, contrary to what was reported in the operative note, and there seems to be definite discrepancies in between the way the Surgeon reported it and the way it was clinically assessed in the recovery room.

After being transferred to Hospital #2, the patient came under the care of Dr. #5. He was immediately rushed to the Operating Room because of the seriousness and acuteness of his condition.

Dr. #5 mentioned in his indication for procedure that the patient arrived by helicopter approximately 7 hours after the initial arrangements have been made. I cannot explain such a long delay in between the discussion over the phone and the actual transfer of the patient.

I have found a few notes that the patient was not stable and was bleeding, but also have reports that Dr. #3 was not actually in the hospital at the time where the orders were originating, and I think that the limb threatening situation was quite acute and was necessitating a very rapid transfer by helicopter to Hospital #2.

When he arrived 7 hours post ischemia, it was already too late to do anything, and the limb was probably almost dead, since the golden rule is that there is some chance of revascularization of a limb if there is less than 6 hours of ischemia. From the records and reports, we have indications pointing that the limb was not vascularized from mid morning until the time he arrived to Hospital #2. Although they attempted a salvage procedure, I think that the limb was already almost dead and, if ever revascularized, would have been the source of severe problems and residuals which probably would have lead anyway to an amputation above the knee.

Also, the operative findings of Dr. #5 are quite interesting in saying that he had significant occlusion of the bypass graft, cadaveric appearance of the foot, attesting to my previous comments, and also that the fasciotomy was shown not to go completely down below the leg and were stopping at about the mid third of the calf and actually were not considered as a complete fasciotomy. He also found that the lateral compartment has not been released, and that the medial and anterior compartment was not completely released.

These incompletely released fasciotomies showed that there was muscular tension underneath, possibly muscular necrosis (gangrene) since it was going on for about two days, and those are contributing factors to prevent distal perfusion of the limb, since there is excessive pressure in those compartments.

I do think from the operative findings at Hospital #2, that there was incomplete compartmental release through the fasciotomies; this incomplete release of the compartment of the left leg could have contributed in someway in preventing distal perfusion of the left lower extremities, and constituted also, a source of muscular compromise since it seems that the muscles were under tension and quite bulging after Dr. #5 completed the fasciotomies.

Unfortunately, the revascularization or attempts in salvaging the limbs were unsuccessful and, although the patient had a debridement (*cutting out of flesh*) of Clostridial gangrene, which is a serious infection originating from dead tissue, he eventually had to go through an above-the-knee amputation in a standard fashion on March 25. This is quite sad, and it seems that this limb could have been saved earlier.

There is also report of a laceration at the popliteal vein, but this was most likely done at the time of the attempt in removing the blood clot on the morning of March 20th.

This case is very complex and interesting and, although he had a very sad and tragic outcome, it raises a few questions. There is definitely indication of a few departures from the accepted standard of care, mainly in the field of Vascular Surgery.

Although there was a transfer of ambulances on the way to Hospital #1, from what I could pick up from the records, which is due to the fact that he needed to have injection of IV drugs to control his pain and symptoms, and this was not available in the first ambulance he took, he was adequately rushed to Hospital #1 in a timely fashion.

The assessment in the Emergency Room by the doctor and by Dr. #2 was done in a timely fashion, and Dr. #2 pointed out that he was suspecting a vascular injury, which is the most common complication and associated injury with anterior dislocation. It happens in about 25-30% of the anterior knee dislocations as reported in the literature.

Closed reduction was done in a standard fashion and timely manner but, what is surprising and could be a source of unnecessary delay and could be departing from the accepted standard of care, is the fact that the patient was extubated, sent to the radiology suite for having a full angiogram, which constituted about two hours delay before starting the actual vascular exploration.

I think there was sufficient clinical evidence and objective findings to attest that there was no pulse returning to the leg, and that the most common cause to it was a vascular injury. This is delineated in every standard textbook, and I think that at this time a vascular exploration should have been decided right then after the closed reduction and without having to go through two hours of delay in performing an angiogram. An on table angiogram could have been done, since it was done by Dr. #3 later on that night, and would have prevented unnecessary delay. We still have to obey by the rules of no more than 6 hours of arterial ischemia to be able to save a limb or to avoid serious residuals or complications.

Then the surgery was done, but retrospectively by analysis of Dr. #5's operative note, it seems that the fasciotomies were not done completely and that the lateral compartment was not released, and this would constitute a departure from at least the standard of care, or the state-of-the-art decompression fasciotomy.

Usually, fasciotomies have to liberate the medial, the anterior and the lateral compartment, and the incision should be carried out down to the distal third of the leg so that all the muscular masses are decompressed. If you leave part of the muscle not decompressed, pressure will build up and the intra-muscular pressure will be superior to the arterial pressure, and will occlude the vessel leading to severe ischemia and eventual necrosis of the muscle. This also constitutes a severe obstacle for reperfusion since the muscles exert extreme pressure and prevent the distal arteries from being reperfused after the bypass surgery was done. So, this constitutes, at least technically, a departure from the state-of-the-art technique.

The follow-up and postoperative care in the first two days seems to be adequate, always there is some detail that could be found, but they don't constitute any major deviation from the accepted standard of care and I don't see any evidence of negligence.

The diagnosis of a thrombus on March 20th was appropriate, the surgery to try to do an embolectomy seems to be adequate, but what I find to be quite suspicious is the fact that the operative reported noted that there was a good distal arterial pulse, and there was completely opposite findings when the patient came to the recovery room. Then, the way the arrangements were done to transfer the patient to Hospital #2 are not quite clear, and there is definitely negligence or departure from the accepted standard of care when you have a limb-threatening ischemia to have nearly 7 hours before the patient arrives at destination, the operating room, for urgent surgery.

For the reason mentioned earlier, I think that the limb was already dead at that time, and they only tried to do a salvage procedure without real chances of success. The fact that Dr. #5 mentioned the 7 hour time frame is basically to point out that he was already beyond the usually accepted time frame for revascularization of a threatened limb.

Basically, the deviation from accepted standard of care and negligence was the way the vascular injury was dealt with. I don't find any deviation from the standard of care from the way the Orthopedic Surgeon did his part, and the only thing that I would question is why didn't he ask for the Vascular Surgeon to come right away and to perform the exploratory surgery while he was having the patient under general anesthesia and still in the operating room the night of March 17th, instead of letting the patient go to the angiogram suite in radiology.

Based on information and records provided, it would appear that the above issues represent viable avenues of pursuit in this case, for negligence or deviation from the accepted standard of care.

Because of the complexity of this case, and also the fact that it involves mainly vascular repair, a Vascular Surgeon would be recommended since most of the deviation from standard of care or the negligence seems to be pertaining to the diagnosis, repair and treatment of the vascular injury resulting from the anterior left knee dislocation.

I don't see any major issues regarding the way the Orthopedic Surgeons handled that case, and I would focus my attention on the vascular portion of that particular case.