Reporting postoperative cranial imaging: tips and pitfalls

Poster No.: R-0107
Congress: RANZCR ASM 2013
Type: Educational Exhibit
Authors: S. Zaheer, C. Winter, A. Coulthard; Brisbane/AU
Keywords: Neuroradiology brain, CT, MR, Catheter arteriography, Education, Surgery, Education and training
DOI: 10.1594/ranzcr2013/R-0107

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply RANZCR's endorsement, sponsorship or recommendation of the third party, information, product or service. RANZCR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold RANZCR harmless from and against any and all claims, damages, costs, and expenses, including attorneys’ fees, arising from or related to your use of these pages.

Please note: Links to movies, .ppt slideshows, .doc documents and any other multimedia files are not available in the pdf version of presentations.

www.ranzcr.edu.au
Learning Objectives

• To understand the normal range of imaging findings post intracranial surgery

• To be aware of the appearances of neurosurgical implantables post intracranial surgery

Background

Intracranial pathology can be treated with a wide range of neurosurgical techniques. Follow up imaging is part of the postoperative routine. Interpreting postoperative imaging after cranial surgery may be confusing to the reporting radiologist due to the presence of blood products, contrast enhancement, surgical site, approach and technique and/or appearance of surgical implantables. Awareness of common expected postsurgical appearances should lead to more useful and accurate reports.

Imaging Findings OR Procedure Details

This exhibit uses case examples to illustrate common and not so common findings after cranial neurosurgery.

**Midline Shift**

Midline shift (MLS) in a preoperative scan may be an indicator of significant pathology. The neurosurgeon should be informed urgently. However midline shift may be an expected appearance in the postoperative patient.

In this case (Figure 1) the post operative scan was reported as showing MLS due to postoperative subdural collection (arrow). In fact the reason for the midline shift was cerebral oedema (block arrow) and contralateral placement of an external ventricular drain (EVD), leading to reduction in volume of the lateral ventricle. It can be seen that the sulci and gyri deep to the subdural collection are not effaced (Figure 2), which is a good indicator that the brain underlying the subdural collection is not under pressure.

**Fluid collection in surgical bed or beneath craniotomy site**
Neurosurgeons often use bone substitutes around the craniotomy site. To prevent the bone substitute from falling into intracranial cavity, surgicel, a haemostatic agent, is layered under it (figure 3). This can appear as collection on postoperative imaging. Therefore it is important from a radiologist's point of view to be aware of artificial materials commonly used by neurosurgeons intraoperatively

**Infarction**²,³:

Postoperative non-contrast cranial CT is a routine investigation after cranial surgery. Postoperative surgical edema can be mistaken for infarction.

1) Intracranial haemorrhage (ICH) secondary to aneurysm rupture in a 55 year old patient. Post clipping CT images showed frontal lobe hypodensity (arrow in figure 4). This was queried as possible infarction. However the patient had no correlating symptoms. In fact the hypodensity had been evident on the pre operative imaging. (arrow in figure 5)

2) 40 year old patient presented with Subarachnoid haemorrhage (SAH) following rupture of a left pericallosal aneurysm, which was surgically clipped via an inter hemispheric approach. The post operative scan showed a small region of hypodensity within the anteromedial left frontal lobe (Arrow in Figure 6). The possibility of left ACA territory infarction was raised. There were no correlating clinical symptoms. The hypodensity is due to cerebral oedema

3) 66 year old patient with large bifrontal meningioma (figure 7) had surgical resection performed via bifrontal craniotomy and interhemispheric approach.. Post operative scan showed loss of grey white differentiation in the left frontal lobe (arrow in figure 8) and was suspicious for acute ischemia. The findings were due to frontal lobe retraction during surgery, causing cerebral oedema. The patient had no correlating clinical symptoms

**Appearance of Prosthesis:**

**Cranioplasty implants**²:

Craniectomy (removal of skull bone) is a common neurosurgical procedure. It may be performed to treat medically unmanageable raised intra cranial pressure, cranial bone osteomyelitis, or compound fracture of the skull bones. At an appropriate time after the patient has recovered a cranioplasty is performed. The neurosurgeon decides which type of graft to use.
Autologous: patient's own bone if still viable and available.

Prosthetic: Custom made for specific patients. This could be either made of titanium (figure 9 and 1) or acrylic (figure 11 and 12) (two of the most commonly used cranioplasty implants)

Burr hole covers

It is very common for a burr hole to be left uncovered after surgery. However, occasionally a circular plate (arrow in figure 13), usually made of titanium and secured with screws, can be used as a burr hole cover. It should be recognized on a postoperative scan

Cranio Fix

Cranio fix are securing devices, which can often be used to secure a craniotomy flap after surgery. They have specific appearance and reporting trainee should be aware of it. As shown in figure 14 & 15.

VP shunt, EVD and ICP monitor

Ventriculo-peritoneal (VP) shunts, External ventricular drains (EVD) and Intracranial Pressure Monitors (ICP) are amongst the most common prosthesis used in neurosurgery, both in emergency and elective surgeries. It is imperative that a radiology trainee is aware of the normal postoperative appearance of these implants on imaging and what could be the potential complications of these implants. Figures 16, 17 & 18 show normal appearance of VP shunt on X rays and CT and the the artefact caused by the VP shunt valve on MR. Figure 19 shows the trajectory of EVD from burr hole site to the ventricle. Figure 20 shows the tip of ICP monitor and a small associated haematoma in the right frontal brain parenchyma.

Aneurysm clips

Surgical clipping of an aneurysm is a common neurosurgical procedure and required long-term follow up imaging. The clip may cause significant artifact in postoperative imaging (as seen in figures 15 & 16), whether MRI or CT, which makes reporting a scan challenging. DSA is the gold standard imaging test but it is not without risk.

Common findings after cranial surgery
Pneumocephaly:

The presence of intracranial air after cranial surgery is commonly noted on postoperative scans. Tension pneumocephaly is an emergency condition and should be reported to the clinician as soon as identified. The postoperative image may give the appearance of tension pneumocephaly although the patient remains clinically stable. This may be seen after prolonged cranial operations or after long periods with the patient lying flat in bed post surgery.

Post Cranioplasty:

Expected appearance post craniectomy:

Craniectomy is generally performed when a patient’s intracranial pressure is persistently elevated and is refractory to all medical management. Figure 23 and 24 show example of expected post operative appearance after craniectomy with presence of brain herniation, sub dural collection and dural calcification.

Documented but rare appearance after cranioplasty:

This 60 year old patient had decompressive craniectomy for spontaneous intracerebral hemorrhage (ICH), followed by autologous cranioplasty. Few months down the track patient noticed fluctuating bone under the surgical scar. Scans showed resorption of the patient’s bone with loose prosthesis. Patient went on to have titanium cranioplasty. There was no evidence of infection from the residual bone sent to laboratory for microscopy. Figure 26 and 27.

Location of Craniotomy:

The location of craniotomy can give an indication of the procedure performed. Figure 28 indicates commonly performed craniotomies.

Images for this section:
Fig. 1: Post operative non-contrast CT brain (axial image) Showing Subdural collection (arrow) and oedema surrounding the surgical cavity (block arrow)
Fig. 2: Post operative non-contrast CT brain(axial image) showing patent sulcal pattern under the subdural collection (arrow)
Fig. 3: Post pterional craniotomy CT brain (axial image) showing surgicel under craniotomy site (arrow)
Fig. 4: Post operative non-contrast CT brain(axial image) showing hypo density (arrow) around the evacuated haematoma site.
**Fig. 5:** Pre operative non-contrast CT brain (axial image) showing presence of hypodensity (arrow) surrounding the haematoma.
Fig. 6: Post operative non-contrast CT brain (axial image) showing hypo density (arrow) in anteromedial left frontal lobe.
**Fig. 7:** Preoperative non-contrast CT brain (axial image) showing large bifrontal meningioma.
Fig. 8: Post operative non-contrast CT brain (axial image) showing loss of grey white differentiation (arrow)
Fig. 9: Coronal CT image showing normal appearance of titanium cranioplasty implant. (arrow)
Fig. 10: Sagittal CT image showing normal appearance of titanium cranioplasty implant. (arrow)
**Fig. 11:** Coronal CT image showing normal appearance of an acrylic cranioplasty implant (arrow).
Fig. 12: Sagittal CT image showing normal appearance of an acrylic cranioplasty implant (arrow).
Fig. 13: Post operative frontal skull image showing burr hole cover (arrow).
Fig. 14: Axial CT head (bone window image) showing appearance of Crani fix (arrow).
Fig. 15: Sagittal CT head (bone window image) showing appearance of Crani fix (arrow).
**Fig. 16:** Lateral skull X-ray showing Vetricular catheter (small arrow), Valve (long arrow) and peritoneal catheter (block arrow)
Fig. 17: Non-contrast CT brain (axial image) showing normal appearance of valve with CSF inside (arrow).
Fig. 18: MRI brain (axial image) showing artefact caused by VP shunt valve (arrow).
**Fig. 19:** Series of coronal CT brain images showing EVD trajectory from burr hole site to right lateral ventricle

**Fig. 20:** Non-contrast CT brain (axial image) showing ICP monitor tip (arrow) and haematoma around the tract (block arrow) which can be seen after insertion of an ICP monitor.
Fig. 21: CT brain (axial image) showing artifacts caused by bilateral middle cerebral artery aneurysm clips (arrows)
Fig. 22: MRI brain (axial image) showing artefacts caused by right distal ICA and left MCA aneurysm clips (arrows).
Fig. 23: Post operative CT brain (axial image) showing bifrontal pneumocephaly (arrows).
Fig. 24: Non contrast CT brain (axial image) immediately post op. Underlying oedematous brain herniating through the craniecomy defect (arrow)
Fig. 25: Non contrast CT brain (coronal image) few weeks after the surgery showing dural calcification (arrow). As the cerebral swelling has settled, there is now no herniation of brain thorough the defect. A small subdural collection is noted (block arrow)
**Fig. 27:** Fig 27 a: Bone window image of axial CT brain showing loosened titanium plate and screw which was previously holding the autologous cranioplasty implant. Fig 27 b: Axial image of CT brain section showing resorption of autologous cranioplasty implant.
**Fig. 26:** Fig 26 a: Axial CT brain image post craniectomy. Fig 26 b: Axial CT brain image section post autologous cranioplasty

**Fig. 28:** Commonly performed craniotomies.
Conclusion

Radiologists should be aware that surgical material, techniques and operative approach all influence the postoperative imaging findings. This awareness should lead to more useful radiological reports.

Personal Information

References

1) Greenberg, MS. Handbook of neurosurgery. 7th ed. Florida: Theime; 2010

