

Internal carotid artery injury in Transsphenoidal surgery

How to avoid and cope with serious complication, Japanese single-center experience and experts' opinion

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Abstract

Study design: Single center study. retrospective.
Method: Review all the patients’ data from 2018 to 2022 in Japanese high-volume center. Extract patients experienced ICA injury, and assessed causes, treatment, and patient outcomes.
Result: Five patients experienced ICA injury(0.7%) among 740 patients who underwent TSS. All patients are treated with internal trapping immediately. Injury occurred before exposure of sella turnica in 4 patients(80%), during manipulation in Cavernous sinus in one patient(20%). All hemostasis was achieved with direct compression with Gelfoam/ Teflon patties(100%). All cases went through Immediate angiogram(100%) and after checking collateral flow, ICA trapping performed for all(100%). One patient(20%) experienced permanent neurological deficits.
Conclusion: The incidence of ICA injury is low. There are many steps needed to be taken care of, but need so much care especially for re-operative cases.

Introduction

ICA injury is one of the most serious complications in neurosurgery during transsphenoidal surgery, and is likely to lead to a catastrophic outcome. With the recent development of endoscopic surgery in skull base surgery, even young neurosurgeons need to know how to respond to ICA injury after its occurrence, but they have few opportunities to actually experience it.

In this poster presentation, the response after the onset of the injury is on the Video (<https://drive.google.com/file/d/1IG9q9vE1nnaTBFyp-KHM-nwTWvp0JFrE/view?usp=sharing>). Preoperative evaluation, intraoperative procedures that should be performed, and measures that should be taken after occurrence will be discussed, as well as a review of the literature and experts’ opinion.

Methods and Materials

- Single center trial, Retrospective
- Patients underwent TSS From 2018 to 2022 in Moriyama Memorial Hospital in Japan(740)
- Patients who have experienced ICA injury during TSS, assessed the factors, treatment, and patients’ outcomes.

Table 1. Patients’ description

	Patho	Pre-OPE	Lesion	Treatment	Collateral	Pre-OP mRS	Post-OP mRS
60yo F	Cushing	+	Pseudo Aneu	PAO	Acom	1	1
57yo F	MGM	-	Pseudo Aneu	PAO	Acom	2	1
31yo F	GHoma	-	Pseudo Aneu	PAO	Acom	0	0
56yo M	PitNet	+	-	PAO	Acom	1	5
45yo M	Carci	+	Pseudo Aneu	PAO	Acom	2	3

Table 2. Cause and things we learned from the cases.

	Patho	Pre-OPE	Time of Incident	Cause	Solution
60yo F	Cushing	+	Drilling before CS	No bone in front of CS due to bone erosion	Close look at CT for re-OPE case
57yo F	MGM	-	Peeling off Tumor from ICA in CS	Weakness of ICA wall	Reside some tumor around ICA for MGM case
31yo F	GHoma	-	CS bone removal by Kerrison	Bone was too thick	Enough thinning bone in front of CS
56yo M	PitNet	+	Removing adherent tissues using monopolar	Monopolar slipped	No usage of monopolar
45yo M	Carci	+	Sucking tumor in front of ICA	Weakness of ICA wall	Consider preoperative IC occlusion for SRT case

Results

Result: Five patients experienced ICA injury(0.7%) among 740 patients who underwent TSS. All patients are treated with internal trapping immediately.Injury occurred before exposure of sella turnica in 4 patients(80%), during manipulation in Cavernous sinus in one patient(20%). All hemostasis was achieved with direct compression with Gelfoam/ Teflon patties(100%). All cases went through Immediate angiogram(100%) and after checking collateral flow, ICA trapping performed for all(100%). One patient(20%) experienced permanent neurological deficits(56yo Male case; motor aphasia, Rt hemiparesis).

Discussion

Japanese expert facility has experienced 5 cases of ICA injury in740 cases. All of them are treated immediately by IVR. 4 of them are treated without any problem, but one had bad mobility after surgery, which was caused by change in blood flow due to manipulation around Acom after continuous surgery.4 of them occurred during before exposure of sella turnica. 3 cases are done by fellow, 2 cases are done by senior. Table 3 is mainly expert opinion in order not to make them happen again. Usachev st al reported 8 cases of ICA injuries, one case treated with High-flow bypass. The paper concluded the risk of ICA injury diminishes with better preoperative preparation, intraoperative navigation, and ultrasound doppler. (1)
Xiao et al. introduced a treatment for ICA injury through proximal control and distal control at the bleeding site, and application of clip depending on the injury site, using cadaveric specimen. (2) For this procedure, The ICA trunk must be exposed to perform this procedure, but clipping the top and bottom of the damaged area allows the damaged area to be seen with certainty and the necessary repairs can be made without a trip to the IVR.

Table 3. Experts’ opinions for each steps we need to care of .

	Experts Opinions
Pre-Ope evaluation	• Pre-ope? (bone structures) SRT? • Collateral BF? (Acom, Pcom: Angiogram if ICA is involved) ★If IC is involved, BTO is considered. • Type of tumor?(Carcinoma: consider pre-ope PAO) • Distortion of ICA? • CS invasion? Upward extension? (How much we need to remove the tumor and)
Intra-Ope Evaluation	▪ Doppler US/Navigation is Mandatory ▪ Consider MEP for Upper extension case • Re-ope?→Abnormal bones/adhesion: more difficult • Make bone thin enough before CS • Make space between bone & CS • If it is MGM→reside some tumor around ICA [Steps to tumor resection by Japanese expert] 1. Sella turnica for decompression 2. Go lateral sides (CS, ICA) 3. Upward extended part *In order not to spread blood into subarachnoidal space if ICA injury occurs.
After Occurrence	• Start compression of neck, call for other medical staff • Ask anesthesiologist to lower BP (take care of MEP) • Suction at the bleeding point, using cotton patti • Replace cotton w/ Teflon patti/Gelfoam w/fibrin glue • Direct compression for 5 munites • If clip is applicable, we do not have to go to immediate angiogram
Based on Angiogram	• No Pseudoaneurysm formation → consider suspension of OPE • If collateral is enough, parent artery occlusion. If not, consider bypass or stenting. • If PAO is done and go back to OR, MEP is recommended.

Conclusions

Japanese high-volume hospital experienced 5 cases of ICA injuries, and only one patient experienced neurosurgical deficit. There are something we need to take care of before and during surgeries.
Pre-, Intra-operative evaluation is extremely important to prevent the occurrence.

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