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ABSTRACT

Earlier cranioplasty after decompressive craniectomy for severe traumatic brain injury (sTBI), including in the active military zone, has been considered a possible approach for improved neurologic outcomes. This is due in part to several reports in the literature that have described an association with early cranioplasty (<90 days) and improved neurologic outcomes when compared to late cranioplasty (>90 days). On the contrary, studies evaluating early vs late cranioplasty have found that patients with early cranioplasty have had higher rates of complications, with one retrospective multi-center study reporting fewer complications.

Because of the heterogeneity of data in the literature and the possibility for a more data driven treatment algorithm in these patients, a concerted effort has been made at our institution to perform cranioplasty within 90 days of craniectomy as part of an observational trial while collecting several biomarkers to guide surgical decision making. Preliminary analysis in this study examines cranioplasty timing, Early vs Late, and complication rates in the sum of patients from the historical cohort and study group.

METHODS

Adult patients presenting to Grady Memorial Hospital in Atlanta, Georgia with sTBI (Glasgow Coma Scale 3-9) from August 2015 to the present were recruited for participation as part of the Surgical Critical Care Initiative (SC2i). Patients that required decompressive craniectomy for treatment were followed after hospital discharge to facilitate early cranioplasty. Time to cranioplasty and complications were compared to the institutional historical cohort of sTBI patients who underwent decompressive craniectomy and subsequent cranioplasty. Statistical analyses used include student's 2-tailed t-test and fisher's exact test to evaluate differences between groups where appropriate.

RESULTS

Eighteen of 31 participants in the study group (SG) required decompressive craniectomy, of which 8 have undergone cranioplasty to date and were included in the analysis. The historical group (HG) included 79 patients who had underwent decompressive craniectomy and subsequent cranioplasty. Both groups had a median GCS of 7. There was no significant difference in time to cranioplasty (SG: 76 days, SDV +/- 33, HG: 171 days, SDV +/- 184, t-test p= 0.1508) or complications between groups (SG: 4/8, 50%, HG: 20/79, 25%, X2 = 2.21, p = < .01).

When examining all patients, there was a significant increase in the number of complications in patients who underwent Early cranioplasty (Early: 16/32, 50%, Late: 8/55, 14.6%, X2 = 12.73, p = < .01)). After stratifying SG and HG, this association was still significant (SG: p< .03, HG: p = < .01). The Early cranioplasty group had a significantly increased cases of hydrocephalus, hygroma/EDH/SDH, and overall complications. Though not significant, the Early cranioplasty group also trended toward a greater number of reoperations. Data and statistics are summarized in **Tables I and II**.

DISCUSSION

These preliminary data have highlighted differences in the early vs late cranioplasty groups. As part of the SC2i initiative, this raises the importance of more precise clinical decision making paradigms for deciding when to perform cranioplasty. The reality of the situation may depend on the individual sTBI, clinical measures (e.g. GCS), imaging findings (CT based flap sunkenness), and other biomarkers found in the CSF and peripheral blood. While the literature has suggested that early cranioplasty may be advantageous for neurologic outcomes, it seems that this should proceed with a conscious effort to minimize increased risk of certain complications.

Table I: Study Group vs Historical Group

	Study Group		Historical Group		p (T-Test)
	Mean	SDV	Mean	SDV	
Time To Cranioplasty	76 Days	+/- 33	171 Days	+/- 184	0.1508
	N	Percentage	N	Percentage	p (Fisher's)
Complications	4 / 8	50%	20 / 79	25.32%	0.208

SDV – Standard Deviation

Table II: All sTBI Patients – Post-Operative Complications in Early vs Late Cranioplasty

	Early		Late		P (Fisher's)
	N	Percentage	N	Percentage	
Complications	16 / 32	50.00 %	8 / 55	14.60 %	< 0.01*
Reoperations	8 / 32	25.00 %	5 / 55	9.09 %	0.06
Hydrocephalus	8 / 32	25.00 %	3 / 55	5.45 %	< 0.02 *
SDH/EDH/Hygroma	7 / 32	21.88 %	2 / 55	3.64 %	< 0.02 *
Infection	2 / 32	6.25 %	2 / 55	3.64 %	0.62
Ischemic Stroke	0 / 32	0 %	0 / 55	0 %	-
Resorption	0 / 32	0 %	3 / 55	5.45 %	0.29
Wound Dehiscence	1 / 32	3.13 %	1 / 55	1.82 %	1.00

*Significant, p < 0.05

CONCLUSIONS

It is feasible to shorten time to cranioplasty in an inner-city hospital setting, however early cranioplasty may be associated with improved neurologic outcomes (not reported in this study) but with paradoxically increased complication rates as seen in our study.

The relationship of timing will be important to reassess as more participants are included in the SC2i cohort, and applied more broadly to the unique military cohort and combat-associated trauma in the future.